GOOD PRACTICE GUIDE 231

Introducing information systems for energy management

GOOD PRACTICE GUIDE 231

BEST PRACTICE PROGRAMME

ENERGY EFFICIENCY

BEST PRACTICE PROGRAMME

ETSU would like to acknowledge the assistance of Chenton Technology Management and Hart Consultants in preparing this Guide.

INTRODUCING INFORMATION SYSTEMS FOR ENERGY MANAGEMENT

This Guide is No. 231 in the Good Practice Guide Series and is intended to provide readers with a basic understanding of energy information systems. The technologies and systems covered by this Guide can also be applied to services such as water and compressed air.

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111. MONITORING AND TARGETING IN FOUNDRIES
112. MONITORING AND TARGETING IN LARGE COMPANIES
113. MONITORING AND TARGETING IN THE SEMI-MANUFACTURE OF NON-FERROUS METALS
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131. MONITORING AND TARGETING IN THE GLASS INDUSTRY
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FOREWORD

This Guide is part of a series produced by the Government under the Energy Efficiency Best Practice Programme. The aim of the programme is to advance and spread good practice in energy efficiency by providing independent, authoritative advice and information on good energy efficiency practices. Best Practice is a collaborative programme targeted towards energy users and decision makers in industry, the commercial and public sectors, and building sectors including housing. It comprises four inter-related elements identified by colour-coded strips for easy reference:

— *Energy Consumption Guides:* (blue) energy consumption data to enable users to establish their relative energy efficiency performance;

— *Good Practice Guides:* (red) and *Case Studies:* (mustard) independent information on proven energy-saving measures and techniques and what they are achieving;

— *New Practice projects:* (light green) independent monitoring of new energy efficiency measures which do not yet enjoy a wide market;

— *Future Practice R&D support:* (purple) help to develop tomorrow's energy efficiency good practice measures.

If you would like any further information on this document, or on the Energy Efficiency Best Practice Programme, please contact the Environment and Energy Helpline on 0800 585794. Alternatively, you may contact your local service deliverer – see contact details below.

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1

INTRODUCTION

The development of computers and information technology, together with privatisation of the utilities, has changed the face of energy management information. At the start of the 1990s, automatic data collection was considered exceptional and only for those with significant capital to spend. However, the development of metering technology necessary for the competitive energy market means that many sites can now easily, and at low cost, access consumption data every 30 minutes. We also have newly emergent bureau services using the latest computer and communications technology.

This Guide looks at the basic elements of an energy information system and discusses data collection, analysis techniques and communication methods. It shows how to assess the requirements of a system with reference to a practical example from an engineering site. Finally the Guide provides a series of tools that will help you to assess the energy information system requirements of your own company.

The systems and techniques covered can be applied to other services such as water, industrial gases and compressed air. The Guide provides a basic introduction to energy information systems but is not intended to provide definitive advice on software, metering or other hardware.

Energy Information and Energy Management

For the purpose of this Guide an Energy Information System is defined as a system for the collection, analysis and reporting of data relating to energy performance that supports energy management.

An energy information system may be stand-alone, part of an integrated system or a combination of several different systems.

For an engineering plant, an energy information system might comprise meters connected to an existing data highway and accessed by dedicated data collection software. The output could be used by a number of software systems, including engineering, accounting and purchasing. For a commercial organisation, it might be a software system, accessing billing data stored on an accounting system and feeding into various management software modules. For a large multi-site operation, it might be an external bureau service interfacing with an internal management system.

An energy information system consists of more than meters and a PC. It also includes all the organisational procedures and methods that allow it to operate. Energy information systems can be hybrids that draw on external and internal sources of data.

The prime function of the energy information system is the support of energy management as part of the overall strategy of the organisation.

However, energy information systems are also needed to support environmental management. For example, it may be difficult to become certified to ISO 14001, *Environmental Management Systems*, without an effective energy information system.

Technology

The impact of technology on energy information systems cannot be underestimated:

- It is less than 15 years since the PC was introduced.
- Most energy managers now have easy access to a reasonable standard PC.
- There have been significant cost and performance improvements in metering and electronic data collection.
- Many organisations have access to electronic mail and the Internet.

Whilst the cost of an entry-level PC has not decreased significantly, its capability for data processing and presentation has increased considerably. We can collect data at much lower costs, analyse larger data sets, and explore coloured graphic outputs in ways we would not have thought possible five years ago.

Integration

Effective energy information systems are usually integrated with other systems: hardware, software and organisational. Research carried out under the Energy Efficiency Best Practice Programme shows that marginalisation is a major cause of failure in energy management. Integration can help to avoid marginalisation and can also provide more cost effective solutions.

Each case needs to be judged on its own merits. To develop an integrated solution, you will want to talk to a range of people across the organisation, in particular, those involved in the development of other information systems such as information technology departments and management accountants.

How to Use This Guide

This Guide provides information and practical tools to help you establish or develop the right energy information system for your company. It is an introductory document that covers both buildings and industry. The principles that apply are similar although some aspects differ in application.

Going Further

As you progress through the development of your energy management information system, you will want to seek further advice and guidance on specific topics. This may include setting up detailed systems, specific training or even using consultants to advise on particular issues.

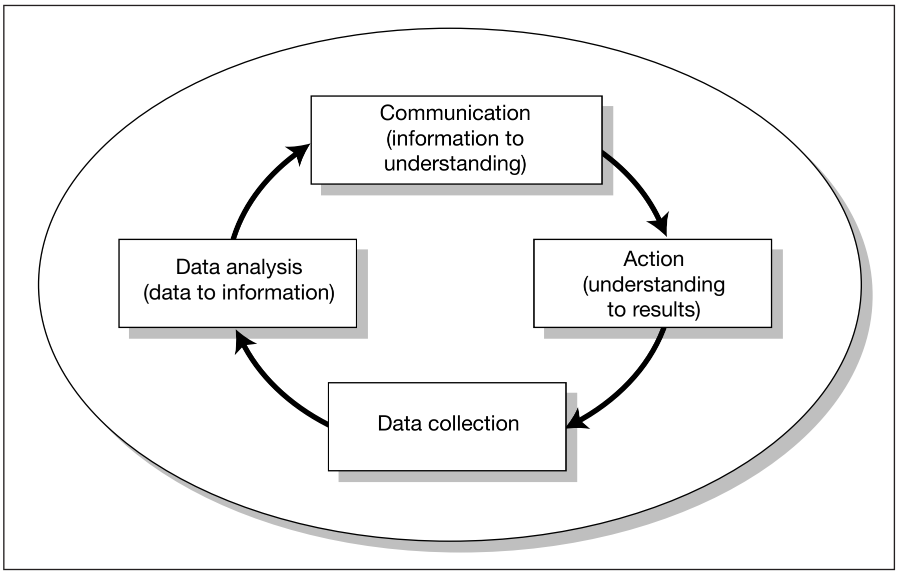
2

DEVELOPING AN ENERGY INFORMATION SYSTEM

Most organisations will already have some level of energy information system, even if it is not identified or managed as one. It should be appreciated that in a changing working world, any information system will need to develop to meet its prime objective - supporting management decision making.

The Operational Cycle

The day-to-day working of the energy information system can be illustrated by a closed loop diagram.



The operational cycle

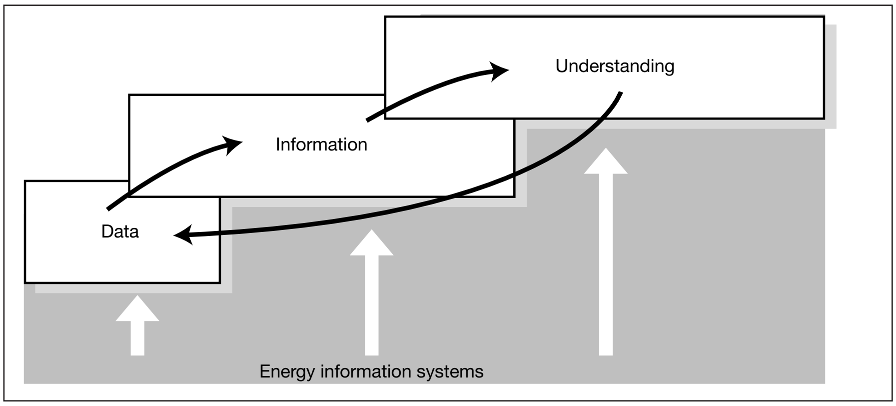
The operational cycle is based on four processes: data collection; data analysis; communication; and action. These elements apply to any information system. **The function of the cycle is to turn data into action and thereby improve energy performance.**

Data, Information and Knowledge

Data are the raw materials of the information system. Examples include:

- a listing of energy meter readings;
- a record of maximum and minimum external temperatures;
- a log of activity.

In the raw form, data are of little use. Unfortunately, some energy managers become totally immersed in data and see data collection and collation as their primary task. To gain value from data they must be transformed into information (used to support the knowledge development of all those managing energy) and understanding (used to action energy savings).



System hierarchy

The system hierarchy shows how data, information and understanding are related, how each is dependent on its predecessor and that information systems are needed for support.

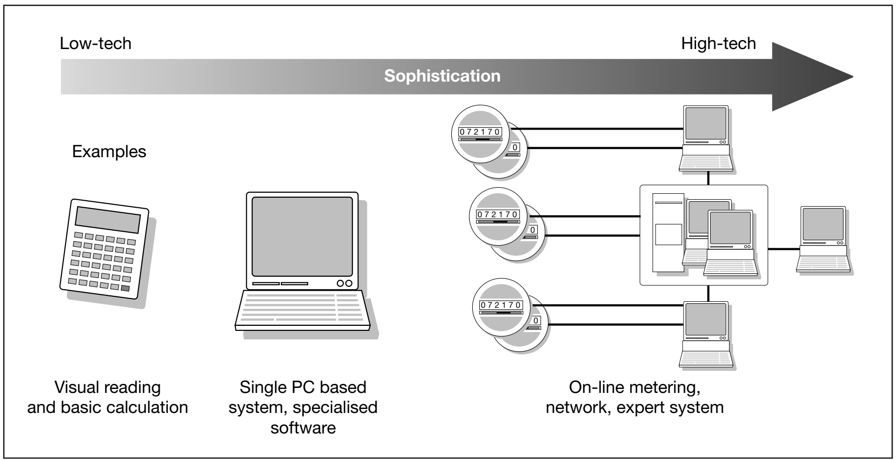
The three elements are also linked by a closed loop which leads from data through information to understanding. It is also valid to work back from understanding to determine the information needed and therefore the data collection requirement. In practice, you will work in both directions to identify the optimum solution.

Whilst the prime purpose of an energy information system is to support energy management, it has other valuable information outputs as well. For example, improved allocation of energy expenditure may be of great value for internal accounting purposes. This may influence budgets, product costings, etc. The ability to provide such information provides you with a 'tradable commodity' within your organisation; 'tradable' in the sense that in return for your information you can access other information or resources that you need.

There is a wide range of solutions that can take you from data to information:

- For an individual process it may be possible to use a simple graph or chart to plot performance.
- For a single site, a spreadsheet developed in-house might be appropriate, working from manual meter readings and other relevant data.
- For a site with a large number of meters, the solution may be a sophisticated, real-time, data collection system linked to an analytical and reporting system available over a network of computers.
- For a complex, multi-site operation the solution may be a bureau-based service, operated by an outside contractor, collecting data remotely and providing reporting electronically.

Systems may be further sophisticated with an expert- or knowledge-based system that provides advice and recommendations.



The range of solutions

At one time, information systems were limited by a lack of low-cost, effective technology. We are now fortunate in having access to a wide range of metering and information technology and Energy Managers must decide upon the most appropriate technology to provide the solution required. **It is critical is that the information system adopted is appropriate for your organisation and is 'owned' by those that use it.**

Two very different solutions are illustrated by these Good Practice Case Studies (GPCS) from the Energy Efficiency Best Practice Programme:

- GPCS 221, *Monitoring and Targeting in a Hospital Laundry*, shows how this system at North Staffs Hospital Trust is based around a £1,000 software package used on a single PC. Savings at the end of the first year were £10,300, giving a simple payback of around three months.

- GPCS 330, *A Comprehensive Energy Management Information System at a Large Process Site*, outlines how BP Chemicals introduced a sophisticated, integrated system costing £5 million. This system achieved £2 million/year energy savings and avoided £2 million of capital expenditure. Taking all savings into account it had a payback period of 1.5 years.

3 DATA COLLECTION

Data collection is a fundamental part of any information system. However, it is all too easy to become swamped with data. This happens when the data are seen as valuable, rather than the analysis. When specifying the data collection system you need to keep in mind the question:

What is the purpose of the system?

Data Types and Sources

Energy management data falls into three main categories:

- consumption;
- cost;
- drivers.

Consumption

Consumption data are the most basic data required for energy management. They are also essential for any environmental reporting. (For example, tonnes of carbon dioxide generated by energy use can be estimated from energy consumption multiplied by an appropriate factor. Similar calculations can estimate quantities of sulphur dioxide or oxides of nitrogen). Consumption data can also cover other utilities such as water and industrial gases.

For electricity and natural gas, the prime data source will be metering. Some fuels, such as coal and oil, may be delivered in bulk and not metered on site. In these cases, where metering is not provided, some alternative means of measurement is needed. At one large manufacturing site, coal use is measured by the loader bucketful!

Cost

Cost control is the main reason for most organisations to practice energy management. Cost also provides a common language across various disciplines. The principal source of cost information is the energy supplier, either from tariffs or actual billings. If the information system is to support the organisation's corporate goals it must provide relevant financial information.

Drivers

A driver is any factor that influences energy consumption. Weather is the main driver for most buildings and for most industrial processes, production is probably the primary driver. Drivers are sometimes referred to as variables or influencing factors.

There are two main types:

- ***Activity drivers.*** An activity driver is a feature of the organisation's activity that influences energy consumption. Examples include: hours worked, tonnes produced, number of guests and opening hours.

- ***Condition drivers.*** A condition driver is one where the influence is not determined by the organisation's activity but by prevailing conditions. Examples include: weather, condition of the raw material and hours of darkness.

Data probably already exists for production and other business drivers, but the quality of this data should not be taken for granted. It needs to be checked.

A metal finishing contractor in the automotive sector delivered processed parts in batches of 1,000 as part of a Just in Time supply chain. Observed variations in energy consumption ratios led to a check on the actual batch sizes which were found to range between 850 and 1,200. This illustrates the need to verify the accuracy of the data input to the energy information system.

Typically, collection of activity data will be from internal sources. Weather data, usually degree days, may be externally provided or supplied internally using dedicated equipment or a Building Management System (see Fuel Efficiency Booklet No 7, available from the Energy Efficiency Best Practice Programme, for further details of degree days).

Single and multiple sites

This is the area where we see some of the greatest differences between industrial and buildings-based systems. For example, a retail shop chain may have hundreds of sites, each with quarterly billing. Alternatively, a large industrial site may have 20 incoming meters with half-hourly readings and a large number of internal sub-meters.

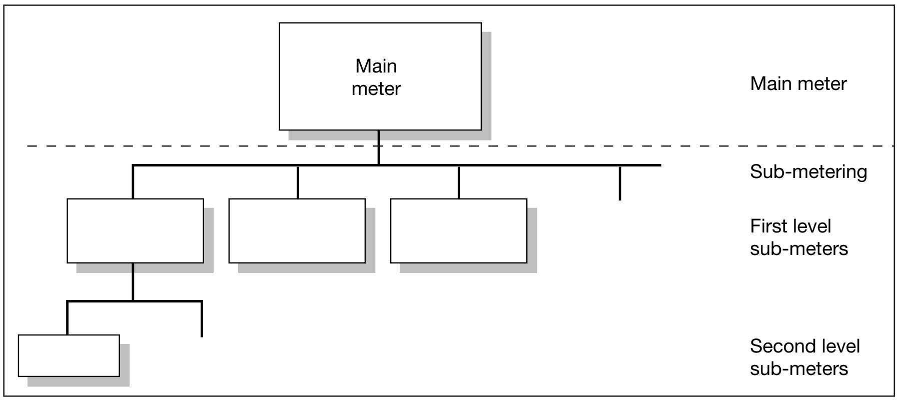
One important point about multiple sites is that each site will normally have its own utility supply and associated billing. This means that utility invoices should already be available for each site and provides a good starting point for the energy information system.

Meters and Metering Periods

Main meters

A main meter is the supply meter provided by the utility or meter operator for the purposes of charging for supply. (It may also be called a fiscal meter or a statutory meter.) Typically, there will be one main meter for each utility supply. However, in the case of larger sites, or complex supplies, there may be multiple main meters. Main meters should normally meet an appropriate British Standard and the utility/regulator's code.

A large car manufacturing site has 20 main electricity supply meters which are all read remotely by the utility at half-hourly intervals. The Energy Manager accesses this half-hourly data to prepare weekly energy reports.



Meters and sub-meters

Sub-meters

A sub-meter is a meter installed **after** the main meter. Extensive sub-metering is used in organisations where departmental/process cost accountability is required. (In these circumstances, the prime purpose of the meters is cost accountability with energy management information as a by-product.)

A feature of sub-metering which must be appreciated is that for a totally sub-metered supply the sum of the consumption of the sub-meters does not normally equal the consumption of the main meter. This is due to the accuracy bands of the meters involved. For example, the main meter might be ±0.5% with the sub-meters at ±2%. In the case of gas, the main meter may be pressure- and temperature-corrected and the sub-meters not.

More meters and more frequent reading?

Code 5 is a Code of Practice from the Office of Electricity Regulation (OFFER), detailing the requirements for half-hourly metering systems. As part of the progress to full electricity supply competition in 1998, it is proposed that all sites using 100 kW or above will be fitted with Code 5 metering.

With modern metering systems, any site with an electricity Maximum Demand (MD) over 100 kW can have Code 5 metering which will provide half-hourly electricity consumption data. Without Code 5 metering many sites only have monthly meter readings from their utility company.

Would fewer meters read more often provide better data/information/ understanding? An industrial site might get more useful data from 5 meters read every half hour than from 50 meters read once a month.

For a local authority, where the cost of sub-metering may not be justified, half-hourly metering from main meters may be the only cost effective way to investigate individual site performance.

Metering periods

The **metering** period is the time between meter readings. The **reporting** period is the time between energy information reports.

For a Code 5 site, the metering period would be 30 minutes, but the reporting period could be weekly or monthly. The metering period is often determined by the technology used. Many systems not using on-line metering use a monthly period.

A month may be 28, 29, 30 or 31 days, or even 35 days when a five-week accounting period is called a month! The week is a better period to use for a number of reasons:

- it has a universal definition - 7 days;
- if a reading is missed, it is only one of 52, rather than one of 12;
- suitable sets for data analysis can be generated quicker;
- the week also allows the system to be more responsive and timely.

The major disadvantage of weekly reporting is the increased amount of data collection and entry. In practice, this needs to be balanced with the improved quality of information delivered.

The use of on-line metering provides greater flexibility in the choice of metering and reporting periods.

Data Collection Methods

The complexity of data collection depends on the:

- number of data collection points;
- method of data collection;
- frequency of data collection.

Physical distance is also relevant. Single sites such as an international airport, a large hospital, or a chemical works, may have distances of several kilometres between remote meters and the central data system.

Consumption data comes from two main sources: invoices and direct metering.

Collecting data from invoices

Double processing of energy data should be avoided. A common example is where accounting and energy management functions are working in isolation.

Invoices are the major source of energy data for many buildings-based systems. Typically, for a large property portfolio, there will be separate gas, electricity and water accounts for each site. Processing this invoice data can present a significant work load in a large organisation. However, much of the processing effort is required for accounting purposes. In such cases, integration between accounting and energy management is critical.

If sites have the appropriate metering then the utility company will use actual meter readings to compile the invoice. However, problems exist with smaller, remote, or difficult to access sites where the utilities often use estimated readings. Such invoices have little value in energy management terms. In these circumstances, you need an alternative source of data.

As part of their overall function, many energy information systems will be required to validate invoice data using metering data. There are varying definitions of invoice validation. These range from simple checking of the arithmetic on the invoice to software packages which use an estimation or prediction of the consumption and compare this with the invoice. Full invoice validation must include the following:

- confirmation of site and tariff details;
- checking of arithmetic;
- comparison of utility reading with organisation's own reading.

Collecting data from meters

There are two basic methods of reading energy meters: manually or electronically.

Manual (or visual) readings are taken by staff recording data from either dials or digits on the meter. These give a quantitative measure, in units appropriate to the utility, such as kWh for electricity and m^3 for water. In some cases, a metering multiplying factor may be needed to convert the reading into the appropriate units of consumption.

Data can be collected by noting down the figures on a collection sheet or by using a hand-held electronic data collection unit (DCU). Data collection units often include a bar code reader to identify the meter and are pre-programmed to check the validity of the data.

The most common electronic meter is the pulse output meter. This meter generates electronic pulses proportional to the quantity measured. A pulse counter is required to make use of the readings. It is also necessary to know the ratio of pulses to consumption. Most meters which have an electronic output also have a visual output which can be used to validate the electronic data.

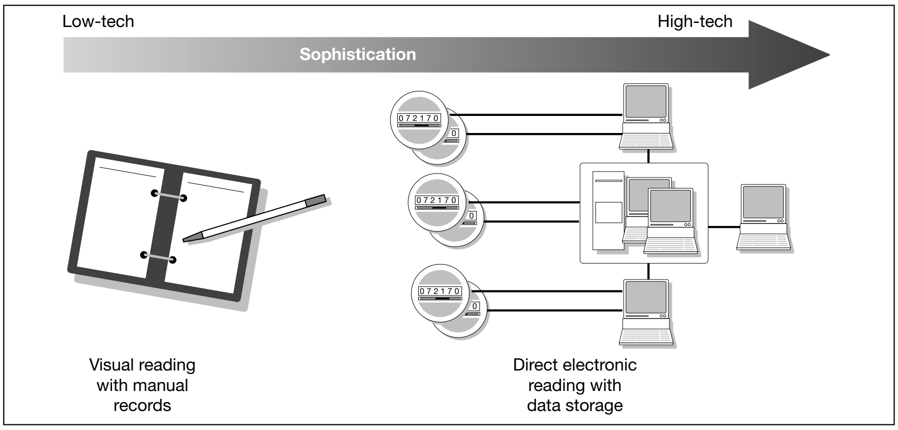
Meters with electronic output comprise either a basic meter which simply generates output pulses or an 'intelligent' meter which can store data for reading at a time convenient for the meter reader. An advantage of the 'intelligent' meter, over the basic pulsed output meter, is that stored output can be used to cover data transmission problems.

Having measured the consumption and obtained a reading, the information needs to be transmitted to the next stage in the information system. Visual readings may be 'transmitted' on paper or electronically from the data collection unit. They can also be entered into a PC and then transferred electronically. Whereas manual readings must be manipulated by hand or entered into a PC, electronic signals can be transmitted directly to the data collection unit.

Electronic options include:

- direct hardwiring;
- modem;
- mains-borne carrier techniques;
- links to data highways;
- low power radio systems.

Each method has advantages and disadvantages: the use of a modem may reduce wiring costs, but incur telephone charges; direct hardwiring may give secure, reliable, low-cost transmission but it also adds considerably to installation costs.



Sophistication of consumption data collection

Energy cost information

Cost information normally comes from the utility supplier. The time frame of the cost information should be considered with the consumption data collected. This is usually more of a problem with electricity when the actual unit rates charged may not be known until the end of the billing period. At a simple level, if energy is supplied at a fixed unit rate, cost information can be generated as the consumption data is collected. One solution to the problem of unknown costs is to use an estimated or past average unit cost.

If you use estimated costs, how do you handle differences between estimated and actual costs? One solution is to use consumption figures for immediate energy management use and then provide financial information separately later.

Data on drivers

Data on activity or production-related drivers will usually already be available and often in electronic form as a part of normal business management information systems.

External climate is an important driver and is typically recorded as degree days. Degree days are derived from the maximum and minimum external temperatures over a 24-hour period. Many Building Management Systems can collect data for degree days, it is also possible to buy dedicated degree day monitors. Some sites, for example, airports and universities, may be already collecting daily maximum and minimum temperatures for other purposes. Degree days are more applicable to traditional buildings with heating and natural ventilation, and less applicable to integrated design buildings with full air conditioning and high internal heat gains.

The collection of driver data will be dependent on other/existing information systems, in contrast to energy consumption data which will probably be only collected by the energy information system.

The cost of data collection

Whichever data collection option you follow, be it low or high technology, it comes at a price. **There is no point in spending more money to collect data than can be saved by the useful application of that data.**

Points worth considering about the costs associated with data collection include:

- for a given energy type, the cost of data collection is not normally related to the level of consumption. It costs the about the same to collect data from a meter ‘recording’ £50 of energy as it does for one ‘recording’ £5,000 of energy;
- time and money are both data overheads;
- investment in data collection should lead to reduced running costs;
- manual meter reading is an identifiable running cost;
- all energy information data collection systems have ongoing running costs.

A local authority site had a modem link for monitoring and control. The telephone and maintenance costs of the system were found to be 50% of the energy expenditure.

A large industrial manufacturing site was found to be taking over three weeks each month to collect the data from visually read meters.

Clearly neither are optimum solutions.

Data Quality

Data are the raw materials of the energy information system and good quality output is dependent on good quality raw materials.

Good quality data should not be confused with high accuracy data.

For energy management purposes, the level of data accuracy required is not excessive but the data must be repeatable and dependable. Time spent ensuring the quality of the base data in any information system will not be wasted. Some analytical techniques will identify suspect data points but it is better if they are not included in the first place.

The data in any energy information system should be able to withstand the rigours of a formal audit process. All too often it is assumed that energy information systems are self auditing - this is not the case.

Some examples of the need for good data quality:

- The electricity consumption in a hospital boiler house was read as one-tenth of actual consumption for over five years. This was because the first reading was not checked properly and all subsequent readings were validated against the original.
- A retail organisation using invoice data to track energy use discovered that some of its sites had only received estimated readings over the past three years.
- A local authority had confused the energy data for two sites. This was only revealed when one site was closed!

4

DATA ANALYSIS TECHNIQUES

Data analysis is a vital process in the transformation of data into information. The desired information output will influence which analytical techniques are used. However, during the development processes, data availability may influence the analysis techniques considered. Data analysis normally develops through two stages.

- ***Stage 1. Looking only at energy.*** For example, converting meter readings into consumption figures, comparing the current period of consumption with the same period the previous year. Stage 1 techniques are often used at the outset based on historical invoice or consumption data.

- ***Stage 2. The use of energy data and drivers.*** The results of this should prompt questions: Why does that happen? Should that happen? Is that what we expect? Can we do better? How well do we compare?

There are two ways in which analysis techniques are applied:

- ***Routinely.*** To provide the regular output of the system. Routine analysis can often be automated, or carried out by someone without specific energy management skills.

- ***Investigative.*** To investigate the process rather than report upon it. This type of analysis can be applied periodically to review the effectiveness of the system or it may be used to follow up exceptional results arising from routine analysis. This application requires a level of energy management skill.

As this is an introductory Guide, the details of applying analysis techniques are not covered. However, the scope and application of the majority of techniques in use are discussed. Some techniques are more suitable than others, depending on the organisation or activity. Certain techniques have been developed for specific applications and all have limitations on their use. You need to identify these issues when considering which techniques to use.

Data Volume

The volume of data available will have an influence on the techniques used. For example, the availability of half-hourly electricity data has lead to the development of profile analysis and contour mapping techniques. Such techniques require a high volume of data.

Statistical techniques need a minimum size of data set, typically between ten and 20 points. (The set comprises a value for the energy and the driver for each point.) If an analysis of the relationship between heating and weather is required, you can encounter problems using monthly data. This is because the heating season is usually less than ten months, so the data set collected is too small to apply the technique at the appropriate level of confidence. One solution is to use the data from two heating seasons, this requires the system to be identical in operation for those two seasons. An alternative is to use weekly data. This enables more than one suitable data set to be obtained from a single heating season. (However, this will also increase the amount of energy data to be collected and require the use of weekly degree days.)

In general, the more data collected, the wider the range of analysis possibilities, although an increase in data collection usually leads to increased overheads. Another potential problem is 'paralysis by analysis'. Unlike 'drowning in data', this is when the analysis becomes the primary function and analysis leads to further analysis, all at the expense of effective energy management.

Selecting Analytical Techniques

Not every organisation will need to use every technique, and some techniques may not be economically viable.

As the system develops, the techniques used may change and become more sophisticated. However, it is important to remember that there may be considerable inference that can be made from existing data.

The first step is always to study available data before developing the system.

Many practitioners have been able to demonstrate significant potential for performance improvement simply by looking at existing data in a different way. As part of the regular review of a system, you should try different analytical techniques to see what they show.

For any set of data there are many techniques that can be applied. These range from simple comparison techniques, through line fitting, to sophisticated statistical methods. The techniques selected will depend on your aims. First understand the techniques and then select those suited to your use.

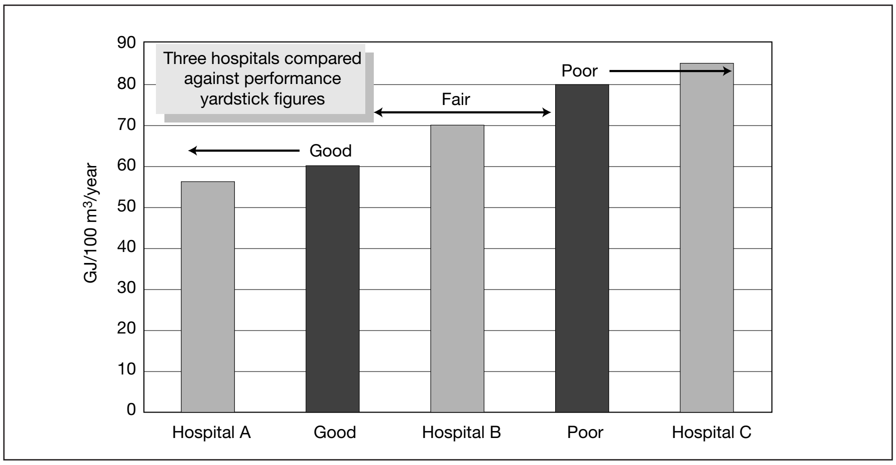
This Guide outlines ten data analysis techniques that can help to present and interpret energy and driver information.

When selecting techniques, key questions are:

- Which techniques are appropriate to my situation?
- What do others use in my sector?
- Which techniques can I use to benchmark my performance?
- What do I want/need from the analysis?
- How much data is required?
- Do I have that data? If not, can it be obtained economically?

Analysis technique	Buildings	Industrial sites	Description
Normalised Performance Indicators (NPI)	✓		benchmarking against buildings of similar type.
Specific Energy Ratio (SER)		✓	simple industrial process benchmarking.
Current and Past Comparison	✓	✓	comparisons against previous energy performance.
Trend Line	✓	✓	graphical display of energy use against time.
Profiles	✓	✓	to show consumption patterns over specific time periods.
Contour Mapping	✓	✓	3-D way of displaying of energy profiles.
Lines of Best Fit	✓	✓	for approximating simple mathematical relationships between energy consumption and key drivers.
Variances	✓	✓	to show deviation from anticipated energy performance.
CUSUM	✓	✓	CUmulative SUM of variances from standard performance - useful to identify changes in the pattern of energy use.
Control Charts	✓	✓	using predetermined control limits to alert exceptions to planned performance.

Normalised Performance Indicator (NPI)



Normalised Performance Indicator (NPI)

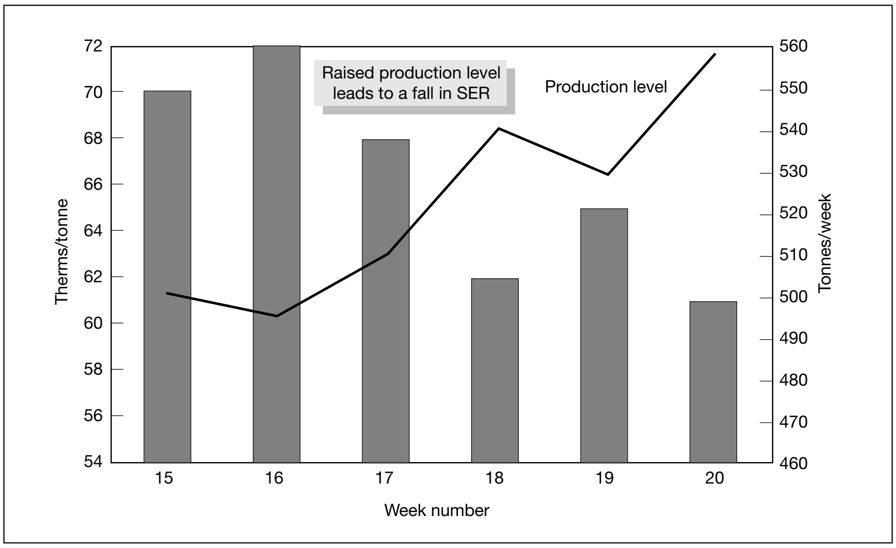
The Normalised Performance Indicator (NPI) is a technique for buildings, usually calculated annually. It provides a **yardstick** figure of energy consumption as kWh per m^2/year (in the case of the health sector, it is more usually volume based i.e. per m^3). The calculation requires a total annual energy consumption and a floor area or volume. This gives the Performance Indicator. It can then be **normalised** by reference to tables covering operating hours, weather, etc. NPIs can be produced for total energy; energy type (gas, electricity, oil etc.); or by use (heat, lighting, air conditioning etc.).

The NPI allows the comparison of buildings of a similar type. This comparison can be used within the organisation, against other organisations or with benchmark data from publications produced by the Energy Efficiency Best Practice Programme.

As this technique is based on floor area, it is important to know what floor area figures you are using. Are they accurate? Are they for the total floor area or occupied floor area? This is particularly important when making comparisons.

The NPI technique can be refined by using a moving annual calculation, on a monthly basis. This extension to the technique gives monthly output, allowing regular review against annual targets. It can also be used to provide a trend line.

Specific Energy Ratio



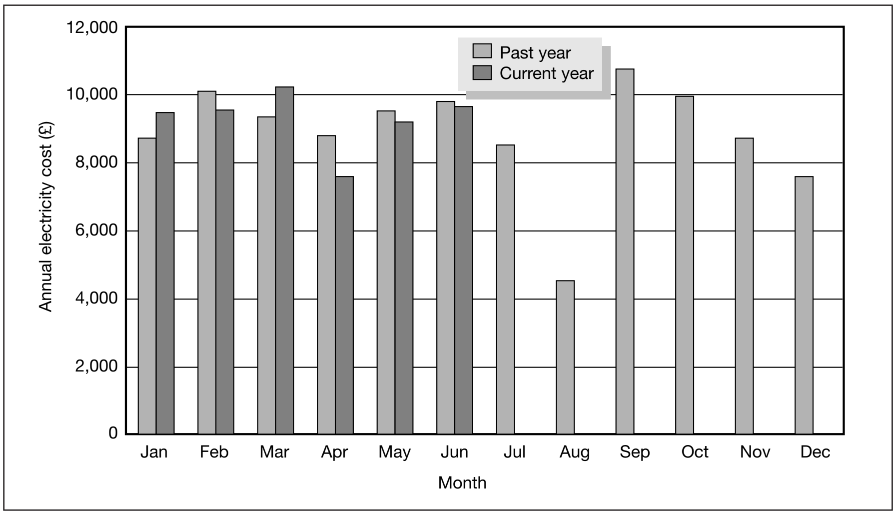
Specific energy requirement for glass melting

Specific Energy Ratio (SER), also known as Specific Energy Consumption (SEC), is a technique used in industry. It is simply the energy used divided by an appropriate production measure (i.e. a driver). It can be calculated for any fixed time period, or by batch. SERs need to be treated with care because their variability may be due to factors, such as economies of scale or production problems, rather than energy management.

There are many process benchmarking schemes based on SER and their ease of use makes them attractive to many companies. SERs feature widely in the Energy Consumption Guides produced under the Energy Efficiency Best Practice Programme.

Some practitioners are strongly averse to SER, regarding it as too simplistic and flawed. However, it has the value of being easy to calculate, understandable and straightforward to communicate, making it widely used in many industries.

Current and Past Comparison



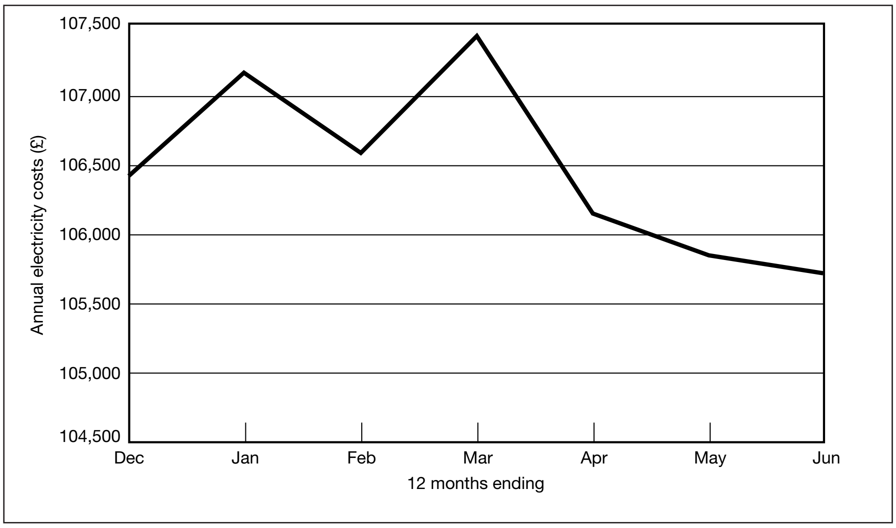
Current and past energy expenditure

This approach is suitable for buildings and industry. It is usually in a graphical format where a bar or column chart is used to compare the data from the current period with a similar previous period. A tabular form of this comparison can also be used with a quantity or percentage figure for the difference. It is useful for monitoring year-on-year changes and cyclical patterns, and can also be used for daily and weekly profiles. The technique can be applied to energy-only data, or energy/driver data.

Trend Line

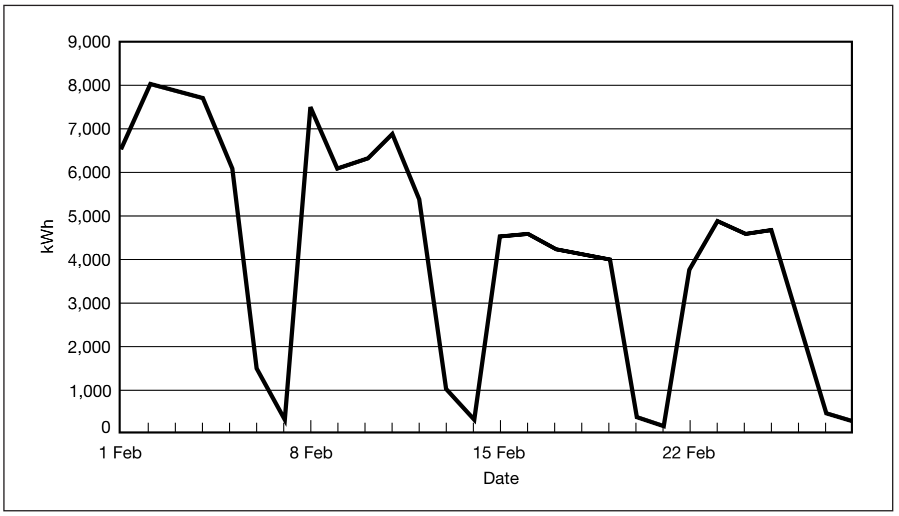
This approach is suitable for buildings and industry. Most energy managers are interested in the underlying trend of consumption or cost and trend lines are a graphical way of showing this. Typically, the trend line will be the trend of the data series over time. At its simplest, it is a line graph of the data for each period.

A more refined application of the technique is to use moving annual totals or averages. This approach is useful since it reduces seasonal influence and allows other influences to show through. Since a trend line can be produced from time-related energy data alone, it is a common technique to use at the early stages of investigating energy consumption.



Moving annual costs

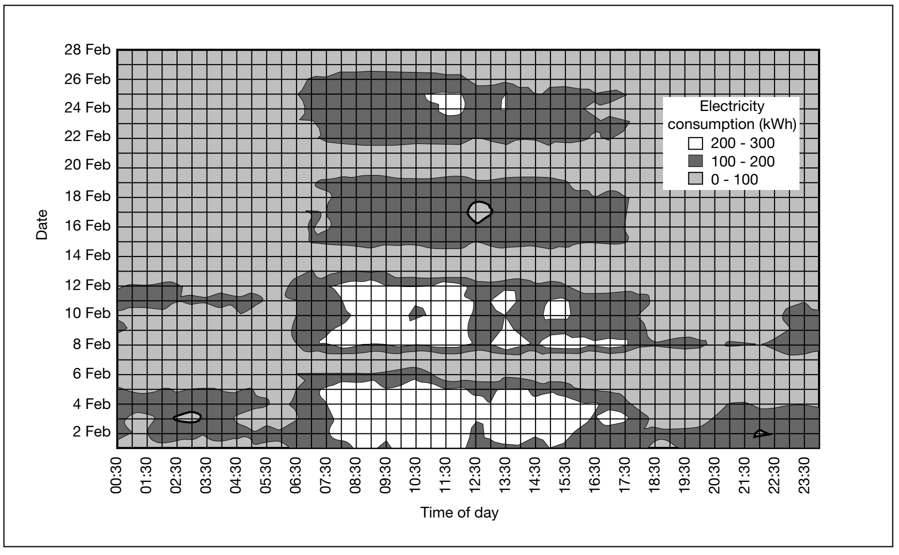
Profiles



Site electricity profile

This approach is suitable for buildings and industry. Profile analysis has gained in popularity with the wider availability of half-hourly electricity metering. Profiles for the day, week, month or year can be prepared. The technique can be expanded by the comparison of current and past profiles, average profiles, or checking against ± limits set on a base profile. Profiling is particularly valuable where the pattern of consumption is repeatable. As well as being used visually, profiles can be used arithmetically. For example, subtracting the data from two profiles and displaying the result either as a table or a chart.

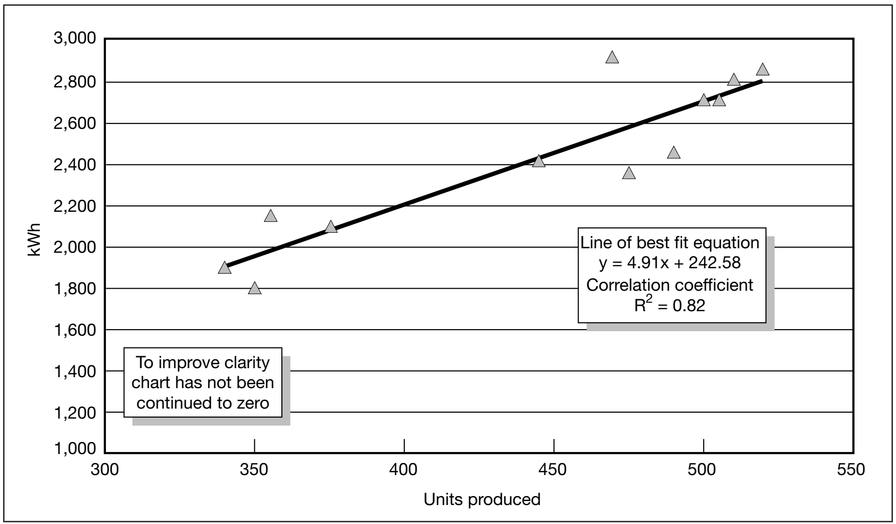
Contour Mapping



Electricity contour map

This is approach is suitable for buildings and industry. The ‘contour map’ offers a more pictorial use of profile information. Here, half-hourly data, typically for a month, is displayed as a multi-coloured contour chart. This provides a very easy way of viewing 1,400 data points (30 days x 48 half-hours).

Lines of Best Fit



Line of best fit - energy vs. production

This approach is suitable for buildings and industry. Understanding how drivers influence energy consumption is one of the most important energy management techniques. The starting point is to plot energy and the selected driver on an X-Y chart (a scattergram). Usually the Y axis is chosen for energy and the X axis for the driver.

From process knowledge, you need to assess if a straight line is a reasonable relationship to expect between the driver and energy use. (For example, we can be reasonably confident of this with space heating or metal melting.) If this is a reasonable assumption, we can produce an equation by inserting a straight line in the scatter, i.e. a mathematical model, describing the relationship between driver and energy. It may be necessary to experiment with several different drivers before a suitable relationship is determined.

For a given value of driver on the X axis, reading the value on the Y axis, by way of the straight line, will give an expected value for energy. (The value of X can be used in the derived equation to give a value for Y). Note that care should be taken if the values of driver are outside the range of the chart as confidence in the model is questionable outside this range.

The technique can be employed in its simplest form with pencil, graph paper and ruler. (This is a good way of understanding what is involved.) A statistical calculation, known as regression by the method of least squares, can be used. An effective way to explore this technique is to use a PC spreadsheet that includes the function.

Most spreadsheets will include a function that will identify a line of best fit and calculate its equation:

- ***Excel*** - create an X-Y chart and use the commands: Chart/Insert/Trendline.
- ***Lotus*** - from a table of data use the commands: Range/Analyse/ Regression.

This technique is also included in most commercially-produced Monitoring and Targeting (M&T) software. When using the technique it is important to use good quality data. Any suspect points should be checked out and, if necessary, eliminated from the analysis.

When first applying this technique, some users are concerned about data scatter and correlation coefficients. (Correlation coefficient is a measure of how well the line represents the data. When using a spreadsheet it can be calculated automatically). Typically, a well-controlled process will exhibit a correlation coefficient of 0.9 or higher. Do not be disappointed if your process does not achieve this.

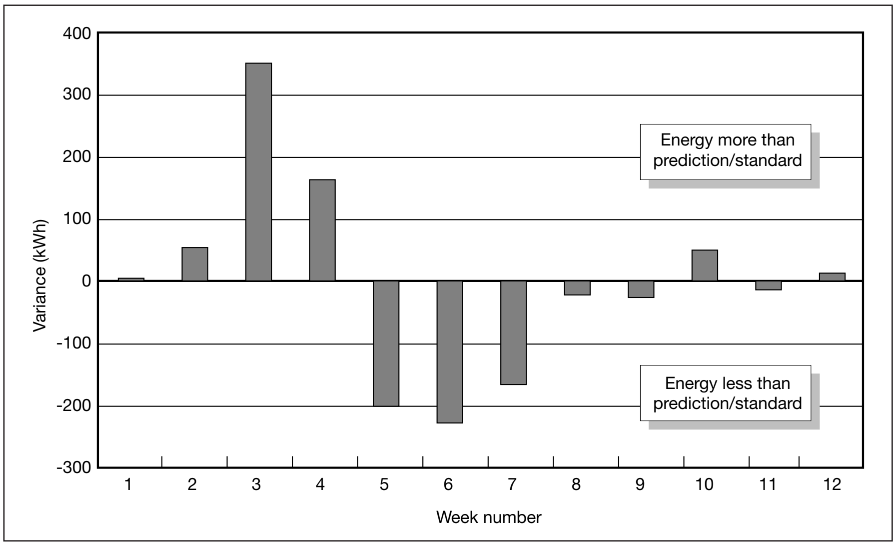
If the underlying relationship between the energy and the driver is correct, then a large scatter (low-correlation coefficient) indicates poor control and large scope for improvement.

The ‘line of best fit’ established by the technique is called the Standard Line. Additional analysis can be undertaken to determine a Target Line - this represents a planned improvement on standard performance.

Standard statistical texts plus Fuel Efficiency Booklet No. 7, *Degree Days*, and Good Practice Guides on Monitoring and Targeting all have examples of line of best fit.

Further information on ‘line of best fit’ can be found in a range of text books.

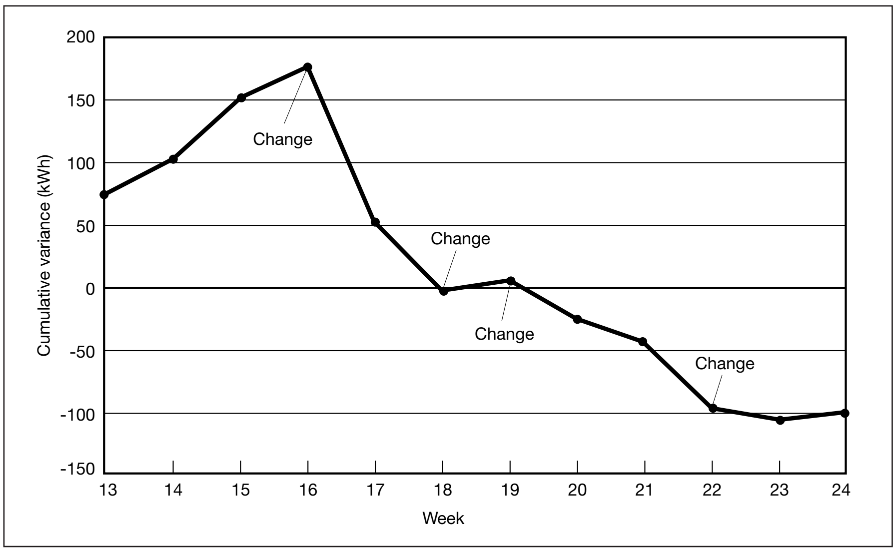
Variances



Weekly variance chart

This approach is suitable for both buildings and industry. Having established a standard or expected level of energy consumption, a simple and useful routine analysis is to calculate the variance, or deviation, of actual consumption from the expected or standard consumption. This variance can be charted and/or tabulated. Variance analysis is often popular with accounting-based users as they show parallels by comparing actual expenditure with budgeted expenditure.

CUSUM



CUSUM chart

This approach is suitable for buildings and industry. CUSUM is the CUmulative SUM of the differences from standard or predicted performance. The technique originates from quality control and, following development work, has been widely applied to energy management.

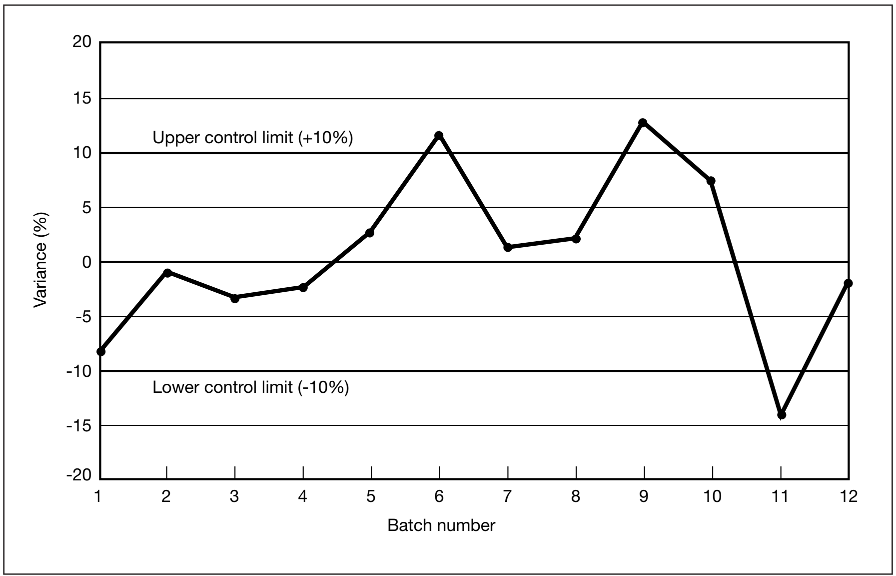
CUSUM can be simply calculated, using a spreadsheet, but needs to be displayed as a graph or chart to gain full benefit of its use. A characteristic feature of a CUSUM chart is that it usually produces a series of straight lines, representing steady performance, separated by sharp kinks indicating events which change the underlying pattern.

There are two important applications of CUSUM in energy management information systems:

- Identifying and quantifying the impact of changes in the pattern of energy use.
- Identifying the time of the last change in pattern, enabling data to be identified which can be used as a basis of control.

The quality of CUSUM analysis depends on the quality of the data used and the relevance of the baseline calculation. Changes in baseline equation can produce significant changes to the shape of the CUSUM line. Once correctly established, CUSUM provides a powerful technique to investigate and monitor performance.

Control Charts



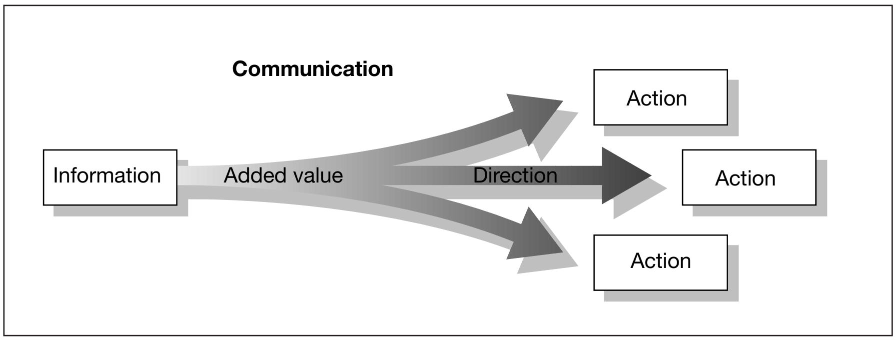
Control chart

This approach is suitable for buildings and industry. Control charts also come from quality control and anyone in manufacturing familiar with Statistical Process Control (SPC) will have used a control chart. For a control chart, a 'baseline' value is required. This value can be derived by using CUSUM to identify the relevant base data. Control limits are then established around this baseline; these limits may be arbitrary or can be developed from an analysis of the process. The limits can also be used to provide an alert or alarm status, for example ±5% and ±10%. This approach can be particularly useful if a large number of meters are being monitored and exception reporting is required.

5

COMMUNICATION

Having collected and analysed the data, it must be communicated to complete the transformation from data to understanding. If an energy information system is to fulfil its prime objective - to support energy management - effective communication is a critical part of that system. There is little point in collecting, collating and analysing data for storage purposes only. Equally if communication is little more than a reiteration of the base data, the system has not succeeded in 'adding value' to the data.



Communicating data

Typically, communication falls into one of three categories:

- ***Regular*** - typically, the weekly or monthly report. Issued on a time basis rather a need basis.
- ***Exception*** - produced when something has gone wrong - or right!
- ***Ad-hoc*** - initiated by request or as the result of investigation. Possibly produced to coincide with a relevant event or activity.

Identifying Information Needs

It is essential to discover who needs what information to support their role in the energy management process. This means finding out what people need rather than making assumptions. It should be clear that the information needs vary throughout the organisation. Consider an engineering factory: What information does the managing director need? Is this the same as the works engineer or the production scheduler? Consider a hospital: What information does a unit manager need? Is this the same as a ward nurse, or unit engineer?

There are two basic questions that you need to answer. There are generic answers but the specific answers will depend on individual circumstances.

Question: Who needs energy information?

Answer: All those individuals that can influence energy performance.

Correctly identifying the recipients of energy information is essential for communication to be efficient and effective. Therefore who needs to know? The answer, though very general, is anyone and everyone who can have an impact. For any organisation this will cover a wide range of people.

It could be argued that, for most organisations, everyone needs to receive some energy information. With the growth of environmental management, we also have to consider communication with stakeholders. Stakeholders include shareholders, employees, regulatory bodies, interested groups and members of the public. To satisfy this need, the external reporting/communication requirements for most organisations will increase.

What should be immediately apparent is that information needs vary widely. At one extreme it may be a single key statistic, at the other a comprehensive and detailed report.

Question: What information do recipients need?

Answer: The minimum necessary to enable them to improve energy performance.

Not everyone needs to know everything. The information that is communicated should be the minimum required for achieving results. It should also be information that recipients can easily assimilate. This may mean training, it may mean that the style and nature of output needs to be tailored.

One approach to consider is providing sample outputs for comment. Many of the commercial bureau services start by offering a wide range of reporting outputs to allow the user to make a choice. They then optimise the system to a limited rage of outputs selected by the customer.

	Annual report	Monthly report	Weekly report	Key indicators	Exception report
Chief executive	■			■	
Accountant	■	■		■	
Department heads	■		■	■	■
Purchasing	■			■	
Supervisors		■	■	■	■
Workforce				■	

What information do recipients need?

A major financial institution was reporting energy consumption to its staff in consumption terms only, i.e. kWh. As part of a staff survey, it became apparent that they felt a need for the information to be presented in financial terms as well. The opinion was that, as finance was the company's core activity, anything not explained in financial terms had little relevance.

Timing of Communication

There are two key time-related aspects to the issue of communication:

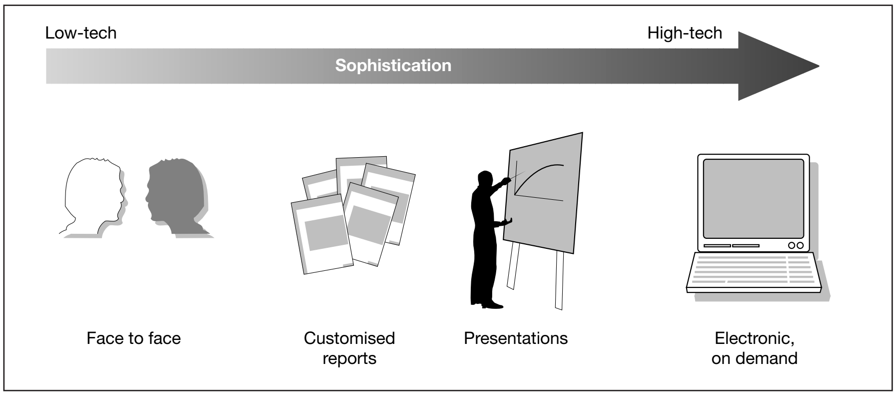
- ***Speed*** - The value of information is time dependent. Information delivered at the right time has a high value. Information delivered too late, when little can be done, wastes time in being assimilated and can discredit the system.
- ***Frequency*** - Communicating too often introduces information overload. It is commonly accepted in today's work environment that managers have access to too much information, rather than too little. Conversely sending reports and information too infrequently can mean that interest is lost.

These two examples show how established communication methods are often the most successful:

- At a university it was noted that water consumption had increased significantly. The Facilities Manager decided to send an e-mail with the figures and costs around the campus. It took him less than ten minutes. Within a month water consumption had fallen by 30%.
- At a large car plant, use was made of the electronic notice board system. (In practice similar to an on-site teletext system.) This used a simple graphic to indicate energy cost performance.

Communication Methods

A number of communication methods are available. The most commonly used are tabulated figures and graphs/charts. In many cases, the chosen method is pre-determined by the software used or organisational practices. It is important that the options chosen by these limitations match the needs of the organisation.



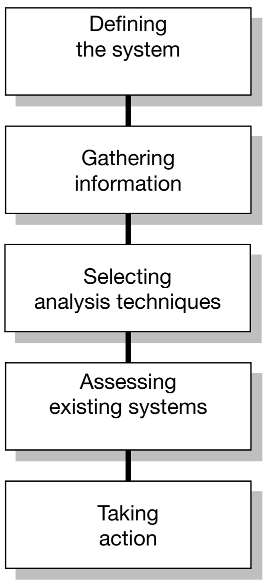
Communication methods

For some people, you may need to deliver information in an exact form to their desk; for others you may need only to give them access to the system. The best methods to choose are the ones which achieve results. This will vary from site-to-site and from year-to-year. What works for one group of people may not work for others.

ASSESSING ENERGY INFORMATION SYSTEM NEEDS - A WORKED EXAMPLE

6

In this Section the example of an engineering site is used to show the process of assessing your company's information system requirements. The process has five steps:



The example engineering site has an annual energy bill of a little over £1 million/year. The site consumes electricity, gas and water plus diesel for its transport fleet. The company uses a software package for Monitoring and Targeting (M&T) and its information system is based upon monthly meter reading and reporting.

Defining the System

As the function of the system is to support energy management, it should be apparent that **the information system must exist as a part of a structured approach to energy management.** If such a structured approach does not exist within the company, this needs to be addressed first.

If the company has a structured energy management approach you can proceed to defining the requirements of the energy information system. You should set clear quantifiable objectives, taking into account the present systems and levels of energy efficiency and the resources you have access to. This system definition is not a technology wish list: it needs to be a clear set of requirements and objectives for a system to support energy management, both technology and people.

To help frame the system definition it is important to look at the energy savings potential in your organisation.

The following table shows utility spend and savings estimates for our example of an engineering site.

Savings potential				
Utility	**Annual spend £k**	**% of total spend**	**% savings potential**	**Savings £k**
Electricity	510	50.0	4	20.4
Gas	220	21.6	6	13.2
Water	180	17.6	15	27.0
Diesel - transport	110	10.8	10	11.0
TOTAL	**1,020**	**100**		**71.6**
Total savings/annual spend			**7%**	

The spend figures were taken from the M&T system. The savings potential figures are consultant's estimates. In this example, it can be seen that water presents the greatest savings opportunity; does the existing system support this area? Also, electricity accounts for half the total expenditure; again does the system support this?

Another part of defining the system is to ask people what they want from the system. This will be of limited value if they do not understand energy management, although you can find out what form and style the information output should take. Answers might range from a full written report to occasional on-line access. Form and style will also be influenced by the custom and practice of the organisation.

Gathering Information

You will need to gather information about the company's existing metering and invoicing data and the methods of communication that are available to you.

This data gathering should include:

- raw data - meter reading and invoices;
- analysis - calculations and assessments;
- communication - reports and other outputs.

You should also consider drawing up a flow chart for all these items. Questions you should be asking include:

- What raw data is already available?
- Which analysis processes are used and why?
- Where is data and information stored?
- How is information communicated?
- Do people get what they want?
- Is information delivered on time?
- Is the information both of good quality and reliable?

Metered supply - main meters					
Utility	**Number of meters**	**ID/ location**	**Type** A = on-line metering B = (Basic) manually read; Other - specify	**Reading frequency** Q = quarterly; M = monthly W = weekly; D = daily 30 = 30 minutes Other - specify	
				By utility	**By organisation**
Electricity	1	M186 Main gate	A	30	W
Gas	2	M0875 M67899 Gas house	B B	M M	W W
Water	1	12567 Entrance road	B	M	W
Total	**4**				

You may find it advantageous to include meter numbers (M numbers) and postcodes, as this data is required when seeking competitive supply quotations. The example shows the possibility of half-hourly electricity readings which are not being used.

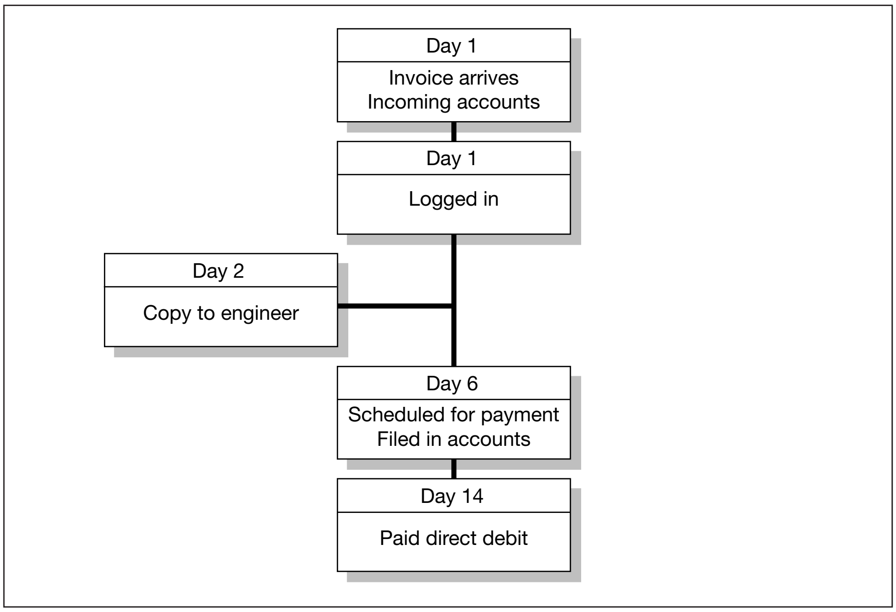
Not all utilities will be metered at point of supply. For our example site, the only bulk supply is road diesel delivered to the underground storage tanks. In this case, the consumption of the diesel is metered by way of the fuel pump when vehicles re-fuel. Accordingly it is possible to get consumption data by vehicle.

Bulk supply - unmetered			
Utility	**Method of charging**	**Frequency of charging**	**Consumption metering**
Road diesel	By delivery	By delivery	At point of use

The next area to consider is the processing of invoices. For our example company this will be straightforward. This is the area where large buildings-based organisations will differ significantly from our industrial example.

Invoice tracking				
Detail	**Gas**	**Electricity**	**Water**	**Total**
Invoices per month	2	1	1	4 (48 per year)
Paper or electronic? P/E	P	P	P	
Estimated readings? Y/N	Y	N	Y	
Direct debit payment? Y/N	Y	Y	Y	

We can see that with four paper invoices a month (48 a year) invoice processing should not be a major task. The next part of invoice tracking is to produce a flow chart tracking the progress of the invoices, and copies, around the organisation. This physical tracking is a very important part of the review of multi-site buildings-based systems.



Invoice flow chart

Here we see that the engineer is included on an 'information only' basis with payment automatically taking place. If the engineer is to be part of the invoice validation process, then he/she needs to respond quickly to meet the direct debit payment schedule, and be part of the main flow line.

Moving on from the supply, it is possible that sub-meters have been installed. These should be logged in a similar way to the main meters.

Sub-meters			
Metered utility	**Number of sub-meters**	**Type** A = on-line metering B = (Basic) manually read;	**Reading frequency** Q = quarterly; M = monthly W = weekly; D = daily A = on-line, X = not read
Electricity	5	B	W
Gas	0		
Water	0		
Diesel	2	B	Tank filling
Total	**7**		

For our example site we have five electricity sub-meters but no water sub-meters, yet the greatest potential for saving is with water. Are more water meters required?

If we are to correlate energy use against production or other drivers, we must identify and gather information on the factors that have an influence on energy consumption.

Energy drivers		
Driver	**Process affected and energy type**	**Source of data**
Tonnage	Furnaces and machinery - electricity and gas	Production control system
Weather degree days	Heating - gas and electricity	Energy management magazine
Mileage	Fuel consumption - diesel	Transport log books

In our example, the site has chosen typical drivers. We cannot ascertain how relevant they are without additional site knowledge.

The next area of interest is communications. Try to identify all forms of communication that might be relevant.

Communication

Report	Frequency	From	To
Company Energy Report	Annual	Energy Manager	Managing Director and Department Heads
Energy Indicators	Monthly	Energy Manager	Department Heads
Budget Report	Monthly	Accountant	Relevant Department Head
Fuel Economy	Monthly	Fleet Manager	Accountant

In our example, two of the communications did **not** originate with the manager responsible for the energy information system. These are a financial budget report, produced by the accountant and a fuel economy report produced by the fleet manager. Although not produced by the energy information system, these reports are communicating energy information. Should they be integrated? Do they 'agree' with the output from the energy information system?

The communications that relate to energy but are generated independently from the energy information system are very important. Firstly, they may provide a development opportunity for you, and secondly, they may be in conflict with what you want to do.

Next we investigate the cost of operating the energy information system. There is little point in spending more than we save!

Audit of energy information system running costs

Item	Annual Cost **(A)**ctual or **(E)**stimated
Meter reading	£825 (E)
Meter calibration	Nil
Software and software support	£100 (A)
Hardware and hardware support	£145(A)
System operators	£600(E)
External contracts	Nil
TOTAL COST	**£1,670/year**

Actual costs have been taken from records. The estimated costs have been based on labour rates and an estimate for time spent. Is it right that there are no meter calibration costs? Are the hardware support costs exclusively for the energy information system?

When the collection of data and information is completed, look at the options for data analysis that are available to you.

Selecting Analysis Techniques

It is not possible to propose standard data analysis techniques as requirements and possibilities will vary from system to system. There are basically two activities to be undertaken:

1. Check existing analysis techniques to see if they are being used accurately and appropriately. (In our example one site claimed to be using CUSUM but investigation showed that in practice they were using moving annual totals. The output was useful, but misleading!)

2. Take samples of raw data and apply different analytical techniques to them. The techniques may be more, or less, sophisticated. The reason for this is simple:

The most common fault with an energy information system is not making effective use of existing data.

There is little point in spending time and money on collecting additional data if the prime objective - supporting energy management - can be carried out with the existing data.

Assessing Existing Systems

You should now have a good understanding of the information sources available and will be able to make an assessment of the existing information system. Before drawing any conclusions, you need to assess the quality performance of the system particularly accuracy and reliability.

Accuracy

Select, at random, an energy management report.

Check any calculations that have been made using the data in the report. For example, if there is an SER, tonnage and energy, check that the SER is correct. If you find problems, are these as a result of rounding errors, misunderstanding or software errors?

When the report has been passed as correct, on the basis of its own data, you then need to follow an 'audit trail' back to the origins of the data. To do this, select a number of data items, for example, energy consumption, degree days, production volume, hours of operation. Then, taking each in turn, check them back to their original data source e.g. the meter, log sheet, recorder.

- You may want to go further and verify the data sources themselves. For example: When was the steam meter last calibrated? Is the measure of floor area gross or net?

- Using methods similar to quality control techniques, you need to make an assessment when errors are found - are they single errors or indicative of system errors?

Any organisation working towards ISO 14001, *Environmental Management Systems* should be prepared for the certifying body to carry out an audit process as above.

Reliability

Having checked accuracy, the next task is to look at the delivery of information. Is it on time and in the required form? If the system is based on regular reporting, identify all the regular reports that are 'promised' by the system and then look at their delivery.

- ***Regular reporting*** - At a simple level, this might be 12 monthly reports and one annual report. In this case the check would be whether all 13 reports were produced. If the right number of reports have been produced, how long after the month end did they appear? How long after the year end did the annual report appear? Having established the performance, is it acceptable? A monthly report that is eight weeks after the end of the month has far less value than one appearing during the week after the month end. (If you want to use a ratio to rate this area of performance you can divide the actual time for report delivery by the target time for report delivery. Anything less than unity is good, anything over unity indicates a missed target.)

- ***Exception Reporting*** - It is essential that exception reporting is reliable, as without a report the user assumes all is well. This audit has two parts. The first is to apply the timeliness criteria from above, i.e. how quickly were the reports provided? The second is more complex and is to check that all exceptions that should have been reported were reported. To do this, you will need to look at the historical data and identify the points of exception. Were reports raised to cover these? If not, why not? Clearly if your system does not identify exceptions then you cannot report them!

Communication

Having satisfied ourselves about quality, we need to assess the effectiveness of communication. If reports are accurate and reliable, what happens to them? Are they understandable? Are they useful? Try the following process to check the effectiveness of your communication methods:

- Select, at random, a number of reports that have been issued and then arrange meetings with the recipients:
- Prepare a structure for the meeting so that you can find out what recipients do with the reports:

  - Do they file, distribute or bin them!
  - Do they understand the reports?
  - Are reports sent to the right people?
  - Can they suggest improvements?
  - What actions have been taken as a result of the reports?

The output of this process will be more qualitative than quantitative. Depending on the results of these interviews, you may decide to send a questionnaire to a wider group or use some other means to widen the consultation.

Comparative ratios

Determining some key ratios can assist in assessing the system. The first of these is the ratio of total energy cost and number of meters.

Taking information from delegates attending Energy Efficiency Best Practice Programme workshops around the UK, the spread of results for energy spend per meter has ranged from less than £2,000 to over £1 million. The £2,000/meter site had a requirement for making all departments cost accountable. The £1 million/meter site was a major chemical plant. This Guide does not recommend an appropriate level for energy spend per meter. The aim is to make you aware and encourage you to assess your own situation.

Energy spend per meter	
Total energy spend	£1,020k/year
Total main meters	4
Total sub-meters	7
Total meters	11
Annual energy spend £k/Meter	**£93k/year**

We can now consider the results for our example company (see tables). With an energy spend of £93,000/meter we may feel that additional investment in metering may be worthwhile.

When we see that the energy information system operating cost is less than 0.2% of the total energy spend, and the total savings potential is 7%, we can see there is good justification for developing the system further - if that will lead to additional energy savings.

Information system ratios	
Operating cost/meter	£152/year
Operating cost/total energy spend	0.2%
Operating cost/savings potential	2.3%
Savings potential/total energy spend	7.0%
Based upon the following data:	
Operating cost	£1,670/year
Number of meters	11
Total energy spend	£1,020k/year
Savings potential	£71.6k/year

Taking Action

This assessment will highlight the differences between the existing information system and the requirements you have identified for its improvement. Having identified these areas for improvement, you can plan and implement appropriate actions.

System development should not be carried out in isolation. For example, if a new financial management system is being introduced, it may be an ideal opportunity to integrate some elements of the energy information system. For a high street based organisation it may be worth looking at how any rolling refurbishment programmes can help.

From a clear understanding of your current position and your planned destination, all that remains is to get there. However, there are too many examples of energy information systems where one person takes all responsibility and attempts to carry out all the work.

Taking action needs the support, commitment and participation of other individuals who have a stake in the successful operation of the company's energy management activities.

7

TOOLKIT

The forms provided in the section can be copied and used as a toolkit. It is more likely that you will want to customise them for your own organisation on a spreadsheet (where you can build in calculations and do further analysis) or a word processor.

If you work within a multi-site organisation, you may want to apply the tools to each of the sites. Alternatively, you may wish to audit a number of sample sites. The balance here will be between the effort and cost required and the potential gains.

Action Plan

The Action Plan has been prepared to set targets and responsibilities for an initial review of the company's energy information system needs.

Action Plan

SITE DETAILS: . . . .

Item	**Responsibility**	**Start date**	**Completion date**
System definition			
Information gathering			
Analysis			
Assessment			
Implement			
Next audit			

Date Prepared: ______________________________

It would be reasonable to plan for completion of the system definition, data gathering, analysis and assessment stages by week ten. Implementation would then follow, with the next audit taking place 12 months after this initial review.

Potential Savings Assessment

The starting point is to look at the annual expenditure and savings potential for each utility used. Savings potential is your estimate of the percentage savings you think can be made, without significant capital investment. For a site that has not addressed the management issues of energy and workforce awareness, savings of around 5% are normally possible.

Utility Savings Potential

SITE DETAILS: . . . .

Utility	**Annual spend £k**	**% of total spend**	**% savings potential**	**Savings £** (annual spend x % potential savings)
Electricity				
Gas				
Water				
Oil				
Total		**100%**		
Total savings/annual spend %				

If you are running a cost-optimised energy management programme you should be focusing your effort on the largest savings potential. If you are driven by environmental objectives, you could prepare an alternative analysis based on environmental impact. However, since, to an extent, cost is proportional to environmental impact this may not be necessary.

Metered Supply - Main Meters

This table shows the meters used by the utilities to compile your invoices. On-line metering indicates that the meters are read remotely, i.e. the utility does not have to visit the site to read the meter. Code 5 is an example of on-line metering.

Main Metering

SITE DETAILS: . . . .

Utility	**Number of meters**	**ID/ location**	**Type** A = On-line metering B = (Basic) Manually read; Other - specify	**Reading frequency** Q = quarterly; M = monthly W = weekly; D = daily 30 = 30 minutes Other - specify	
				By utility	**By organisation**
Electricity					
Gas					
Water					
Total					

This table covers the main utility meters. Although you may have paid for the installation of these meters, they normally remain the property of the utility or meter operator. If you want to connect reading devices to these meters, they will need to be approved by the meter owner/operator.

You will find recording the meter identification and location useful if you decide to change utility suppliers.

If you have no other meters, these meters can provide a cost effective data source for an energy information system.

Bulk Supply - Unmetered

Include in this table each of the utilities that are supplied in bulk, e.g. oil, coal, and perhaps water.

Unmetered Bulk Supply

SITE DETAILS: . . . .

Utility	Method of charging	Frequency of charging	Consumption metering
Oil			
Coal			
Water			

Since these supplies are not metered you will be provided with supply information rather than consumption data.

If water is supplied at a flat charge regardless of consumption, there is little financial incentive to reduce consumption. However, changing to a metered supply may be an option.

Invoice Tracking

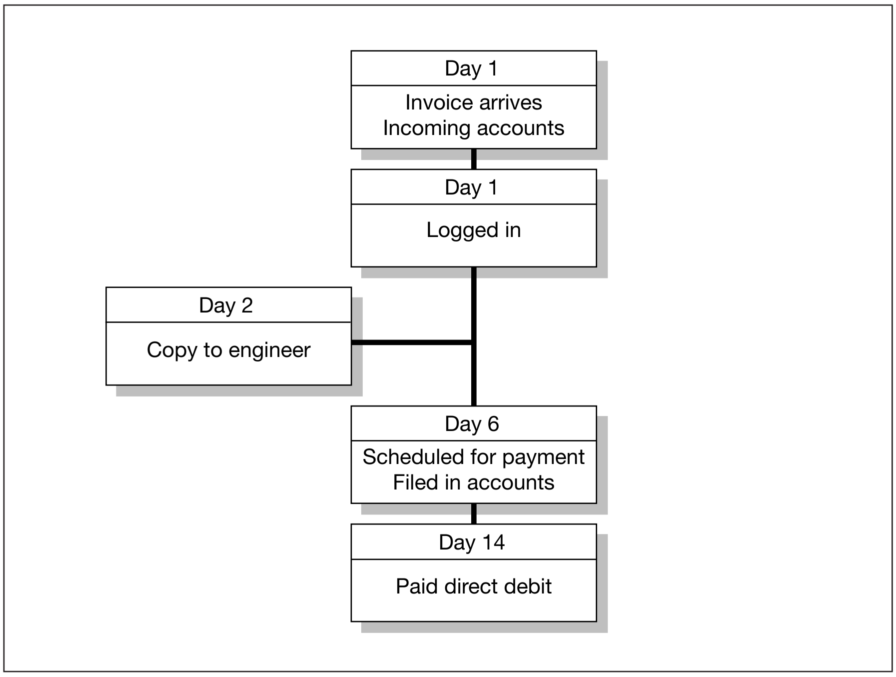
First identify how many invoices are processed and their key characteristics. For example, estimated readings will lead to problems with consumption measurement. Direct debit will change how the Accounts Department handles the invoice, whilst electronic invoices should be easier to enter into a system.

Invoice Tracking

SITE DETAILS: . . . .

Detail	Gas	Electricity	Water	Total
No. of monthly invoices				
Invoices per year				
Paper or electronic? P/E				
Estimated readings? Y/N				
Direct debit payment? Y/N				

You will find it useful to draw a flow diagram of the invoicing process:



Flow diagram for energy invoices

Sub-meters

This table covers the meters used to break down consumption by service or department. They may be used simply for monitoring or for departmental charging.

Sub-metering

SITE DETAILS: . . . .

Metered utility	**Number of sub-meters**	**Type** A = on-line metering B = (Basic) manually read;	**Reading frequency** Q = quarterly; M = monthly W = weekly; D = daily A = on-line, X = not read
Total			

You will also want to record the locations of any sub-metering and the processes they monitor

Energy Drivers

The energy consumption of your site is 'driven' by a number of factors, such as the weather, tonnes of product, moisture content of raw material and hours worked.

For this Section you need to list **what you think** are the significant energy drivers for your site.

Energy Drivers		
SITE DETAILS:		
Driver	**Process**	**Source of data**

Communications

This table is used to plot energy reporting that takes place within the site/organisation - regardless of origination (i.e. not just what is produced by energy management).

Energy Reporting			
SITE DETAILS:			
Report	**Frequency**	**From**	**To**

Other Relevant Communicated Methods		
Type	**To**	**From**

Running Costs

This looks at the costs of operating the energy information system. This is done using annual costs with best estimates where actual figures are not known. Complete the first column in year one - then compare this to the planned or actual costs for year two.

Energy System Operating Costs

SITE DETAILS: . . . .

Item	**Annual cost year 1** **(A)**ctual or **(E)**stimated	**Annual cost year 2** **(A)**ctual or **(E)**stimated
Meter reading		
Meter calibration		
Software and software support		
Hardware and hardware support		
System operators		
External contacts		
Total cost		

Notes:

- ***Meter reading*** - This is the staff cost associated with reading the meters. It may be a dedicated job or a small part of another function.
- ***Meter calibration*** - This is normally required for steam meters, although other meters may require re-calibration
- ***Software and software support*** - You may have to pay annual fees for software, and/or its maintenance.
- ***Hardware and hardware support*** - This will be for any dedicated hardware, or any hardware costs that are charged to the system
- ***System operators*** - This covers the staff cost of the energy information system operators.

System Performance Ratios

Energy Spend Per Meter	
SITE DETAILS:	
Total energy spend	£ /year
Total main meters	
Total sub-meters	
Total meters	
Annual spend/meter	£ /year

You would expect the energy spend per meter to fall year on year as a result of energy efficiency measures. However, in the early stages it may fall as a result of increased awareness through better metering.

Information System Ratios	
SITE DETAILS:	
Operating cost/meter	£ k/year
Operating cost/total energy spend	%
Operating cost/savings potential	%
Savings potential/total energy spend	%
Based upon the following data:	
Operating cost	£ k/year
Number of meters	
Total energy spend	£ k/year
Savings potential	£ k/year

As guidance, you should expect operating cost/total energy spend to be a fraction of the potential savings/total energy spend. If it is not, you are spending more than you are saving! You also need to be comfortable with the operating cost per meter.

Progress

To review progress over a series of annual audits you might like to use the table below.

Progress Record

SITE DETAILS: . . . .

	Audit 1	**Audit 2**	**Audit 3**
Date			
Annual energy spend £k			
Savings potential %			
Total savings/total spend %			
No. of main meters			
No. of sub meters			
System operating cost £k			
Spend/meter £k			
Operating cost/meter £k			
Energy savings achieved £k			

Most of the figures in this table can be taken from the tools in this section. The exception is the last row ‘Energy savings achieved’, which must be added as appropriate.

Comparing performance against previous audits enables you to identify progress in energy savings or enhancing the energy information system. It may be useful to compare trends in some of the key indicators too.

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

Further information

For buildings-related publications please contact:
Enquiries Bureau
BRECSU
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Garston, Watford, WD2 7JR
Tel 01923 664258
Fax 01923 664787
E-mail brecsuenq@bre.co.uk

For industrial and transport publications please contact:
Energy Efficiency Enquiries Bureau
ETSU
Harwell, Didcot, Oxfordshire,
OX11 0RA
Fax 01235 433066
Helpline Tel 0800 585794
Helpline E-mail etbppenvhelp@aeat.co.uk

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

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

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

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

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

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

Energy Efficiency in Buildings: helps new energy managers understand the use and costs of heating, lighting etc.