GOOD PRACTICE GUIDE 148

Monitoring and Targeting in the textiles industry

GOOD PRACTICE GUIDE 148

ENERGY EFFICIENCY
BEST PRACTICE PROGRAMME

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.

ENGLAND

London
Govt Office for London
6th Floor
Riverwalk House
157-161 Millbank
London
SW1P 4RR
Tel 020 7217 3435

East Midlands
The Sustainable Development Team
Govt Office for the East Midlands
The Belgrave Centre
Stanley Place
Talbot Street
Nottingham
NG1 5GG
Tel 0115 971 2476

North East
Sustainability and Environment Team
Govt Office for the North East
Wellbar House
Gallowgate
Newcastle-upon-Tyne
NE1 4TD
Tel 0191 202 3614

North West
Environment Team
Govt Office for the North West
Cunard Building
Pier Head
Water Street
Liverpool
L3 1QB
Tel 0151 224 6401

South East
Sustainable Development Team
Govt Office for the South East
Bridge House
1 Walnut Tree Close
Guildford
Surrey
GU1 4GA
Tel 01483 882532

East
Sustainable Development Awareness Team
Govt Office for the East of England
Heron House
49-53 Goldington Road
Bedford
MK40 3LL
Tel 01234 796194

South West
Environment and Energy Management Team
Govt Office for the South West
The Pithay
Bristol
Avon
BS1 2PB
Tel 0117 900 1700

West Midlands
Regional Sustainability Team
77 Paradise Circus
Queensway
Birmingham
B1 2DT
Tel 0121 212 5300

Yorkshire and the Humber
Sustainable Development Unit
Govt Office for Yorks and the Humber
PO Box 213
City House
New Station Street
Leeds
LS1 4US
Tel 0113 283 6376

NORTHERN IRELAND
IRTU Scientific Services
17 Antrim Road
Lisburn
Co Antrim
BT28 3AL
Tel 028 9262 3000

SCOTLAND
Energy Efficiency Office
Enterprise and Lifelong Learning Dept
2nd Floor
Meridian Court
5 Cadogan Street
Glasgow
G2 6AT
Tel 0141 242 5835

WALES
Business and Environment Branch
National Assembly for Wales
Cathays Park
Cardiff
CF10 3NQ
Tel 029 2082 5172

MONITORING AND TARGETING IN THE TEXTILES INDUSTRY

About this Guide

This Good Practice Guide (GPG) gives an introduction to the basics of Monitoring and Targeting (M&T) with specific examples from the textiles industry. More detailed guidance on how to implement M&T is provided in GPG 112, *Monitoring and Targeting in large companies,* and GPG 125, *Monitoring and Targeting in small and medium-sized companies.*

Prepared for the Department of the Environment, Transport and the Regions by:

ETSU
Harwell
Didcot
Oxfordshire
OX11 0RA

and

Cheriton Technology Management Ltd
PO Box 916
Swavesey
Cambridge
CB4 5UE

This Guide was part-funded under the SAVE programme.

SAVE (Specific Actions for Vigorous Energy Efficiency) was set up to encourage the more efficient use of energy in the European Union through ‘organisational means’ by:

- developing Standards/Specifications for energy efficiency;
- developing financial techniques to promote and encourage investment in energy efficiency (e.g. Third-party Financing);
- promoting training and awareness for the efficient use of energy.

Further details of SAVE activities in the UK can be obtained from:

Energy Efficiency Enquiries Bureau, ETSU, Harwell, Didcot, Oxfordshire OX11 0RA
Tel: 01235 436747 Fax: 01235 433066 E-mail: etsuenq@aeat.co.uk

CONTENTS

1

INTRODUCTION

The UK textiles industry includes wool, cotton and man-made fibres which are processed into a diversity of different fabrics and finished products. In 1996, annual energy consumption in the textiles industry was about 48 PJ, at a total cost of around £200 million. The major energy consuming activity is textile finishing which includes bleaching, dyeing, application of finishes and printing. Many mechanical processes in the textiles industry require precise conditions of humidity and temperature, so heating and ventilation systems represent another significant source of energy consumption.

The industry is characterised by small and medium-sized companies with energy costs typically representing 10 - 15% of total production costs. Most companies are able to achieve around a 10% reduction in their energy costs, without any investment, simply through improved energy management practices.

The Benefits of M&T

The first step in reducing energy costs is to understand how energy is consumed, and also wasted, within your company's processes. Monitoring and Targeting (M&T) is a group of straightforward, information-handling techniques that help you to do this and so reduce energy costs through improved energy efficiency and energy management control.

Besides energy cost savings, M&T has many other benefits for textile companies. They include:

- reduced raw material wastage;
- reduced water consumption;
- improved product quality (lower defect rates);
- better preventative maintenance;
- improved production budgeting;
- closer control of production processes;
- enhanced environmental performance.

Most of the data you need are readily available from normal production and business activities. M&T uses these data, collected and analysed on a regular basis, to provide management and staff with the information they need to manage energy usage more effectively.

Besides providing the information needed to improve the way energy is managed, M&T provides a framework for assessing and justifying company investment in energy efficiency or environmental projects.

This Guide will help you to establish an effective M&T system which can:

- **identify areas of energy wastage** - for example by determining the proportion of energy that does not directly contribute to production and is often a source of energy savings;
- **evaluate process efficiencies** - by establishing a relationship between energy use and some measure of production;
- **highlight changes to energy consumption patterns** - these are either a result of a specific action to improve efficiency or due to an unknown factor which may have a detrimental effect upon efficiency and lead to process failure or poor quality product;
- **identify sporadic faults or events** - to alert operators to excursions from normal, or predicted, production performance;
- **provide support for environmental management activities** - M&T has much in common with the requirements for an effective information system within recognised standards for environmental and quality management (e.g. ISO 14001, ISO 9000, EMAS and TQM).

The main applications for M&T in textiles companies include:

- energy efficiency and performance of:
  - manufacturing processes: stenters, dryers and looms,
  - utility plant: boilers, air compressors,
  - space heating and ventilation systems;
- managing water usage;
- monitoring scrap rates.

2

IMPLEMENTING M&T

M&T is a group of information-handling techniques that enables energy usage to be managed more effectively within a company. It has many similarities with other production and financial information systems and should be developed in accordance with the company's existing systems and general management approach. Energy M&T can be an extension of quality-led activities or a starting point for more general improvement.

There are four main elements of a successful M&T system:

Data collection: most of the data needed for M&T are available from existing meter readings, energy bills and production-related data.

Analysis and interpretation: analysis enables you to turn the data into useful information on which to act. Proprietary M&T software is available, although standard PC spreadsheets are quite adequate for many applications.

Reporting: this means ensuring the right information reaches the individual with the ability and responsibility to act. Information needs to be timely, concise and delivered in a form that is appropriate and useful to the recipient.

Action: without action the data collection and analysis are a waste of effort! M&T needs to be geared to the management activities of the company so that action is taken and energy-saving results are achieved.

M&T can be applied to single, or groups of, processes or buildings, or entire factories. The initial choice will depend on available energy metering, but over time this will be refined by your increasing understanding of areas where energy can be better controlled. M&T techniques are not limited only to energy usage but are equally applicable to water consumption and production indicators such as scrap rates or yield.

Industry Benchmarking

A simple method of benchmarking your company's energy performance against the industry sector norm is by a comparison of **specific energy consumption (SEC).** SEC is a measure of energy use per unit of production, e.g. kWh/te throughput.

Benchmarking ratios, such as SEC, can be derived using production and business data available within the company. These include:

- **production data** - quantity of product manufactured or treated;
- **fuel consumption** - electricity, gas, fuel oil, etc. recorded from utility invoices or meters.

Even limited data will allow you to make preliminary comparisons of energy performance with other sites or similar processes and will provide a baseline against which to start tracking on-going energy consumption.

Although establishing benchmarks for industry-wide performance is useful, the energy consumption of a single process or factory will almost certainly be of much more interest to energy managers. If your company is multi-site, or has similar operations within the same site, consider making comparisons between similar processes to see if there are significant differences in energy consumption. This **internal benchmarking** is a valuable technique for sharing best practice within a company.

It may also be possible to exchange experience of energy management techniques with companies from different sectors (neighbouring firms or, perhaps, your suppliers). This can provide a new and creative insight into your energy management practices.

The Four Chart Types Used in M&T

Displaying information graphically makes it clear and easy to understand and is a good format for communication to colleagues. It also enables you to identify trends in data.

There are four chart types commonly used within a basic M&T system:

- energy use vs. production;
- specific energy consumption (SEC) vs. production;
- CUSUM;
- control chart.

The first two of these chart types are for displaying and interpreting energy data, while the others are used primarily as tools to assist in management and control.

In this Guide we look at each of these chart types in turn, using a real example from the textiles industry. For each, we explain how to create the chart from collected energy and production data, and how to interpret and apply what the chart can tell you about energy use.

This Guide is designed to provide an introduction to M&T in the textiles industry. Comprehensive guidance on how to implement M&T, and interpret the information it provides, is given in GPG 112, *Monitoring and Targeting in large companies*, and GPG 125, *Monitoring and Targeting in small and medium-sized companies.*

For further guidance on specific textile industry technologies and techniques, and advice on how to implement cost-effective energy management measures, refer to GPG 168, *Cutting your energy costs - a guide for the textile dyeing and finishing industry.*

3

MONITORING AND INTERPRETING ENERGY DATA

Energy Use vs. Production Chart

This first chart type (Fig 1) shows energy consumption (in this example, electricity) plotted against production using data that have been collected at regular intervals (daily, weekly, monthly). Most processes will exhibit a pattern through which a straight line (best fit line) can be drawn. This can be drawn by hand or generated on a spreadsheet by using the regression analysis function. Note that the line should not be forced to pass through the origin point (0,0).

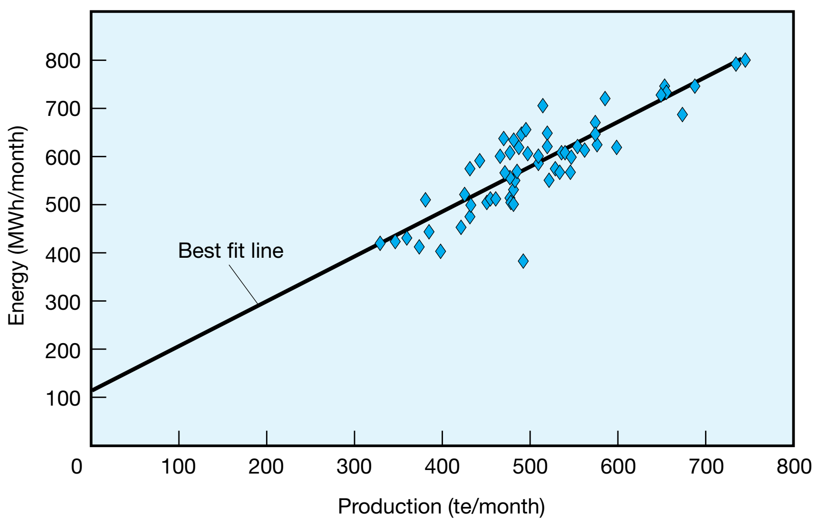

Fig 1 Energy vs. production for a textile finishing works

The best fit line indicates the relationship between energy consumption and its driver (in this case, production) and we can learn several things from calculating the equation of the straight line in the standard mathematical form:

$$y = m x + c$$

In this equation, y is the energy axis, x is the production axis, m represents the slope of the line, and c its intercept with the y axis.

In this instance the equation of the line is:

energy (MWh/month) = 0.93 x production (te/month) + 113.5

Energy vs. production charts are used to determine:

- process efficiency;
- the proportion of energy use not linked to production.

There are three important features of this chart:

Intercept (c) - the energy that would still be required even if production was reduced to zero. In this case it is 113.5 MWh/month.

Slope (m) - the amount of energy required to process each additional unit of production, leading to the process efficiency. In this case it is 0.93 MWh/te.

Scatter - the distribution of the data points away from the best fit line, indicating the variation in energy per unit production from one period to another.

From this chart it is also possible to calculate the proportion of energy that does not contribute to production by dividing the energy that is unrelated to production (113.5 MWh/month) by the average monthly energy usage. Average production in this case is 507 te/month.

Thus, the proportion of energy not related to production

$$= \frac{113.5}{113.5 + (0.93 \times 507)} \times 100\%$$

$$= 19.4\%$$

So, 19.4% of the energy used is not linked to the amount of production and is an area worth further investigation for energy savings.

The **efficiency of a process** can be determined if the theoretical energy requirements of the process are known. Research associations will be able to help you determine this figure for specific processes and duties. The efficiency is found by dividing the derived energy requirement by the actual energy consumed (given by the slope of the best fit line - Fig 1).

Correct control of humidity and temperature conditions is extremely important in many textile processes, and poorly adjusted heating and ventilation systems are a common source of energy wastage. Degree days are a measure of the difference between external temperatures and the temperature at which your building is maintained. Plotting **energy vs. degree days** will reveal the proportion of energy consumption that is weather-related and, from a knowledge of the building's fabric losses (i.e. heat loss through walls, roof, windows, etc.), can be used to carry out an approximate check of ventilation rates.

Degree day data are published regularly and further details on their use within M&T are provided in GPGs 112 and 125.

Further interpretation of the chart

When considering the energy consumption of some intermittent textiles processing equipment such as stenters, dryers, dye-fixation units, etc., it is necessary to distinguish between the **time spent idling** and the **time spent in production.** In this situation the intercept (c), representing energy not related to the volume of production, will be made up of two components and the best fit line will be given by

$$\text{energy (GJ/week)} = m \times \text{production} + Ah_i + Bh_p$$

Where h_i is the number of hours the plant stands live but idling, h_p is the number of hours in production, and A and B are empirical constants. These constants can be determined from statistical data or from physical measurements of the process.

For some plant, the consumption during idling can be a significant proportion of total energy consumption - M&T is a useful way of identifing and minimising this idling time.

Another form of the energy vs. production chart that may be encountered is where the intercept occurs on the x (production) axis, which would seem to indicate a level of production occurring with zero energy consumption. This is generally accounted for by energy received by the process from an unquantified source, e.g. heat recovery from a separate process.

Although the straight-line form is most common for these charts, characteristic non-linear forms do occur (curves, bent lines, etc.) and are discussed in GPGs 112 and 125.

Specific Energy Consumption vs. Production Chart

This chart type plots specific energy consumption (SEC) against production. SEC is calculated simply from the data used in Fig 1 by dividing energy consumption by production. The chart generally produces a characteristic curved form (Fig 2).

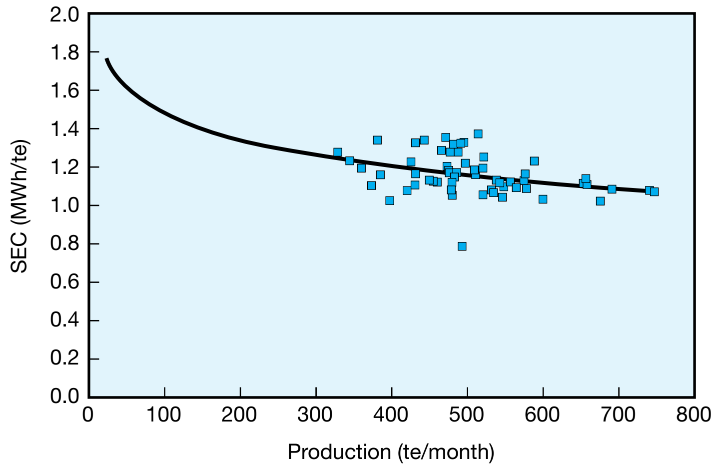

Fig 2 Specific energy consumption vs. production for a textile finishing works

SEC provides a simple indicator for benchmarking.

For this example, the curvature of the line is not easily seen within the process range of production, but this is not always the case. SEC is often used in industrial management as a summary indicator, but is not suitable as a basis for energy monitoring and control. The curvature means that it is difficult to draw a best fit line and the information in the straight line intercept (Fig 1) is lost.

Energy monitoring by SEC should be avoided if there is a significant proportion of energy which is not related to production (this causes the curvature), and where the process has a wide range of production rates.

4

USING ENERGY INFORMATION FOR PROCESS CONTROL

The purpose of M&T is to translate energy information into a form that can be readily used to improve energy management control. The two chart types described in this section show how this is achieved through M&T.

M&T is applied as follows:

- establish energy performance standards;
- calculate the difference between predicted and actual performance;
- highlight exceptional differences;
- manage performance differences over a period of time.

Commonly, performance standards are based on measures that are simple to derive and easy to understand, e.g. SEC, but such standards are not very sensitive. In M&T, a better initial standard of performance is found by looking at historic energy use compared to production.

The success of this approach depends on being able to set control limits that recognise exceptional differences in energy performance (higher or lower than predicted), yet are not so sensitive as to be triggered by normal variations in operation. The smallest difference that identifies a fault is called the **resolution** of the system. Resolution can be improved by selecting the data for the particular periods (days, weeks, months) that will provide the best standard from the historic information.

The following chart types show how this is achieved in energy M&T by a combination of a technique called **CUSUM** and a method taken from quality management called the **control chart.**

CUSUM Chart

CUSUM stands for the **CU**mulative **SUM** of differences and is a technique which uses equal interval time series data (i.e. information of the same kind, collected at the same time each day, week, month, etc. and organised in the same time order as it was measured). CUSUM plots the cumulative difference between predicted and actual energy use against time.

There are two uses for CUSUM. One is to identify changes in historical energy performance patterns (to measure planned or unforeseen changes in the way energy is used); the other is to determine the period since the last change, as data over this period may be used as a reference for establishing control standards.

CUSUM involves four steps:

- Predicting energy use from the production data for each time interval (daily, weekly, monthly, etc.). This is done using the best fit line of the energy vs. production chart - Fig 3.
- Subtracting predicted consumption from actual usage to obtain a difference for each time interval.
- Summing the differences over time to obtain CUSUM.
- Plotting a chart of CUSUM against time.

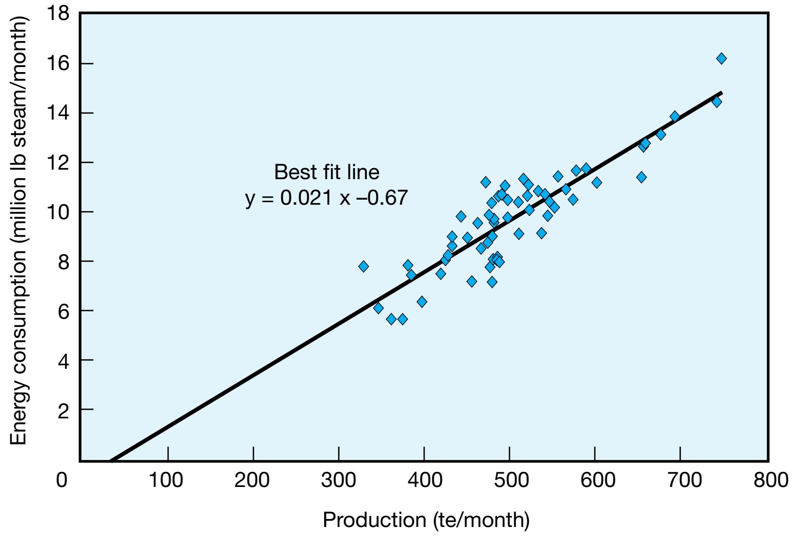

Fig 3 Steam consumption vs. production for a textile finishing works

The equation of the best fit line is determined and used to predict energy consumption.

The following table shows the CUSUM calculation performed on the data for the steam consumption of a textile finishing works (shown in Fig 3).

In this instance the equation of the line is:

energy (million lb steam/month) = 0.021 x production (te/month) – 0.67

CUSUM table for steam consumption at the textile finishing works

Month	Production (te)	Steam consumption (million lb) Recorded	Predicted	Difference	CUSUM (million lb)
Jan 89	745.9	16.20	14.99	1.21	1.21
Feb	491.9	10.76	9.66	1.10	2.31
March	443.8	9.86	8.65	1.21	3.52
April	493.0	11.08	9.68	1.40	4.92
May	481.7	9.71	9.44	0.27	5.19
June	496.5	10.54	9.75	0.79	5.98
July	384.9	7.44	7.41	0.03	6.01
Aug					
Sept					
Oct					
etc.					

The resulting CUSUM chart is shown in Fig 4, overleaf.

The CUSUM chart shows changes to the underlying pattern of energy consumption.

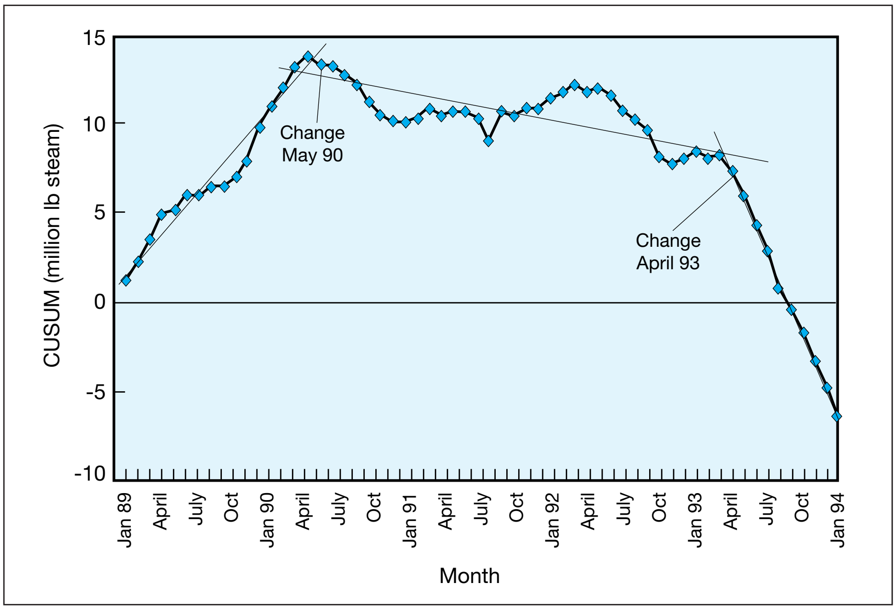

Fig 4 The CUSUM chart for the textile finishing works

If all the scatter in the steam vs. production chart were only random about the best fit line, then the differences from predicted energy use would also be randomly positive and negative. The cumulative difference (CUSUM) would also be random and not far from zero, and would track horizontally on this chart.

However, if something happens that changes the pattern of consumption, the differences will not be random. They will be biased positive or negative and CUSUM will track up or down from the time of that event. The CUSUM chart therefore consists of a series of straight sections separated by kinks, each kink representing a change in pattern.

In this case there are two significant changes in pattern - in May 1990 and in April 1993. The first is known to have been due to the introduction of heat recovery and improved control of water use in the scourers.

The two changes in the pattern mark a trend in the CUSUM data and indicate changes in the operating regime or energy performance of the process. The data records are gathered at the end of each month so the event occurs in the month immediately following the kink.

Using CUSUM to evaluate the impact of past events

CUSUM can be used to calculate the effect of past actions or events which have influenced energy consumption. The CUSUM chart in Fig 4 uses a relationship between energy use and production predicted from all of the data available for the five-year period. However, within this period you can see that there are three distinct patterns. By recalculating CUSUM using a prediction formula based upon the first of these patterns you can measure the energy saving impact (or increased consumption) of subsequent changes.

This is shown in Fig 5 which has been recalculated using the data from the first 16 months to derive a straight-line prediction formula for the finishing works' energy consumption. The first part of the CUSUM chart now appears horizontal, as there is only nominal variation between the actual consumption and the predicted usage. The changes in pattern (May 1990 and April 1993) now produce deviations from the horizontal line.

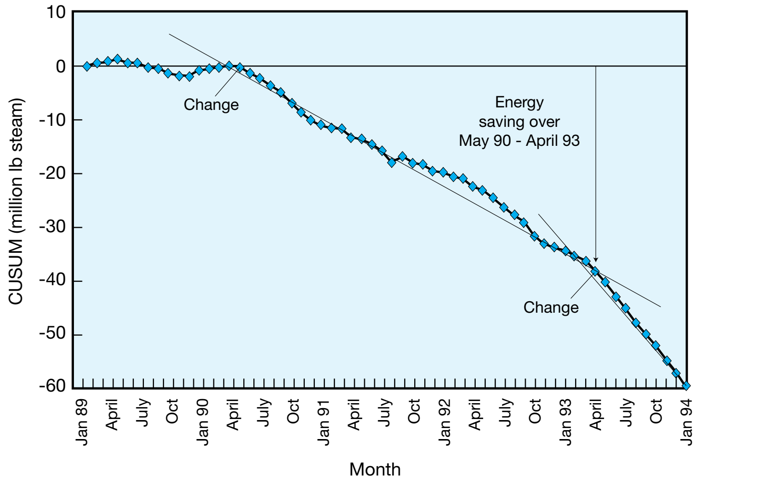

Fig 5 The CUSUM chart for the textile finishing works re-referenced for new baseline period

In this case, the action in May 1990 reduced energy consumption by about 34 million lb of steam by the time of the next action in April 1993, 34 months later. The value of these savings was £41,000/year and the capital cost of the heat recovery and control equipment was £38,100. Therefore, by the end of April 1991 the system had almost paid for itself and was soon to start providing savings at the rate of £3,400 per month to fund other activities.

CUSUM can be used to show how much energy is saved over time since a specific event or process change.

Control Chart

The second use of CUSUM is to identify data in the historical record that represent the current energy consumption pattern and to use these as reference data for establishing the control chart.

Control charts are based on the principles of statistical process control which will be familiar in many textile companies. The charts are used to track current performance, in this case energy consumption, and to highlight where performance falls outside a band, within which performance is considered acceptable for normal process operation. Any deviation outside of this band alerts management to the need for investigative and, perhaps, corrective action.

Control charts compare current energy usage with a prediction formula, and the control band is based upon the energy consumption during a recent reference period that is considered to represent normal process operation. Consequently, the control band must be recalculated for a new reference period each time there is a significant change in this underlying energy consumption pattern. Such changes in pattern are indicated by the CUSUM chart.

Fig 6 (overleaf) shows a control chart based upon the data for the textile finishing works. It shows the monthly differences between actual energy consumption and predicted energy consumption over the three-year period (Jan 1989 - Jan 1992). The control bands and prediction formula are based upon the initial 16 months, being the reference period in this case.

There are seven steps in calculating a control chart:

1. Use the CUSUM chart to identify data from a recent reference period that best represents energy consumption under normal operation. (In Fig 6 the reference period taken is Jan 1989 - April 1990.)

2. Recalculate the best fit formula for the energy vs. production data for the reference period.

3. Recalculate the predicted energy use (using this formula) for the actual production in each month.

4. Calculate the differences between actual consumption and the prediction.

5. Plot these differences against time (as shown in Fig 6).

6. Decide on an appropriate control band such that excursions from the band will be investigated and actioned.

7. Repeat the above procedure for a new reference period when the CUSUM chart shows a significant change in the energy consumption pattern. In this example, after May 1993, the prediction and control bands would have been recalculated using the period May 1990 to April 1993 as a new reference.

The control chart highlights excursions from normal performance so management can take investigative and, perhaps, corrective action.

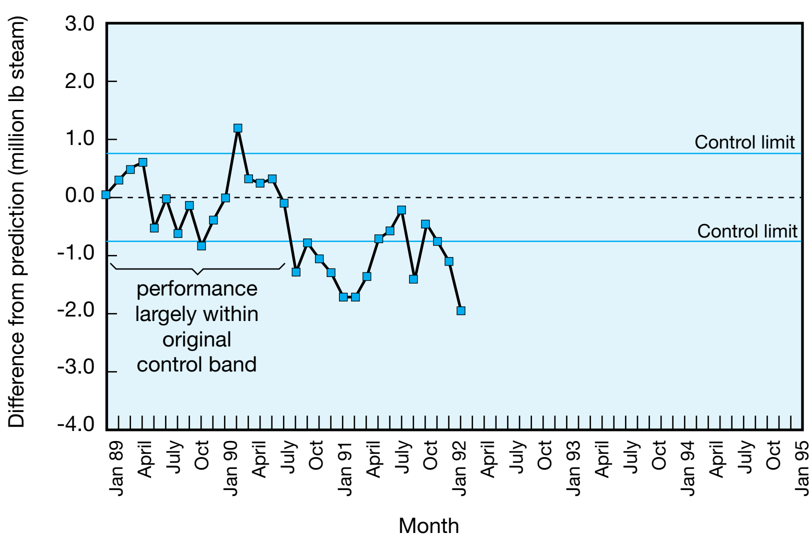

Fig 6 The control chart for the textile finishing works

From the CUSUM chart we know there was a change in pattern in May 1990. The control chart shows the energy performance begins to fall outside the control band subsequent to this change. Managers would have to determine whether this effect was due to a temporary change in performance or whether it indicated a process change that required further investigation.

The control band can be based on absolute differences (in energy units) or expressed as a percentage. The differences are calculated on the same basis in either case (if percentage control levels are being used, calculate the differences as percentages, too).

The width of the control band needs to be sufficiently narrow to indicate to operators that the process is being monitored by management, yet wide enough not to raise questions so often that it becomes a nuisance and so loses credibility. Although control band width can usually be determined by experience, statistical methods are available to aid decision-making.

CUSUM analysis and control charts can be applied to a wide range of process and production parameters in a textile factory, as shown in the table below.

Application of CUSUM and control charts in the textiles industry

Area	**Data required**
Stenters, dryers, dyeing machines and heat treatment	Weight of fabric, volume of water, waiting time, running time, etc.
Looms for spinning, weaving and knitting	Electricity, m^2 fabric, garments, output weight
Sewing machines	Running hours
Space heating	Fuels used, degree days
Air conditioning	Compressor power, cooling degree days, state points in refrigeration circuits
Pumps	Electricity consumption, volume delivered
Fans	Electricity consumption, volume delivered (often as some other variable)
Air compressors	Electricity consumption, air delivered, leak rate
Vacuum pumps	Running hours
Boilers	Fuel used, steam generated

5

TAKING M&T FURTHER

The successful application of M&T leads to:

- reduced energy consumption and lower energy costs;
- improved control of processes;
- knowledge of changes to energy consumption patterns;
- highlighting of process problems (e.g. need for maintenance);
- the ability to evaluate the impact of energy-saving activities.

Once a basic level of management control has been achieved, further savings depend on extending M&T to other areas of the plant or company and increasing the level of sophistication.

There are several ways to improve the performance of an M&T system:

- improve data quality;
- improve the time correspondence of data;
- increase the frequency of meter readings;
- increase the number of energy drivers analysed.

These are in roughly the right order of priority to optimise benefit and cost. The first applies to quite basic systems, the middle two can apply to both basic and computerised systems and the latter is particularly suited to computerised systems.

If you are interested in developing M&T and energy information systems further, the following Guides are available to you:

GPG 112, *Monitoring and Targeting in large companies*. This Guide takes you deeper into the techniques and analysis used within energy M&T and contains many examples and worked calculations. It is aimed at larger companies where energy use is dominated by industrial processes.

GPG 125, *Monitoring and Targeting in small and medium-sized companies*. This Guide provides a straightforward, step-by-step approach to initiating M&T in a small business where metered energy data are often very limited and heating and ventilation of buildings consume a significant proportion of total energy use.

GPG 231, *Introducing information systems for energy management*. This Guide provides advice on establishing an energy information system in your company. It discusses data collection, metering, ways of analysing and presenting energy information, and how energy can be integrated with existing management information systems.

6

CASE HISTORY

Toray Textiles (Europe) Ltd

The Bulwell factory of Toray Textiles (Europe) has been a textile plant since the 19th century. It is typical of many in Lancashire, Yorkshire, and the East Midlands. The site produces around 20 million metres of fabric per year, with a sales value of £40 million, and employs about 200 staff. Operations on the site include scouring, bleaching and dyeing; three open-width scouring machines, 18 pressurised jet dyeing machines and two stenters are used.

Toray Textiles acquired the site in 1989 and initiated a major energy efficiency drive. Over the period 1989 - 1993 the site achieved an energy reduction of 27%, with half of the savings being generated through measures involving little or no capital expenditure.

The new energy management programme was based on:

- M&T;
- staff motivation;
- capital investment;
- training;
- good housekeeping;
- modern management techniques.

In the new programme, the site's engineering manager was responsible for collecting weekly energy consumption data. These were then indexed to production to give a measure of energy efficiency.

Involvement of all staff was seen to be crucial to the success of the energy-saving programme. Toray Textiles set up Small Group Activities that were based on management and workforce meeting regularly to discuss problems and suggest improvements. This approach has had a significant impact on reducing energy use, in particular through good housekeeping and the identification of the following major energy-saving projects:

- heat recovery from the scouring machines;
- insulation of dyeing vessels;
- economisers for boiler feedwater;
- improvements in condensate return system;
- inverter drives on various machines.

The Monitoring and Targeting system used energy data from steam, electricity, and water meters. The engineering manager was able to use the system to:

- track energy performance;
- monitor overall energy savings (using CUSUM) and determine the contribution made by specific energy efficiency actions to these overall savings.

By December 1993, the energy management initiatives implemented by Toray Textiles had saved nearly 75 million kWh. This equates to about one year's energy consumption for the site and is clearly significant in terms of the company's operating costs and profits.

For further information, see Good Practice Case Study 254, *Implementing an energy management programme in a textile finishing company*.

FURTHER INFORMATION

The Department of the Environment, Transport and the Regions (DETR) provides a wide range of information and other support to help companies reduce their energy bills via its Energy Efficiency Best Practice Programme (EEBPP).

Publications relevant to Monitoring and Targeting in the textiles industry are listed below. EEBPP material is available to you free of charge.

Publications Relevant to Monitoring and Targeting in the Textiles Industry

EEBPP

Good Practice Guide 112	*Monitoring and Targeting in large companies*
Good Practice Guide 125	*Monitoring and Targeting in small and medium-sized companies*
Good Practice Guide 168	*Cutting your energy costs - a guide for the textile dyeing and finishing industry*
Good Practice Guide 231	*Introducing information systems for energy management*
Good Practice Case Study 226	*Energy savings by Total Quality Management techniques*
Good Practice Case Study 254	*Implementing an energy management programme in a textile finishing company*
Good Practice Case Study 332	*Corporate commitment to saving energy at a small site*

Other

Energy Monitoring and Targeting using CUSUM.
Peter Harris. Cheriton Technology Publications, 1989. ISBN 1-872157-00-9.

For copies of EEBPP publications and other literature applicable to energy efficiency in industry, please contact:

Energy Efficiency Enquiries Bureau,
ETSU, Harwell, Didcot, Oxfordshire OX11 0RA.
Tel: 01235 436747. Fax: 01235 433066. E-mail: etsuenq@aeat.co.uk

Overseas customers please remit £3 per copy (minimum of £6) with order to cover cost of packaging and posting. Please make cheques, drafts or money orders payable to ETSU.

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
Building Research Establishment
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.