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Development of an effective energy management tool to help SMEs to adopt an environmental management system

Sarwarzaman, Abul Kalam MD

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Development of an effective Energy Management tool to help SMEs to adopt an Environmental Management System

Abul Kalam Md Sarwarzaman

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ABBREVIATIONS

BSI	British Standards Institution
CPI	Carbon Performance Indicator
DEFRA	The Department of the Environment, Food and Rural Affairs
DTI	The Department for Trade and Industry
EA	The Environment Agency
EMS	Environmental Management System
EMAS	Environmental Management Audit System
EU	European Union
IEMA	Institute of Environmental Management & Association
ISO	International Organisation for Standardization
NPI	Normalised Performance Indicator
NQA	National Quality Assurance Ltd
PAEMS	Phased Approach to Environmental Management system
IRR	Internal Rate of Return
SME	Small and Medium sized Enterprise
UKAS	United Kingdom Accreditation Service
EPI	Energy Performance Indicator

GLOSSARY

CPI:

Carbon Performance Indicator shows how efficient is any house or business in terms of annual carbon released by floor area or production output.

Degree Days:

1 degree day = 1 daywhen mean temperatureis 1 degree below 15.5

degree centigrade.

Energy Efficiency:

It is the goal of efforts to reduce the amount of energy required to provide products and services. For example, Installing fluorescent lights or natural skylights reduces the amount of energy required to attain the same level of illumination compared to using traditional incandescent light bulbs.

EPI:

Energy Performance Indicator determine how efficient is any house or business in terms of annual energy used by floor area or production output.

Life-Cycle Assessment:

A life-cycle assessment (LCA, also known as life-cycle analysis, ecobalance, and cradle-to-grave analysis) is a technique to assess environmental impacts associated with all the stages of a product's life from-cradle-to-grave (i.e.from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling).

Payback period:

In capital budgeting refers to the period of time required for the return on an investment to "repay" the sum of the original investment. For example, a £1000 investment which returned £500 per year would have a 2 year payback period.

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Abstract

This project addresses the needs of SMEs when confronted with the problem of managing of their energy usage. Following a literature survey to determine the key factors influencing companies where it would appear that this is primarily driven by demands from key stakeholders, a set of important energy issues were identified.

Some of the identified issues significantly affect the implementation of an environmental management system (EMS) in small and medium enterprises. The literature review was also used to find out the drivers and barriers to the adoption of an environmental management system. In a global context there are future economic, social and fiscal pressures to reduce carbon footprint. Companies will inevitably have to address these considerations in the longer term.

The present work reports the development of a web publishable electronic tool in “frontpage” to give training, which simulates a real situation as closely as possible, and can be integrated into a company to address its energy related issues with example, environmental issues and formal EMS application. The tool is aimed primarily at SME’s in the manufacturing sector, in service industries such as shops and offices, and in the public sector such as schools but could find application in a wide range of enterprises.

To run the electronic tool transfer the **My EMS tool** folder to the Computer.

There are two ways to access the tool:

a. Start from right click on Basic EMS tool.htm then click on open hyperlink and then navigate as per interested area.

b. direct opening **My EMS tool** folder from CD and scroll down then select and click on Basic EMS tool.htm file and then navigate as per interested area.

Outcomes: The major outcomes of this project are-

- The identification and analysis of the value of EMS in industrial sectors.

-The exploration of the type and nature of the barriers which affect the adoption of EMS, and the advantages and incentives to companies who exercise sound environmental behaviour.

-The development of a web publishable electronic education and training implementation tool for industrial companies using frontpage software.

CHAPTER 1

INTRODUCTION

1.1 Statement of the problem

The United Kingdom is one of the leading countries in carbon off setting, both domestically and internationally and has therefore carried out significant amounts of research in this area and continues to do so, specifically supporting efforts in the environmental management sector. There are key barriers to implementing environmental management systems into industry. The number of ISO 14001 awarded certificates is clearly not enough to tackle the current environmental threats. At the same time the cost of certification is often too high and is therefore unaffordable to many SMEs, clearly this is further exacerbated by the current economic climate. In order to assist companies in addressing the environmental challenges they face, there is a clear need for greater education and more accessible training tools. The UN Summit 7-18 December 2009 in Copenhagen was the biggest environmental summit in world history and the main issue was to reach a worldwide agreement which would agree measures to; reduce dangerous global warming levels, and implement efficient energy management solutions which impact to reduce CO_2 emissions, (in order to reduce global warming as CO_2 is one of the major green house gases which is responsible for increasing the earths temperature). Industrial energy consumption accounted for more than a fifth of all UK energy consumption in 2001, consuming 35,152 thousand tonnes of oil equivalent (source- *DTI,* 2001). If we look at the environmental aspect ,energy is the biggest expenditure, compared with than water, waste and transport. There is a need to increase the concern of efficient energy management procedures, to tackle global warming. Industry needs effective energy management tools to assist in the reduction of their carbon footprint.

1.2 Aim of the study

Overall Aims and specific objectives

- The main aim of this research is to identify effective mechanisms to; assess, stimulate and support the adoption of effective energy management in SMEs, perhaps as part of an Environmental Management System.

Specific Objectives

- The value of EMS in industrial sectors.
- The existence and nature of barriers to the adoption of EMS, and the advantages and incentives for companies to exercise sound environmental behaviour.
- Contrasts in the attitudes and practices for effective energy management.
- Evaluation of industrial needs to support the implementation of EMS.
- Develop education and training tools for industry.

1.3 Literature review

This section describes the literature review for the entire research carried out on 'Develop an Energy Management System' tool to help Small and Medium Enterprises (SMEs) to install an effective Environmental Management System.The implementation of ISO 14001 varies significantly across the world. The regulatory, normative and cognitive aspects of a country's institutional environment greatly impacts on the costs and potential benefits of ISO 14001 adoption and therefore may explain the differences in adoption across countries (ISO Survey-2008). Up to the end of December 2008 a total of 188815 ISO 14001 certificates had been issued in 155 countries (ISO survey-2008). Of these at least 9455 ISO 14001 certificates had been issued in the UK (ISO survey-2008). This poses the question of why the uptake is so low in the UK?The UK has an estimated 4 million companies, using the aforementioned figures this means less than 1% of companies have an environmental policy or EMS. Bernhardt (2006) examined the attitudes of small companies in the UK and found that whilst the owner of the company might agree that EMS could bring benefit to the business, they identified numerous barriers to achieving an EMS as: lack of time, money and expertise. Duckers (2003) reported that small companies respond to pressure from stakeholders, especially major customers, however found implementation of successful EMS hampered by lack of knowledge and skills. Alkividis (2007) investigated changing attitudes to environmental management in the aerospace industry and found that, apart from customer pressure, regulations are becoming increasingly applied to the supply chain. There is a significant amount of literature on the benefits of, and difficulties in, implementation and the need to develop effective tools for implementing EMS (Hillary 2000). Industries that have adopted an EMS tend to operate more effectively (ENDS2006). Other research shows that EMS brought benefits and corporate environmental awareness (Morrow D, Rondinelli 2002). However the benefits in terms of environmental compliance are less clear (REMAS 2006). This programme will revisit the issue of; economic, commercial and less tangible benefits to EMS adopters, and explore the factors influencing a company's decision on whether or not to implement EMS and develop effective mechanisms to stimulate and support the adoption of Environmental Management System.

Despite environmental problems being acknowledged as long ago as 1962 by Carson (1962) and Bruntland (1987) little has actually been done to mitigate some of the major problems, and in particular climate change, which was the subject of protracted negotiations in the 1997 Kyoto protocol. Even with the recent acceptance by the US, Kyoto is not effective and has only a modest target. Stern (2006) recommended timely economic actions to minimize the environment damage.

The international meeting of Global Heads of States in December 2009 in Copenhagen was set up as a platform to negotiate a successor agreement to the first commitment period of the Kyoto protocol.

It is clear that society must place environmental security at the heart of its strategic planning. The outcome of this programme will make an important contribution to empower small companies to engage with environmental initiatives.

1.4 The essential benefits:

This tool has been specifically developed to assist companies in addressing their energy concerns. By careful analysis of the barriers identified in chapter 3, the tool has been developed to help minimise those barriers which arise both from an overall company and staff perspective, for example, accessibility and ease of use. Moreover, the tool is case study based, giving worked examples and descriptions of equipment and technology throughout the research, which should stimulate the recognition of opportunities for (often rapid) implementation of actions to save energy, and hence to save cost.

The benefits of the proposed tools can be described as:

a) Simple and easy to access.
b) Provides rapid insight to the user and permits the user to implement actions quickly.
c) Gives the user 'ownership' or control of the problem.
d) The tool is case study based, giving worked examples throughout.
e) It can help to change attitudes and the company culture.
f) It can help to improve a company's understanding and perception in energy issues.
g) It is cost effective as sometimes it describes saving tips which are achievable with little or no investment.
h) It can help to increase awareness about effective energy management.
i) It gives some addresses and references for the company to get financial help and further help to understand environmental issues.
j) The tool is web publishable.
k) It can help SMEs to adopt a formal Environmental Management System.
l) Finally if they adopt a formal Environmental management system and achieve savings through good management of their energy issues this can contribute towards their ISO14001 certification.

CHAPTER 2

METHODOLOGY

2.1 METHODOLOGY

There has been an overall examination of available literature and then a specific focus on the Manufacturing sector which is active within EMS. A wide investigation through a literature review was conducted to identify barriers to adoption/implementation. The analysis had been supported by primary information collected through a literature review and various existing; education, teaching and training tools which have been helpful in developing support mechanisms to support simple and efficient energy management tools for SMEs.

Initially the work had two components: a review and evaluation of existing tools and support mechanisms, including specific sector base support i.e. manufacturing including; literature, free advice, site visits and audits. It is anticipated that existing software tools may be attractive to industry including EMMA, a UK government package and ACME, a Coventry University package. These tools have been used in the development, revisions, extensions or new concepts have been developed. The existing tools have some interactive features, but are limited in content, and cannot be used to directly link into an environmental management system. The present work will aim to develop an electronic tool by frontpage application both valuable interactive training, which simulates a real situation as closely as possible, and which can be integrated into the needs of a company in addressing its environmental issues and formal EMS application. This should be an attractive tool to engage the user. In some cases simple statistical analysis will be used for presentation of some statistical data. The whole technical content of the tool will be incorporated in this dissertation in chapter 4 and the software package is included in this thesis on a CD.

2.2 Phasing and timescale:

The entire project Gantt chart shows the planning of the research:

Activity		**1st quarter**			**2nd quarter**			**3rd quarter**			**4th quarter**		
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	Identify the value of EMS												
2	Barriers to the adoption of EMS												
3	Contrasts in the attitudes and practices												
4	Evaluation of industrial needs												
5	Select industrial sectors and analyse cost and benefits to individual companies												
6	Investigate the reasons why companies take up or avoid EMS												
7	Review, & critically analyse education and training implementation tools												
8	Develop education and training tools												
9	Write up												

CHAPTER 3

INTERNAL AND EXTERNAL BARRIERS TO THE ADOPTION OF EMS by SMEs

3.0 Internal and External Barriers for the Adoption of EMS by SMEs:

Internal and external barriers to EMS implementation are covered extensively in 28 study reports (see Table 8.1 with findings on Internal and External Barriers). Ten of these reports do not discuss EMS implementation but details SME attitudes, which act as barriers to EMS adoption by SMEs.

3.1 Internal Barriers of SMEs Adopting EMS

Internal barriers are grouped into four categories:

a) Resources
b) Understanding and Perception:
c) Implementation
d) Attitudes and Company Culture:

a) Resources

Resources as a barrier, involved lack of management and/or staff time for implementation and maintenance of EMS,(Hillary R, 1997) inadequate technical knowledge and skills about the process (European Commission DG XI 1997), 75% believe lack of training or awareness for staff to execute the EMS on the premises (The British Chamber of Commerce (1998). Most of the premises don't have specific staff around 75% are a transient workforce and there is a requirement for capital expenditure (Court P 1996). The cost depends on the size of the company and on its activities, experience in Northern European countries shows that there is no standard rule, costs depend on the local market, government programs and the level of external environmental cost and services. Financial resources spent on setting up an EMS including external consulting fees and associated communication and certification costs are based on an average (figures do not include public aid). In most member states SMEs can benefit from public subsidies of up to 75% of the external consultants costs. Information about financial support and other support is detailed.

b) Understanding and Perception

If we describe understanding and perception as a barrier then lack of awareness of the benefits derived from EMS should also be a factor (Baylis R et al (1997), the industry has a lack of understanding of the EMAS environmental statement or the value of reporting (National Association of Local Authorities in Denmark NALAD (1998). A lack of knowledge of formalised systems and uncertainty and concern over possible de-registration (from EMAS) for minor breaches of legislation (The British Chamber of Commerce (1998).Perception of high cost for implementation and maintenance and confusion between ISO 14001 and EMAS and how they relate.

c) Implementation

There are some factors which affect the implementation of EMS , we know implementation is an interrupted and interruptible process but an inability to see the relevance of all stages affects the EMS process. Independent internal audits are required for the implementation of an EMS manual but this can be difficult to achieve it in a small company (Hillary R 1998). Doubts about the on-going effectiveness of EMS to deliver objectives are another barrier (Baylis R 1998).Difficulties with environmental aspects/effects, evaluation and the determination of significance (Hillary R 1997). Uncertainty about how to maintain continual improvement sometimes act as a barrier.

d) Attitudes and Company Culture

Attitude and company culture describes; inconsistent support for EMS, implementation and management instability at a senior level (National Association of Local Authorities Denmark, NALAD 1997).The junior level of those spearheading EMS implementation. Lack of internal marketing of EMS and a negative view or experience with ISO 9000 standards effects ISO 14001's acceptance (Hillary 1998) and finally human rather than financial resources is the major barrier frequently cited in the studies. Lack of human resources and the multifunctional nature of staff become increasingly important as the size of the company decreases, not only to the implementation but maintenance of EMSs.

SMEs are largely ill-informed about EMSs, how they work and what benefits can be derived from their implementation. As such ISO 14001 and EMAS hold relatively little interest for the sector. Furthermore, EMAS has a public reporting component which concerns SMEs and ISO 14001 has an added disadvantage amongst small companies who have had negative experience with one of the ISO 9000 standards.

Negative corporate attitudes towards EMSs and an unfavourable company culture, often cited in SMEs, conspire to create a climate that deprives the EMS implementation process of support, e.g. inconsistent senior management support.

Implementation in SMEs is an interrupted and interruptible process losing momentum and resources. Practical difficulties, such as how to achieve internal auditor independence and how to determine environmental aspects and assign significance, also affect implementation. Fear of de-registration for minor breaches of legislation also make EMAS an unattractive proposition for many firms.

3.2 External Barriers of SMEs Adopting EMSs

External barriers are grouped into four categories:

a) Certifiers/verifiers
b) Economics
c) Institutional Weaknesses
d) Support and Guidance

a) Certifiers/verifiers

The high cost of certification/verification disproportionately penalises small firms (Goodchild E 1998). We can put some data regarding this:

Table-1.1: Cost of EMS as per industry size

Size of SMEs	Cost (approx in £)
Micro-sized enterprises 1-19 employee	5000
Small sized enterprises 20-99 employee	10000
Medium sized enterprises 100-249 employee	17500
Big sized enterprises >250 employee	25000

Lack of experienced verifiers is another barrier for SMEs. There is variation in the approach of accredited environmental verifiers. Cost of verification SMEs pay more per day for verifier's time than large companies, small firms pay on average €1085 or £700/day and large firms pay € 878 or £600/day. External assistance required for review and EMS. Duplication of efforts between verifiers/certifiers and internal auditors is another external barrier for SMEs (Hillary R 1998).Verifiers exceeding their role e.g. influencing audit cycle length and there is variations in verifiers approach to EMAS validation (Baylis R (1998).

b) Economic

Changing economic climate like recent recessions alters the priority given to an EMS in SMEs (Environmental Technology Best practice Programme 1998). Uncertainty about how an EMS will be valued in the market place, insufficient benefits and external drivers from customers, and regulators (Business in the Environment/Coopers & Lybrand (1995).

c) Institutional Weaknesses

Lack of promotion of EMSs and lack of accessible financial support.Lack of clear or strict legislative framework with an absence of a central source of information on environmental legislation (Hillary R 1996). Absence of a single authority body to interpret EMAS acts as a institutional weakness.

d) Support and Guidance

Lack of quality experienced consultants to assist SMEs. Inconsistent approach of consultants to EMS implementation. External assistance e.g. consultants needed to interpret ISO 14001, is required for environmental review and EMS implementation. Lack of sector specific implementation tools, examples and an absence or lack of trade association or business network support. ISO 14004 (BSI, 1996b) is not used and largely irrelevant. A lack of explanation of concepts and guidance needed on environmental aspects and significance evaluation. Poor quality information and conflicting guidance given to SMEs which act as a support and guidance barrier (British Chamber of Commerce 1996).

SMEs face inconsistencies in, and barriers from, the certification system for ISO 14001 and verification system for EMAS. EMAS verifiers and the verification process come in for greater criticism, whereas little comment is made about the certification process for ISO 14001. This does not mean the certification system is perfect; more that it has not been investigated and presented in the reviewed studies.

Many SMEs experience insufficient drivers for EMS adoption and are uncertain about the market benefits of EMSs. In addition, the changing economic fortunes faced by SMEs alter their priorities and pushes the environment to the bottom of the list, further depressing interest in ISO 14001 and EMAS.

Shortcomings in the institutional framework, which facilitates the operation of EMAS and ISO 14001, inhibit SME uptake of the two initiatives. Some of these shortcomings apply to EMAS and are not found in the UK, but others, such as the absence of a single body to interpret EMSs and the absence of a central source of information on legislation, do apply.

SMEs appear to need support and guidance, in particular for the environmental review and environmental aspects and significance evaluation, but experience problems gaining consistent quality information and experienced consultants of good quality. ISO 14004 is rarely used by SMEs. The lack of sector specific guidance and material tailored to different sizes of firms, especially very small firms, is a frequently referred to external barrier.

3.3 Internal Barriers to SMEs Considering Environmental Issues

Many studies commented on the general characteristics and attitudes they found in SMEs which acted as barriers to consideration of the environment as an important business issue. These attitudes act as barriers to the adoption of EMSs. Some overlap with those barriers identified in SMEs, which have, or are in the process of implementing, EMSs.

Internal Barriers to SMEs Considering Environmental Issues are grouped into three categories:

a) Resources

b) Attitudes and Company Culture

c) Awareness

a) Resources

Lack of time to investigate issues or locate support or tools, severe time pressures in micro companies, high costs and therefore savings are low and do not warrant the time to implement EMS, Lack of resource allocation to "bottom up" projects and budget not allocated to address environmental issues, lack of investment in training. Cost constraints on investment, no employee allocated responsibility for environmental issues.

b) Attitudes and Company Culture

There is a widespread belief amongst SMEs that each has low environmental impact and has no environmental issues to consider, (Duckers 2010). Hillary quote that SMEs may create as much as 70 - 80% of the UK’s pollution, Duckers (2008) in MSc lecture notes Coventry University, states a mismatch between beliefs and actions, i.e. positive attitudes towards the environment do not translate into actions which means they know about environmental problem but don’t take any initiative to resolve those issues. Environment is given little or no status as a business issue and there is a general perception that ISO 14001 has no relevance to the business. The inertia of senior management and the desire to maintain the status quo is often a factor in a company's failure to seize the environmental initiative. Scepticism about the potential cost savings and market benefits is another factor. Some companies remain unconvinced or unsure that EMS will help to meet customer needs, although there is evidence of it enhancing customers' views. The belief that the benefits of EMS implementation accrue slowly but are very costly with no improvements in efficiency following from improved environmental performance has also inhibited the uptake of EMS.

c) Awareness

Low awareness of EMSs, low awareness of energy issues, environmental legislation, low awareness of support organizations and information sources act as an external barrier. A profound mismatch exists between the personally held beliefs of management and non-management in SMEs as to the benefits of positive environmental practices and the actual actions taken in enterprises. Positive attitudes are not translated into actions, this, coupled with the view held by many in small firms that their firm has a low environmental impact or faces no environmental issues; conspire to stifle SME adoption of an EMS and action on environmental performance. For many, ISO 14001 has no relevance.

There appears to be widely held scepticism amongst SMEs towards the benefits, cost savings and customer rewards associated with positive environmental action, and there is a belief that benefits accrue slowly but costs quickly in EMS implementation. An important factor for micro companies is their low operating costs mean that savings are likewise low and their investigation does not warrant the allocation of staff time.

Intransigent company culture and the lack of allocation of resources and status to environmental issues prevent acceptance of the idea that the environment is a core and strategic business issue. For these businesses, the absence of customer pressure does nothing to alter their views of the status quo.

In general, SMEs have low awareness of environmental issues and legislation and this awareness decreases the smaller the organization gets.

3.4 External Barriers to SMEs Considering Environmental Issues

External barriers which prevent the adoption of EMSs are discussed below:

Customer attitudes to SME performance are key to SMEs taking action on the environment. Ambivalence of customers to SMEs' environmental performance or satisfaction with the existing level of environmental performance takes away a key driver, which stimulates SMEs to adopt an EMS and improve environmental performance. Customer indifference to environmental performance in micro firms mirrors the micro firms' own lack of concern for company environmental issues. Both appear to perceive the micro enterprise as having little impact on the environment.

The treatment of the SME sector as one homogeneous group has meant that messages on the needs and benefits for improved environmental performance have not been sufficiently tailored to attract the attention or interest of the many sub-groups that make up the sector.

3.5 How are the barriers overcome?

It is a common misconception that waste minimization program cost money. Typically, waste minimization will save the company money - up to 1% of business turnover, either as extra profit or in reduced operating costs. By implementing no-cost or low-cost measures, a company could also reduce water and effluent costs and energy bills by 20% or more. Make sure the senior manager is aware of the facts and dispel any myths or misconceptions that may be held. Find out from the Environment and Energy Helpline on 0800 585794 how much companies have saved from waste minimization initiatives and use the examples to persuade your senior manager of the business benefits.

Lack of time and resources are two barriers that are particularly common in smaller companies and the most frequent cause of companies failing to complete their program. There is no standard formula for overcoming these barriers - each company is different. Consider how to get additional low-cost or no-cost help, such as employing a student or joining a waste minimization club (there are more than 60 across the UK). Use the Environmental Technology Best Practice Program publications for self-help and guidance. Target a few areas where immediate savings

could be made, such as raw materials use and energy, water and solid waste reduction, rather than tackle all potential sources of waste reduction, so that resources are not over committed.
The timing of the start of a waste reduction program should avoid any planned changes in the processes, organization or staff working patterns, so that resources are available to assist and results are meaningful for the company's operations.

3.6 Conclusion on Internal and External Barriers

SMEs face internal and external barriers when seeking to address their environmental issues and adopt and implement EMSs, but it is the internal barriers that initially have the more significant role in impeding progress. Negative company culture towards the environment and the disassociation between positive environmental attitudes and taking action cause the uptake of environmental performance improvements and EMS adoption to stumble at the first hurdle.

On top of this general culture of inaction on the environment, SMEs are also very sceptical of the benefits to be gained from making environmental improvements. In many cases, especially for the smaller organizations, low awareness and the absence of pressure from customers (the most important driver for environmental improvements and EMS adoption) and insufficient other drivers mean that no efforts are made to address environmental issues. SMEs also face the problem of locating, and having the time to locate, good quality advice and information.

Once an SME has embarked on EMS implementation the process is often interrupted and resources are frequently diverted to core business activities. It is the lack of human resources, not financial ones, which SMEs find most difficult to secure and maintain for EMS implementation. The more multifunctional the staff, as is common in micro and small companies, the more likely the process of implementation will be interrupted. Some studies indicate that SMEs, once on the route to certified EMSs, face inconsistency and high charges in the certification system.

CHAPTER 4

Contents of developed tool for efficient energy management in SMEs

From the analysis of the barriers to implementation of environmental management system one of the major factors identified is that of energy management, and in particular the general lack of awareness of energy issues. The tool was therefore developed to provide small step by step instructions and guidance for a large selection of energy issues that might be found in companies from a wide variety of industrial sectors. As an initial step a company should follow the following instruction in order to use the tool:

- The user can either go to the EMS tool and get help electronically or proceed through the following printed pages.
- To run the electronic tool transfer the **My EMS tool** folder to the Computer.

There are two ways to access the tool:

a. Start from right click on Basic EMS tool.htm then click on open hyperlink and then navigate as per interested area.

b. direct opening **My EMS tool** folder from CD and scroll down then select and click on Basic EMS tool.htm file and then navigate as per interested area.

- In order to use the tool the user will need to gather information about the company's historic /current energy consumption. If this information is not available then the tool is still valuable in showing where savings can be made, and monitoring of such data for future use is strongly encouraged because savings can be based on this data.

The information which will be most useful indicator:

Monthly gas consumption (kWh)	Annual data would help if monthly values are not available
Monthly electricity consumption (kWh)	
Monthly degree days (DD)	This will help with energy consumption analysis
Site floor Area (m^2) Production output (Units)	This will help calculate EPI and CPI

Throughout the tool there are numerous examples of energy improvements measures. It would be a good idea to record where you are at the start, so that subsequent savings can be attributed to energy management actions. Further monitoring of energy , by installing sub meters to permit a more detailed analysis of where energy is consumed is often a simple way to identify high consuming activities and hence candidates for energy management.

- List the company's total usage of fuel if relevant.
- List the type of appliances used by the company and replace inefficient one when going to buy a new one. Various examples of technology and appliances have been included in this tool.
- Free advice may be available from local government, Envirowise, the Carbon Trust or other organizations. The links are included in appendices 7.3.

In order to look at all energy issues, there are three basic areas in a company/industry where we could look at for getting detail information about energy management.

Note: As the tool describes three different contexts some aspect or descriptions of process in different area have same contents.

4.1 Energy management in Board Room

4.1.1Energy Management

The Board room in a company is taken here to symbolise the core point of execution of decission to the whole factory or industry. That's why possible issues to the implementation of environmental management system procedure through management and all employees are discussed in this area.

4.1.1.1 Responsibility

Making someone responsible for energy is the best way to ensure that an energy efficiency policy is implemented.

Choosing the right person from existing employees is critical. They must be able to communicate equally from senior management to shop floor.

This appointment must be seen to carry with it the authority of a chief executive. The person should be required to report formally and regularly to the senior management on objective, progress and problems.

How to achieve:

Top management with the help of an Engineer/ Environmental manager and an identified employee. The person responsible should have the following tasks:

-Monitoring the company's energy use.

-Maintaining detailed energy consumption record

-Agreeing energy targets, yardsticks and bench marks.

-Analyzing records for management meeting

-Reviewing energy performance against targets.

-Being aware of energy technology and initiatives.

-Investigating potential energy saving scheme

-Preparing economic justification for capital project

-Communicating energy issues throughout the company.

Example:

During the 12 month period following the appointment of site energy manager a company realized 11.6 % reduction in energy use per unit production. These savings were realized by a mixture of good housekeeping measures, load shadings and capital projects**.** This person should also be asked to draw up a detailed energy action plan for your business.

Table-1.2 : Some Example of Energy consumption in Standby mode per year/item

Appliance	Standby Mode (W)	kWh/ year	cost @ £0.14/item	total item	total save /year in £	total release CO_2 in kg
Computer Monitor	2	17.52	2.45	40	98.11	450.61
TV	2	17.52	2.45	5	12.26	56.32
Electric Kettle	2	17.52	2.45	3	7.35	33.79
Modem/Wireless Router	14	122.64	17.16	5	85.84	394.28
TOTAL			24.52		203.58	935.00

Source: author 2009-2010

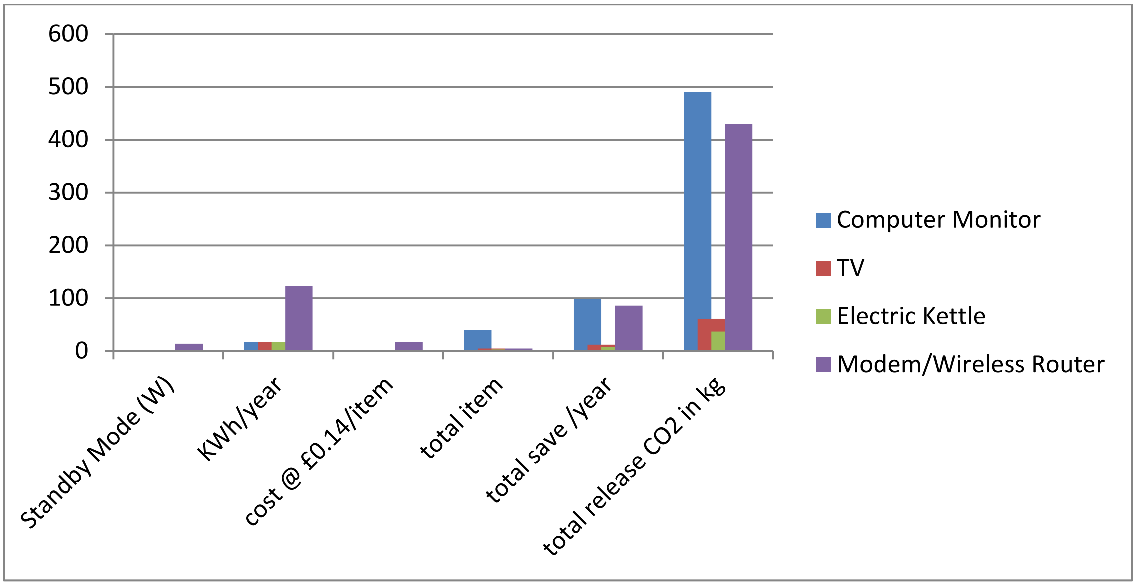


Fig- 1.1: Energy consumption in Standby mode per year per appliance.

4.1.1.2 Energy Audit

An energy audit is the detailed analysis of energy use in an organization. It involves a structured review of how energy is purchased, managed and used with the aim of identifying potential cost savings.

The first step in an energy audit is to establish the quantity and cost of the energy and utility used, by collecting and analyzing your utility bill.

Next you should check whether energy is being purchased competitively and whether management control is in place. Then you could establish consumption and cost.

How to achieve:

To conduct a simple energy audit:

- Assembles all fuel bill last year
- Identify the main usage of energy around your sites
- Calculate energy used per operation/unit production
- Check how well the energy is used against industry norms
- Identify possible energy saving opportunity or measures
- Evaluate the cost and pay back of each measures
- Priorities the opportunities which have been identified

Use the results to raise awareness among employees.For maximum impact use bar graph/pie chart.

Example:

Following an energy audit a chemical company could reduce by 22% their energy usage. These savings were made by ensuring good housekeeping, switching off the lights and machinery when not in use. Adjusting thermostatic heating controls to comfortable levels and keeping window shut when the heating is on. Initially we could identify a potential savings target.

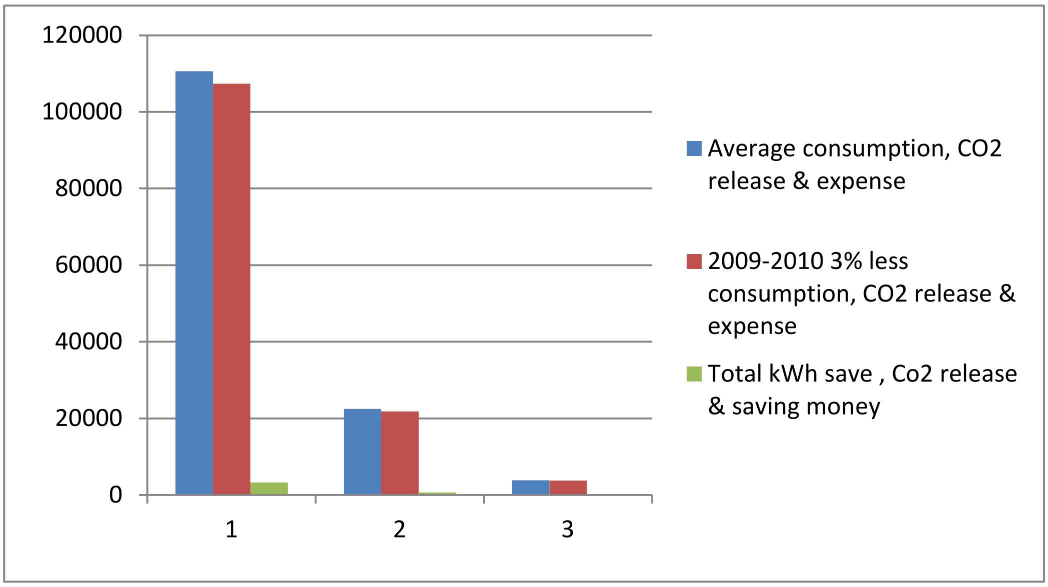
Gas bill analysis and if we set 3% saving target:

We have analysed the gas bill of a company from 2006-2007, 2007-2008 to 2008-2009. As per the figures their annual gas consumption is 110500kWh for the year of 2007-2008 and 120600 kWh for the year of 2008-2009.

Table- 1.3: The gas consumption of three subsequent year and 3 % saving target

Year	kWh	Releasing CO_2 in kg	£ @ 3.52p/kWh
2006-2007	100800		3548
2007-2008	110500		3889
2008-2009	120600		4245
Average consumption, CO_2 release & expense	110633	22458	3894
2009-2010 3% less consumption, CO_2 release & expense	107315	21784	3777
Total kWh save , CO_2 release & saving money	3318	674	117

Source: author 2009-2010



1= Consumption in kWh
2= CO_2 release in kg
3= Saving in consumption,CO_2 release and in £

Figure-1.2: Graph showing the saving impact of 3% less gas consumption

4.1.1.3 Energy Survey

An energy survey involves visiting multiple sites to look at energy using equipment working practices, controls etc.

Gathering information so that energy savings opportunities can be identified and an action plan prepared.The energy survey should be undertaken in conjunction with an energy audit. The audit will identify those areas of the site that merit the greatest attention during the energy survey visits.

How to achieve:

Use a template survey sheet.

Example:

After conducting an energy survey a depot saved £5000 in a year. Initially we could identify a potential savings target.

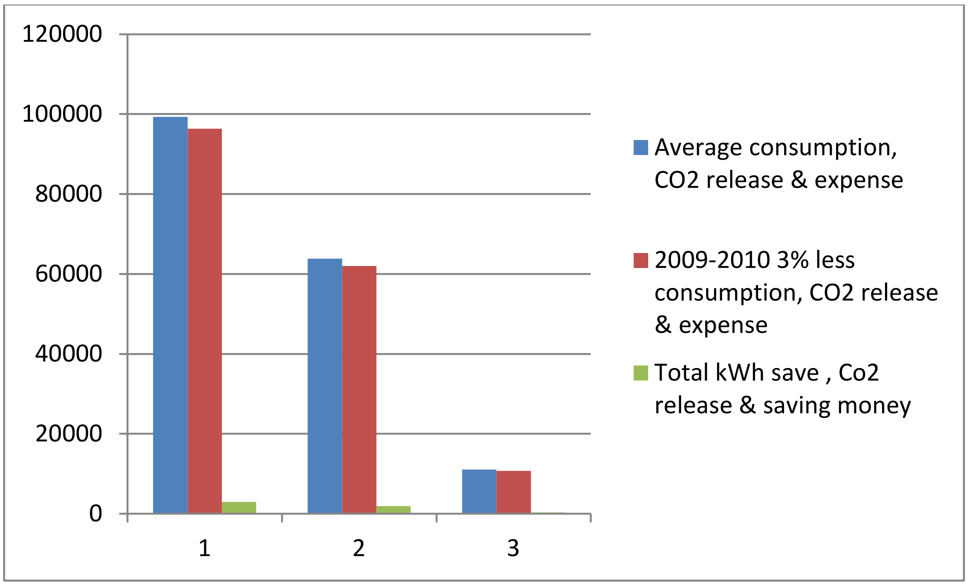
Electricity bill analysis and if we set 3% saving target:

We have analysed the electricity bill of a company from 2007-2008 to 2008-2009. As per the figure their annual electricity consumption is 99500 KWh for the year of 2007-2008 and 101000 KWh for the year of 2008-2009. The average consumption is 99333 kWh. So the consumption is very high. And at the end we have set up a 3% reduction target for year one. Assuming a 3% reduction (by switching of lights for example) 2979 kWh would be saved which equals to £332. Further savings could be achieved by avoiding appliances left on standby, which covers the out of hour's savings.

Year	kWh	Releasing CO_2 in kg	£ @ 11.15 p/kWh
2007-2008	99500		11094
2008-2009	101000		11261
Average consumption, CO_2 release & expense	100250	64461	11177
2009-2010 3% less consumption, CO_2 release & expense	97243	62527	10842
Total kWh save , CO_2 release & saving money	3007	1934	335

Source: author 2009-2010

Table-1.4: The electricity consumption of three subsequent year and 3 % saving target



1= Consumption in kWh
2= CO_2 Release in kg
3= Saving in consumption,CO_2 release and in £

Figure- 1.3: Graph showing the saving impact of 3% less electricity consumption

4.1.1.4 Action plan

An action plan is central to your energy efficiency program as it will form the basis for minimizing your company's bill for; gas, electricity and related utilities such as water, telecommunication and transport.

Your action plan should also ensure that energy management is treated as a process of continuous control and improvement not just a one-time exercise. To ensure maximum acceptance your director should publish a clear policy outlining the importance of effective energy management to the business, as well as to the environment. To find out the EPI and CPI could influence management to get an energy efficiency program. Table 1.5 illustrates this using emission intensity data in the top block applied to 50000 kWh. In table 1.6 35000 kWh of natural gas and 35000 kWh of electricity are illustrated and the related EPI and CPIvalues are calculated.

Table- 1.5 CO_2 emission for selection of fuels

Fuel	unit	kWh / unit	kg-CO_2 / kWh
Natural gas	kWh	1.0	0.203
Combined Heat & Power {HEAT}	kWh	1.0	Overall 0.25
Combined Heat & Power {POWER}	kWh	1.0	
Electricity-Renewable	kWh	1.0	0.005-0.030
Electricity-Grid	kWh	1.0	0.643
Example-Tool for convertyour energy use in T CO_2 for 50 MWh			
Fuel	**unit**	**MWh**	**T- CO_2**
Natural gas	MWh	50	10.15
Combined Heat & Power (HEAT)	MWh	50	12.5
Combined Heat & Power (POWER)	MWh		
Electricity-Renewable	MWh	50	1.25
Electricity-Grid	MWh	50	32.15
Table1.6 Tools for calculating CO_2 emissions in T-CO_2 for 35 MWh natural gas, 25 MWh electricity grid and 60 MWhCHP			
Fuel	**Unit**	**kWh**	**T- CO_2**
Natural gas	MWh	35	7.10
Electricity-Grid	MWh	25	16.07
Total energy & emissions use for the year	MWh	60	23.18
CHP (35MWh natural gas and 25 MWh electricity	MWh	60	15.00
Findout the EPI and CPI considered by using natural gas and electricity grid			
Factory (building) EPI = TreatedFloor Area [m_2]	210		
Production (Output) EPI=Unit	90		
Energy Performance (kWh / m^2)	285.71		
Energy Performance (kWh/Unit)	666.67		
CarbonPerformance(kgCO_2/Treated Floor Area (m^2)	110.38		
Carbon Performance (kg CO_2 /Unit)	257.55		

Note: Information above comes from Intelligent Energy – Europe (RegCep) which is a part of the EU's Competitiveness and Innovation Framework Programme (CIP).

How to achieve:

We could use this list for an initial energy management action plan:

- Define a simple energy policy
- Assign responsibilities
- Involve all employees
- Set up an energy monitoring system
- Conduct an energy audit
- Conduct an energy survey
- Take action on no cost matters immediately
- Set energy consumption targets/yardstick
- Apprise low cost and major cost project
- Ensure that all actions and savings are recorded.

Example from environmental champions:

A part of energy action plan a company installed a computerized monitoring system to analyze meter readings. This identified energy waste in number of areas of the plant, including water leaks that were costing £44000 per year. In total energy and utility savings of £106600 per year were realized for an investment of £12000. Therefore making the payback period just 6 weeks.

4.1.1.5 Involving employees

All employees are energy user and it is vital to obtain their support at an early stage of your energy efficiency program; keep them informed about your actions, invite suggestions, congratulate and thank them for their help and ideas. It's also a very good idea to post a regular progress report on the total amount of energy savings realized on the staff notice board to encourage your staff to support future action. You will also need to 'lead from the front' and set up an example for your staff and managers to follow. So don't forget to switch off the lights when they are not needed.

How to achieve:

All employees need to be made aware off:

- Why and how the energy is consumed at work
- Why it is important to reduce energy cost

- How their behavior affected energy usage.

- What effects saving energy will have on them

Make full use off freely available promotional material such as: posters, videos, and IEMS tools to convey this message. Also consider specific energy efficiency training of staff who have the greatest impact on energy use, e.g. plant operator, security staff, cleaners.

Example from environmental champions:

Rover group saved £1 million over six month at its Long bridge site simply by raising employee’s awareness.

4.1.1.6 Finance

When looking at improve your energy efficiency you must take into account what it will cost you. Costs fall into three categories:

No cost: - this should be done straightway

Low cost:-things which cost less than £100 to implement

Major cost:-projects that require some capital investment.Such as a new lighting system, where you would need to analysis the payback period of the cost.

For projects with a long payback period, a discounted cash flow method such as internal rate of return IRR will give you a better measure of the likely return on your investment.

How to achieve:

When looking at the financial aspect of the project, remember to :

- Work out the simple payback time of the measure.

- Include 'non energy’ savings in your payback calculation

- Decide if a more detailed financial appraisal is needed.

On large capital project such as a new lighting system, remember that existing systems may need to be updated for other reasons e.g. if it is no longer safe, thus some capital expenditure would be incurred anyway.

When energy savings are made try to ‘ring fence’ a portion of the savings for re-investment in further energy efficiency projects.

Example from environmental champions:

A new lighting scheme cost £4500 to install, and it will give us savings at £1800 per year. The simple payback period is calculated by dividing the capital cost of new lighting system by the savings (i.e. 4500/1800). This gives a simple payback time 2.5 year.

A more detailed financial appraisal method is to look at the internal rate of return IRR over the economic life of the light scheme (say 10 years). For this example the IRR is 38% which indicates a good investment.

4.1.2 Energy Sources and Conversion

4.1.2.1 Kilowatt-hour

The Kilowatt hour (kWh) is the standard unit for measuring energy consumption. When analyzing consumption figures it is a good idea to convert all consumption figures to kWh so that they can be readily compared and easily added together to give total energy usage.

Note: we could also consider the environmental impact of a company by working out the amount of carbon dioxide released into the atmosphere as a result of energy use.

How to achieve:

We can convert energy units into kWh and find out the approximate amount of CO_2 released into the atmosphere by using the following calculation:

From Units to kWh:

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Fig- 1.4: A gas meter

If we use 251 units of gas,

Step-1: Cubic meters of gas unit used = 251m^3

Step-2: multiply by conversion factor x 1.02264

Step-3: multiply by calorific value x 39.4 J/m^3

Step-4: convert this into kilowatt-hours / 3.6 kWh

Step-5: giving kilowatt-hours used = 2809 kWh

Note: All utility suppliers use the same calculation.

1 kWh used of gas is responsible for 203 gm CO_2 release.

So, the amount of CO_2 release is kWh used x 203 gm

=2809x203/1000/1000

=0.57 ton CO_2

From Watts and time to kWh:

Power=Watts

Energy= Power x time

=W x S = Joule

=KW x h = kWh

To find out the yearly consumption if 2w of power is used:

2W x 365x 24/1000=17.52 kWh

4.1.2.2 Electricity

Electricity is generally the most expensive fuel, but it is extremely flexible in the ways it can be used. It is typically used in lighting, motor power, refrigeration and air conditioning.

Electricity can be easily controlled, but it is often wasted because individuals forget to turn off lights, office equipment and machines. Poorly maintained refrigeration and compressed air systems are other causes of waste.

Electricity supply cost can be minimized by making sure that you are on the right tariff, and by comparing different suppliers.

4.1.2.3 Natural gas

Natural gas is widely used for space and water heating in industry, commerce and domestically.And another major usage of process heating.

Natural gas burns without producing smoke and soot, thus boiler maintenance cost should be lower in comparison with other fossil fuels. However gas is often wasted through inadequate maintenance of boilers and steam systems.

Gas supply costs can be minimized by making sure that you are on the right tariff, and by comparing different suppliers.

Natural gas is often described as the cleanest fossil fuel, producing less carbon dioxide per joule delivered, than either coal or oil.

Natural gas produces far lower amounts of sulphur dioxide and nitrous oxides, than any other fossil fuel.

4.1.2.4 Fuel oil

Fuel oil is a fraction, obtained from petroleum distillation, either as a distillate or a residue. Broadly speaking, fuel oil is any liquid petroleum product that is burned in a furnace or boiler for the generation of heat or used in an engine for the generation of power. Fuel oils are heavier and more viscous grade of fuel. They must be heated to remove them from the tanks and to ensure proper combustion. This heating requirement reduces the overall efficiency of the fuel oil fired boilers, particularly in winter.

Heavy fuel oil is often cheaper than gas and lighter fuel oil. But capital costs are higher due to; storage, heating, circulation and filtration requirements. Maintenance costs are generally higher than lighter fuel oil and it produces more pollution.

Typically it is used for large boilers.

4.1.2.5 Gas oil

Red diesel is also known as; gas oil, 35 seconds, medium diesel, heating oil, tractor diesel, cherry, generator fuel, digger fuel and many more.

Red Diesel is used by our industrial, commercial, agricultural and construction sectors, in a wide variety of uses from heating right through to; tower cranes, excavators, diggers, tractors etc. Red diesel is the low duty form of diesel and can be used in off road untaxed vehicles i.e. agricultural/industrial/construction machinery and as home heating only.
Using red diesel for other purposes is against the law.
Red diesel is minimally taxed and cannot be used as automotive diesel fuel.Available in 500-36000 litre lots or just a 205 litre barrel. Gas oil is generally lightest and less viscous grade of commercial heating oil, although kerosene is used in some smaller commercial units. It will remain in liquid form even in winter. And hence is not heated normally.

As with other grades of oil it is often cheaper than gas. But capital costs are higher as storage tanks are required. Maintenance costs are higher than gas fired boilers. It is less polluting than heavy grade fuel oil.

Typical usage is space and process heating and plastic production.So it is recommended to find out whether you can replace the existing fuel oil which you are using (see table-1.7) if cost-effective and a comparison is given below:

Fuel	Kg CO_2 /kWh	Pence/kWh
Kerosene (28 sec)	0.272	3.3
Heating Gas oil (35 sec)	0.272	3.2
Light fuel oil (290 sec)	0.282	3.0
Medium fuel oil (950 sec)	0.292	2.7
Heavy fuel oil (3500 sec)	0.35	1.8

Source: author 2009-2010

Table-1.7 Comparing price and Co_2 release among different fuel oil

4.1.2.6 LPG

Liquefied petroleum gas (also called LPG, GPL, LP Gas, or auto gas) is a flammable mixture of hydrocarbon gases used as a fuel in heating appliances and vehicles is increasingly replacing chlorofluorocarbons as an aerosol propellant and a refrigerant to reduce

Fig-1.5: LPG cylinder

damage to the ozone layer. Liquefied petroleum gas LPG is gases, such as butane and propane, which become liquid when placed under pressure. When the pressure is released they change back to gas. These gases are shipped as liquid and are ideal for places which are a great distance from natural gas pipeline. LPG is generally more expensive than natural gas and fuel oils. But it is usually cheaper than off peak electricity. Capital, storage and maintenance costs are higher than natural gas.

4.1.2.7 Coal

The main use for coal is in boilers and industrial furnaces. It is the cheapest fuel to buy but capital costs are higher than other oils, as bulk storage and handling facilities are required. Coal produces considerable amounts of smoke, soot and dust when burnt. So coal fired boilers need more cleaning and maintenance costs are higher than other fuels. Anthracite is a cleaner fuel but maintenance costs are usually higher. Brown coal emits 3 times as much GHG as natural gas, black coal emits twice as much. These are not expected to be available on a commercial scale nor be economically viable by 2025.

4.1.3 Monitoring Energy Use

4.1.3.1 Energy monitoring

However large or small your site and energy usage might be, regular reading and recording of fuel consumed is certainly justified. Using energy bills might be a good starting point but remember that these are often only an estimate of actual consumption and even if your meters are read, it is rarely on the same date each month, therefore you will only be able to set accurate targets if you ensure your meters are read regularly i.e. weekly or monthly. Considerable benefit can also be realized by installing sub metering on high usage equipment and in each building on your site.

How to achieve:

- Train two or three of your staff to read the meters.

- Get them to read your meters on regular basis

- Cross check the accuracy of the meter reading
- Train staff to enter meter readings into a computer
- Analyze the gas consumption against 'degree days' - as it could be an indication of wasted heat on the premises.

Concept of degree days:

A degree day is a unit of measure for recording how hot or how cold it has been over a 24-hour period. The number of degree days applied to any particular day of the week is determined by calculating the mean temperature for the day and then comparing the mean temperature to a base value of 15.5 degrees centigrade. If the mean temperature for the day is, say, 5 degrees higher than 15.5, then there have been 5 cooling degree days. On the other hand, if the weather has been cool, and the mean temperature is 5 degrees lower than 15.5, then there have been 5 heating degree days.

Interpretation of results:

Poor R^2 value shows that either poor control or a highly variable amount of energy is being used for other purposes. So we need to pay attention in energy saving measures on the premises. A sample degree day analysis is given below:

Table-1.8: Yearly gas consumption and degree day's data

Source: author 2009-2010

2008-2009	Gas consumption.	DD Value
June	5900	30
July	7500	55
August	8900	159
September	8500	239
October	12500	221
November	11500	345
December	12600	451
January	15900	502
February	14800	465
March	6400	328
April	3500	157
May	2500	76
2007-2008		
June	6100	40
July	8400	80
August	9500	198
September	8900	285
October	12300	320
November	14500	531
December	12900	513
January	18500	625
February	15900	486
March	6700	350
April	4200	216
May	2700	50

These readings should take place to coincide with your management statistic period. Meter readings takes only 5 or 10 minutes and could signal major loses and possibly unsuspected ways of saving energy.

Meter readings should be analyzed and actual energy used should be compared against consumption targets, yardsticks and industry norms.

After analysis dd graph shows Intercepts of 1356.5 and 1269.4 for the two years respectively. The process energy required, which is independent of the external weather conditions is represented by the intercept and is much the same for bothyears. On the other hand, the gradient shows of amount of energy needed to heat the building as a function of external weather. In year 2 the gradient is < than the year 1 gradient which illustrates that the building has become more energy efficient,probably due to additional insulation or taken good measures in energy management.

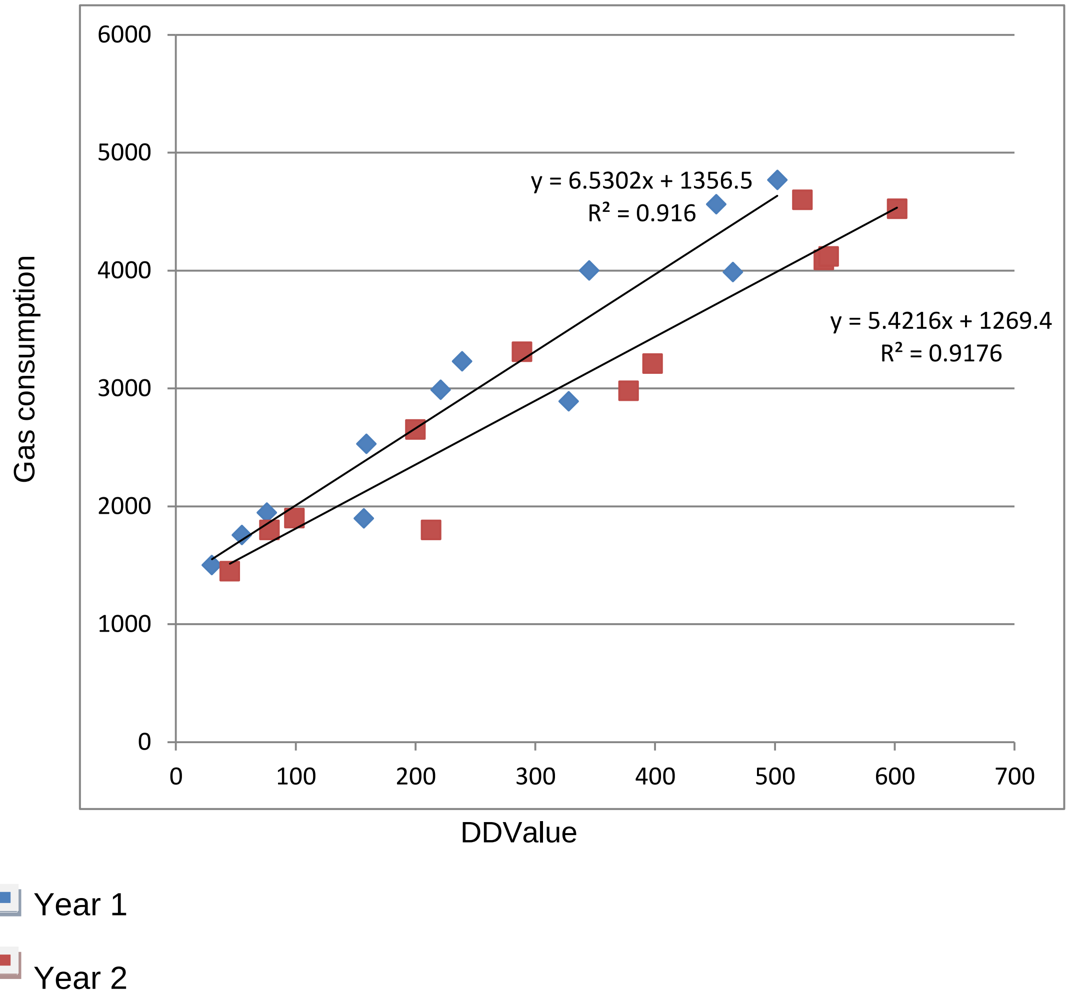

Fig-1.6: 2007-2008 & 2008-2009 degree day analysis.

Example:

In a plastic component industry, managers found that they could not get a clear picture of the patterns of electricity use from a single meter, two portable meters were introduced to investigate the company's electricity usage in the factory and to set energy consumption targets.

This low cost study revealed that the performance of the individual molding machines varied considerably. By introducing new working practices and increasing machine utilization a 10% reduction in electricity consumption was realized saving £36000 a year. The portable metering cost is £640.

4.1.3.2 Yardstick

Yardsticks can be very important performance indicators. They allow you to compare your businesses energy usage with that of other businesses that carry out similar work or who use the same processes or equipment.
For instance by working out the average energy used in producing each item, you can compare your performance with other companies in the same sector.

How to achieve
Common yardstick are:
-Energy usage per square meter or feet of floor space
-Energy usage per unit £ off staff cost or turnover.
-Energy usage per unit of production

Choose the yardsticks that are the most appropriate for your company and use it to track energy use.
Bench marking compares your performance to that of the best performer of competitors. The aim is to close the gap quickly and reach the “best in class” benchmark.

4.1.3.3 Consumption Target

By setting energy consumption targets you can measure how well you are controlling your energy usages. All companies should have a business plan in which energy use is related to other aspects i.e. kWh used per widget produced, kWh per pound of turnover or other similar measures of energy efficiency performance.
How to achieve:
To set the consumption target you need to ensure that:
- All data relevant to your energy usage is collected
- You know what period of time this data covers
- The target you set is realistic and achievable
! Remember that unachievable targets will quickly de motivate.

Example:

In a textile industry a consumption target was set up for each machine. and was achieved, giving an energy cost saving over six years of around £250000.

4.2 Energy management in offices

4.2.1 Office equipment

4.2.1.1 Computer/Monitor

In most offices computers are often left on when they are not in use. For example during lunch time, this wastes energy directly and it also puts an extra demand on space cooling systems .Some modern computers switch off monitors after a set period, to save energy, these types of computers should get preference when considering the purchasing of new computers.
Employees should be encouraged to switch off computers and monitors when they are not needed.

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Fig- 1.7: A typical control room of a cement factory.

How to achieve:

-Educate employees to switch off computers and monitors when they are not in use
-If the computers are networked then display a switched it off message when it is logged off.
-When purchasing a new computer look for a ‘energy star logo’
The energy star logo shows that the computer system will automatically switch to a low power standby mode after a fixed period of inactivity.

Example:

To motivate staff IBM have programmed its computers to display a switched it off message, when staff log off for the day. This message also reminds operators about the cost of leaving equipment on.

If we leave our appliance even in standby mode it will consume energy. Using a simple energy meter you can find out how much energy is being wasted and the associated release of CO_2 that you are responsible for.

Table-1.9:Some Example of Energy consumption in Standby mode per year per item

Appliance	Standby Mode (W)	kWh/year	Releasing CO_2 in Kg	cost @ 14.75 p/kWh in £
Computer Monitor	2	17.52	11.26	2.58
TV	2	17.52	11.26	2.58
Sky Box	6	52.56	33.79	7.75
Electric Kettle	2	17.52	11.26	2.58
Washing Machine	1	8.76	5.63	1.29
Modem/Wireless Router	14	122.64	78.85	18.08
TOTAL		236.52	152.08	34.86

Source: author 2009-2010

Note: To get the calculation please follow>board room>energy sources and conversion>kilowatt-hour

4.2.1.2 Printer

Printing can often be expensive. When purchasing a printer make sure that running costs as well as purchase costs are considered. Some modern printers have a sleep mode to save energy when they are not printing.

Fig-1.8: A printer is on/standby mode

How to achieve:

- Don't leave printers switched on when not needed.
- Only buy printers with a low power standby mode.

Remember that it is generally cheaper to photocopy documents than to print out multiple copies on a laser printer, it is also faster.

Example:

At IBM UK they have an energy policy which insists that the energy efficiency of all new equipment must be considered before purchase. This policy costs little to implement but realizes considerable savings.

4.2.1.3 Photocopier

Most organizations can save money by reducing the amount of photocopying done. A 30% reduction of paper use is often possible.

One of the main problems with photocopiers is that they are often left on when they are not being used. This is due to the time it takes for the machine to warm up when first switched on.

It is also often left on overnight because people think it is someone else's responsibility to switched it off.

Fig- 1.9: A Photocopier left on/standby mode

How to achieve:

- Fit a timer to prevent photocopier being left on over night
- Reduce the amount of photocopying by circulating documents, using notice boards or electronic mail.

-Encourage staff to use double sided copying if possible

When choosing a new photocopier there are models which are more energy efficient than others.Some switched to a standby mode when not in use.

Example:

At a town hall, photocopiers were fitted with simple time switches so that the photocopier automatically turn on 8:45 am then turned itself off for 1 hour during lunch time and turned off at 5:30 pm. The cost of a time switch is around £15 and the payback period is few months.

4.2.1.4 Electric kettle and vending machine

When boiling a kettle it is important to use only the minimum amount of water necessary. Individual kettles should be discouraged and replaced with a single machine or urn.

Vending machine often have more display lights fitted than is really needed, when purchasing a new machine, check its energy efficiency and request the most efficient it is a good idea to fit a7 day time switch to vending machines.

Fig-1.10: A typical electric kettle   Fig-1.11: Atypical Vending machine

How to achieve:

- Educate employees about the cost of overfilling kettle
- Replace personal kettles with communal urns or water boilers
- Fit time switches to vending machines and communal urns.
- Ask suppliers to provide details of the energy usage of their machines

-Remember that employers must test the safety of kettles under the electricity at work regulation. So removing any unsafe kettles will reduce the number of test you need each year, as well as saving energy.

Example:

Old tea urns can be notorious energy wasters particularly if left to boil throughout the day. When the Foreign and Commonwealth Office decided to replace its tea urns with instantaneous water boilers they realized the triple benefit of; lower energy costs, reduced condensation inside the tea room and improved health and safety. It cost £360 for each boiler and the payback period was three years.

4.2.2 Space heating and cooling

4.2.2.1 Office heating & cooling

Good control is the key to the efficient heating of offices. You should check that your heating and air conditioning controls are adequate, one very obvious indication of poor control is the number of windows open by employees in winter.

Many offices were built before the advent of modern personal computers and photocopier, these device generate heat in offices and cause employees to open windows. Many companies have installed air conditioning to improve comfort levels but before you consider this why not check whether you can increase natural ventilation, or use the heat generated in offices, in another areas.

How to achieve:

- Close office windows when the heating is on.

- Check that employees are happy with room temperature

-Install local thermostats and check their settings regularly. As good temperature control is particularly essential, a 1^0 C thermostat reduction could reduce your energy bill by up to 7 %.

Fig-1.12 : A typical thermostat

-Fit a boiler optimizer with compensation features.

-Ensure heat is only provided when and where needed.

-Minimize the number of fresh air changes per hour within the legal obligations. Expelled warm air can be passed through heat exchanger to permit some recovery of heat, which is then used to pre warm incoming cold fresh air.

-Take advantage of natural ventilation wherever possible

-Fit blinds or reflective window films to reduce solar gain

-Lag heating pipes to avoid local hot spots in offices.

Example:

At a quadrant house gas consumption was cut by 66% by; installing careful control measures of the primary air temperature in the building, by minimizing heating and cooling simultaneously, by fine tuning the optimum start and stop times on the

boilers and air conditioning system, by switching off the boiler in summer time and using local electric heaters to provide hot water instead, installing a thermostat because a 1^{0} c thermostat reduction in heating system could reduce your energy bill by up to 7 %.

4.2.2.2 Radiators

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Radiators can lose 10% of their heat output through poorly insulated outside walls. A low cost method of reducing heat lost is to fix aluminum foil panels behind the radiators. This will reflect some of the heat back into the building. If thermostatic valves (TRVs) are not fitted then some employees will open windows

Fig-1.13: A radiator

to adjust the temperature of their working environment, this results in heating more air and fuel bills rising.

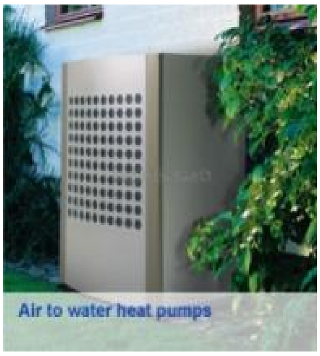
How to achieve:

- Ensure TRVs are fitted on the all new radiators. As it will cost more to retrofit them
- Check that TRVs are not set too high and if they are consider fitting locking mechanisms
- Where radiators are on outside walls place a sheet of heat reflecting material behind them to direct heat into the room
- Ensure there is free air circulation around all radiators and they are not obstructed by furniture
- Choose a suitable radiator for the purpose.

Example:

The British library had a common heating system serving both the public reading room and a behind the scenes storage area. TRVs were fitted to radiators in the storage area, to enable the temperature to be reduced to a lower level than was required in the reading area. The payback period was less than three years.

4.2.2.3 Heat pumps



A heat pump is a device for converting low grade heat into usable high grade heat. It works like a reverse refrigerator process. It can extract heat from; ground water, lake water and atmospheric air, and convert it to high grade heat usually at 35 degree centigrade or above.

Fig1.14: A typical heat pump.

Heat pumps and renewable energy systems are the simplest proven way to cut emissions and drastically reduce the costs of providing hot water and heating to domestic and commercial premises

For example a heat pump can be used to recover low grade or waste ion heat from large refrigeration plants, air compressors or air conditioning units.

How to achieve:

The payback period on heat pump is fairly long. So they are probably worth considering unless you have a good use for the high grade heat generated.

If you have a potential application for a heat pump e.g. waste heat from large refrigeration and air-conditioning plant. Then seek a heat pump manufacturer or contractor for further advice as to whether it is economically viable to install a heat pump.

Example:

A chain hotel group installed small low cost heat pump systems, in six of its premises. The systems were design to cut fuel cost by simultaneously cooling the beer cellar and producing domestic hot water. Only five of the six installations were successful but the average savings were 38% in the public house and 50% in the small hotels.

4.2.2.4 Ventilation

Industrial ventilation is a method of controlling the level of exposure faced by workers to airborne toxic chemicals or flammable vapours, by exhausting contaminated air away from the work area and replacing it with clean air. It is one alternative to controlling employees exposure to air contaminants in the workplace. Other alternatives include; process changes, work practice changes, substitution with less toxic chemicals, or elimination of the use of toxic chemicals. Industrial ventilation is typically used to remove; welding fumes, solvent vapours, oil mists or dusts from a work location and exhaust these contaminants outdoors.

The design and troubleshooting of industrial ventilation systems should be handled by a qualified ventilation engineer or firms specializing in this field.


A)

a)Dust extraction unit b) Air conditioning unit c) Roof extraction fan

Fig- 1.15: Shows some typical commercial ventilation system

By controlling the air flow directly, rather than relying on open windows, the rate of fresh air supply can be adjusted to the desired level, independent of external air pressure or wind speed. Good control of ventilation is essential if the number of fresh air changes is to be minimized and space heating costs contained.

How to achieve:

It is important to remember that when air within a building is replaced by fresh air from outside, this new air must generally be heated or cooled- if room temperature is to be maintained. Thus for an energy efficient operation, the number of fresh air changes in any building should be reduced to the minimum required for employee comfort and health.

Example:

A microfilm studio was fitted with a ventilation plant to remove heat generated from cameras and light. By installing a simple time switch, to automatically switch off the ventilation, overnight and at weekends the studio saved £500 a year. The time switch cost £100 to install.

4.2.2.5 Air conditioning

Air conditioning is increasingly being installed because of the heat generated from computers and other electrical equipment. However the need for air conditioning can be localized and energy cost minimized by careful design.

Having air conditioning on at the same time as space heating is a mistake. This means that both systems will be working against each other and this wastage energy.

Fig1.16: A state of the art air conditioning system

The problem can be avoided by installing thermostatic controls to both the heating and air conditioning systems and ensuring that an appropriate dead band is provided between their set points.

How to achieve:

- Reduce air volume being handled to a minimum
- Set the room cooling temperature to 24 degree centigrade or above
-Set the room heating temperature to 18 degree centigrade or below
- Use as high a proportion of re circulated as possible
- Ensure system running hours are kept to a minimum

- Ensure that ducts, evaporators, condensers, and cooling towers are kept clean
- Ensure that filters are changed regularly
- Avoid simultaneous heating and cooling

Remember that it is always cheaper to use natural ventilation for cooling.

Example:

The Inland Revenue reviewed the operating temperature in its computer rooms. Because modern electronic equipment is less susceptible to temperature it was able to increase set points from 21-24 degree centigrade, this reduced electricity cost by 15%.

4.2.2.6 CHP

Combined heat and power CHP units make use of a single, relatively low cost fuel, (usually natural gas) to generate both heat and electricity. The latter would otherwise have to be purchased at a relatively high cost from an electricity supply company
Large CHP units have been successfully used in industry for process heat and power for many years and more recently small scale CHP units have been developed, that can be easily and cost effectively be applied to certain smaller industrial and commercial operations for space heating.

How to achieve:

CHP is the most energy efficient method of generating both electricity and heat, particularly for larger users with efficiencies up to 90%. As a general rule of thumb you should consider CHP if you have a simultaneous requirement for heat and power for at least 4000 hours a year. However a more detailed financial evaluation is needed to determine its viability in your process.

Example:

In early 1993 a 750 kW gas engine CHP unit was installed at Carlsberg. All most all of the heat rejected in the engine cooling and exhaust system is now being used to augment the output of the existing boilers, which supply heat to the kilns that are used to dry and stabilize the grain after germination. The unit also supplies some of the site's electricity, the projected payback on the CHP scheme was 4 years.

4.2.3 Office lighting

4.2.3.1 Lamp

There are many different types of lamps. The most common being, in decreasing order of efficiency:

-Low pressure sodium for street lighting

-High pressure sodium for Warehouses etc

-Fluorescent for offices etc

-Tungsten filament for domestic use only

Lighting cost can be minimized by selecting the most efficient type of lamp and light fittings, consistent with your aesthetic or color rendering requirement.

The following steps could be taken to reduce energy consumption:

-Tungsten filament lamp should be replaced with compact fluorescent lamps

-Tungsten spot lights should be replaced with tungsten halogen lamps

-Standard 38 mm diameter fluorescent tubes should be replaced with 26mm tubes in switch start fluorescent fittings.

-When refurbishing warehouses or factory premises consider using high pressure sodium in preference to fluorescent lighting.

-In areas where fluorescent lighting is most appropriate, specify high frequency ballasts, which use 20% less electricity than older types.

How to achieve:

Use the appropriate bulbs with luminance and efficiency for different activities.

The luminance and efficiency for different bulbs is given below:

Lamp type	Size	Circuit Load (W)	Output (lumens)	Efficiency (lumens/W)
GLS tungsten	100W	100	1200	12
Compact Fluorescent Lamp	16W	20	700	35
16mm T5 florescent	12 W	58	7500	104
26mm T8 Fluorescent tube	1500mm	71	4900	69
38mm T12Fluorescent tube	1500mm	78	4900	63
High Pressure Sodium SON	70W	81	5500	68
Low Pressure Sodium SOX	55W	68	7300	107

Table-1.10: example of luminance and efficiency in different bulb.

Example:

A bacon factory's joint packaging hall was modified to take modern triphospor fluorescent lamps and high frequency control gear. This produced energy savings of 50% reduced maintenance cost by 25 %. The payback period was 18 months. We can show how and why energy saving bulbs are cost effective and environmentally green, by a simple life cycle analysis which should be clear and concise, providing enough information to make the case to senior management for installing an energy saving lighting system on their premises. The life cycle analysis is shown below:

Table-1.11: Normal Light bulb vs. Energy saver bulbs life cycle analysis

Capital Cost £/unit bulb	 Conventional	Comparing Factor	 Low Energy	Capital Cost £/unit bulb
0.2x8 =1.6	75 W	Power	14W	1
	1000 hr	Life time	8000 hr	
84 85.6	75 1000 kWhx8000x0.14 =84	Running Cost	14 1000 kWhx8000x0.14 =15.68	15.68 16.68
		Save £/unit/yr 68.92		
	75 1000kWhx8000hr x.643kg CO_2 =385.8 kgCO_2	Environmental impact Typically 1kWh=0.643 kg CO_2 releases in UK	14 1000kWhx8000hr x.643kgCO_2 =72.01 kgCO_2	
	Glass Metal Tungsten	Material	Glass Metal Plastic Mercury (Hg)	

	Conventional	low energy
running cost/bulb	84	15.68
buying cost/bulb	1.60	1.0
total cost/bulb	85.6	16.68
total bulb fitting/year	60	60
total cost/year	5136	1000.8
Total savings	= £4135.2	

Source: author 2009-2010

Increase savings by multiply the total number of lights uses in the premises!

4.2.3.2 Manual Control

One of the simplest ways of saving money in terms of lighting costs is to train people to turn lights off when they are not needed. Unfortunately most employees are largely oblivious to the true cost of lighting, therefore a close check should be kept on manually controlled lights and a 'switch it off' reminder periodically issued to employees.

Fig 1.17: Sometimes lights are switched on

How to achieve: Ways of achieving more efficient use of lighting includes:

-Putting up 'switch it off' posters
-Running energy awareness sessions
-Distribution of leaflets e.g. inside wage package
-Make energy efficiency part of the employee code
-Include energy management in supervisor's role descriptions

You could also put a main isolation switch near to the exit door, so that the last person out can switch everything off.

Example:

When light switch are grouped together it is often difficult to know which switch controls which group of light fittings.

4.2.3.3 Localized control

Light switches should allow for localized control of lighting, so, for example lights near windows can be switched off during daylights hours, and the lighting levels reduced in unoccupied areas, in open plan offices. Individual switches should also be fitted to control lights that have been fitted for special tasks such as art work inspection.
Considerable care should be taken to coordinate lighting layout to task positions, as poor lighting will affect productivity. The lighting implications of any changes to the workplace layout should be considered carefully.

How to achieve:

- Check that sufficient light switches are available to enable your staff to control their own lighting.
- The use of individual pull cord switches can provide a cheap and effective solution.
- In open plan areas label light switches to facilitate their use.
- Identify any areas of your building that are occupied intermittently and check if lights are on when empty. If so then better control could provide cost savings
- Check that lights are turned off when sufficient daylight is available
- Where appropriate introduce specific task regarding lighting, with individual controls.

The concept is:

Prepare a computerized control panel and install energy meter in a room and keep monitoring. Switch of lights in areas where there is no activity, by clicking the switches on the control panel, at the same time monitor the energy meter.

Example:

A company changed from a general to a localized lighting scheme, by modifying existing light fittings to provide the recommended luminance in work areas and a lower luminance in non working spaces. This reduced the factory's lighting bills by 47%.the payback period was 2.25 years.

4.2.3.4 Automatic control

Automatic control is a good way to minimize lighting costs. There are a number of low cost options:

-Time switches or timers

-Daylight sensitive, photoelectric cells.

-Infrared motion detectors (short range)

-Microwave motion detector (long range)

Comprehensive lighting management system can also be purchased.Either as astandalone product or as part of a Building Energy Management System (BMES).

How to achieve:

The most cost effective system will depend on:

-The occupancy pattern of your building

-The main activities in each area of the building

-The amount of natural light available

A survey and some research will be needed to gather this data (see under energy management topic).

Example from environmental champions:

A warehouse installed microwave sensors and these automatically turned off the lights when it was unoccupied and reduced the percentage of time that the lights were on from 70%-21%.the payback period was 1.8 years.

4.2.3.5 Cleaning

In offices up to 20% luminance can be lost because of the dust from light fittings and because of dirt and dust on walls and ceilings. It is especially prevalent in foundries and in heavy engineering works, the accumulated dirt and dust in the light fittings can reduce the light levels up to 40%. Dirty windows also reduce

Fig1.18: Cleaning could restore light its design level.

the light available from the natural source. Ultrasonic light cleaning and maintenance restores lighting to its designed level, at a fraction of the cost of replacing fittings.

How to achieve:

A regular schedule should be established to clean:

-Lamps, shades and fittings.

-Windows

-Walls and ceilings.

-Rooms surfaces should be kept bright and clean.

-Before installing any system walls and ceiling should be painted with bright colors.

4.2.3.6 Re lamping

Fluorescent and discharge lamps deteriorate with time. A program of replacement is often more cost effective than a replace on failure policy.

Standard tungsten filament light bulbs are the least efficient form of lighting and should be replaced with compact fluorescent lamps wherever practical.

How to achieve:

In all but the smallest installations, it is sensible to replace lamps as a group, at planned intervals. As a general rule, lamps should be replaced when their output depreciates by around 30%. A light meter can be used to check the light levels.

Similarly it is usually more economical to replace the starter switches on fluorescent lights in groups.

Example from environmental champions:

A company who replaced their lights on a failure basis and cleaned their light fittings at irregular intervals, decided to plan a regular program of maintenance and lamp replacement. By cleaning their light fittings every 2000 hours and replacing lamps every 4000 hours they saved 6.5% of their lighting costs even after the increased maintenance cost were included.

4.3 Energy management in Factory Process

4.3.1 Process heating & cooling

Advantage temperature control units are designed to circulate a fluid medium (typically water or oil) through a process application for heating or cooling at elevated temperatures.

a) Water b) Oil

Fig: 1.19: water and oil temperature control unit

4.3.1.1 Drying & cooling

Dryers when used in controlled way, can save 10-20% energy without any capital expenditure however in some cases capital expenditure is required. These appliances can be rented. A useful use of these appliances could save energy.

Fig 1.20: Some heating, drying and cooling unit.

How to achieve:

- Do a dryer audit.

-Dewatering a product before it reaches to dryer

-Use heat recovery technology; dehumidifiers, and alternative methods of drying e.g. infrared, and frequency heaters, microwave or radio. These options should be consider when changing dryers

4.3.1.2 Recycling waste heat

Many processed produce waste heat as a byproduct. By recycling the heat into space heating or water heating systems, significant savings can be made. Waste heat is partly recovered (recycled) by passing exhaust air through a heat exchanger.

How to achieve:

Simple heat exchange can be used if it is economically viable, this should be done by a specialist contractor.

Recovery type:

Gas to Gas

Gas to liquid

Liquid to liquid

Fig-1.21: some heat exchanger units

Super conductor Heat Pipe technology is used in many industry sectors, for the benefit of high energy users, where waste heat can be recovered and re-used. Low cost manufacturing processes ensures that, the many technical advantages of heat pipe exchangers, are available to industrial users, who wish to reduce running costs and carbon emissions.

Heat pipe exchangers are used to recover waste heat from furnaces, boilers, ovens, thermal oxidisers & incinerator exhausts. The recovered heat is converted into; useable hot air, water or thermal oil for use in processes, space heating or even electrical generation, to significantly reduce the fuel costs and corre

Fig-1.22: A heat pipe exchanger unit sponding CO_2 emissions.

4.3.1.3 Furnaces and Kilns

Furnace efficiency, especially in the metal industry is notoriously low. A substantial cost savings can be made by simple good housekeeping measures such as; controlling air fuel ratio, preventing air ingress, eliminating holding times and lower temperature operation. Other improvements such as installation of low thermal mass insulation, more efficient burners and better controls should also be considered. When buying a kiln or furnace select an energy efficiency one as otherwise the running cost could be higher, up to 50%.

How to achieve:

-Monitor energy consumption regularly

-Set energy consumption targets for each furnace

-Compare your performance with that of other companies

-Change production schedule with shorten holding time

-Perform a detailed energy audit to identify faults

-Examine opportunities for waste heat recovery.

If you are refurbishing old furnaces or selecting new ones check that you have the most efficient burners and the most effective form of insulation.

4.3.1.4 Flow controls

Accurate controls of flow rates are essential for the efficient operation of most industrial processes. Accurate controls will not only minimize energy costs but it will maximize throughput and improve product quality.

Accurate controls cannot be maintained unless high quality instrumentations are used to measure flow rates. Too many plants have an inadequate number of meters for key parameters such as steam, water and compressed air flow. Energy savings of 10% is often realized by the installation of new steam and water meters, and the use of an effective monitoring system to spot leaks.

How to achieve:

The pressure and flow behavior of steam, water and other fluids should be monitored at several locations around their distribution network, then:
-Monitoring and targeting should be used to spot leaks
-Flow controls should be Inspected and serviced regularly
-Regular calibration checks should be carried out on flow meters.
A computer package can be used to estimate the benefits of installing new flow controls at particular locations around your distribution network. This is a specialized job and should be done by an experienced contractor.

Example:

A manufacturer of furniture produces a large quantity of chippings, shavings and dust that must be removed by a large air extraction system. Costs were reduced by installing variable speed drivers to control the rate of air extraction, based on the output of the number of sensors located on various machines. For an investment of £9000 the company achieved a £5800 energy bill saving in 12 months, the payback period was 20 months.

4.3.1.5 Utilizing waste steam

Very low pressure waste steam can be recovered for use in process and space heating, before being returned as condensate to the boiler.

How to achieve:

The simplest way of using waste steam, is to duct the steam to a point where it may be condensed back in to water by spraying cold water over it. The hot water is then collected and used elsewhere in the process. Energy can also be recovered from high temperature steam or waste gases generated by kilns and furnaces using a heat exchanger.

Example:

A laundry's washer extractors were modified to allow for the recycling of heated water and the use of flash steam to the heat water for washing and rinsing. The annual water and energy savings of £10000 were realized for an investment of £19000 .The payback period was 23 months.

4.3.1.6 Industrial cooling

Industrial cooling or refrigeration is mainly found in:
-Food and chemical processes
-Food storage and retailing
-Air conditioning
Although each of these applications uses a different type of refrigeration system the same basic vapor compression cycle is used. Regular maintenance is required to ensure efficient operation. Often refrigeration systems use 30% more electricity than is necessary. Most common faults can be fixed with little capital expenditure.

How to achieve:

We can use the following check list to identify wastage:

-Are you over cooling products?
-Are cold store doors left open regularly?
-Are door seals intact-look for ice and draughts?
-Do your blast/freezer fans slow/stops when the line stops?
-Could you use stripe curtains on doors?
-How often is your condenser checked for dirt and leaves?
-Have you optimized your defrost cycle?
-Could you fit electronic expansion valves?

Example:

A small cold store in a food processing factory was spending £30000 a year on electricity. The company discovered that more than half of these costs were due to the cold stores doors being left open. By altering working practices and improving employee awareness, the company was able to save £10000 a year – simply through ensuring, that where possible, doors were kept closed.

4.3.1.7 Plant insulation

Insulation of plant and pipe work is not only essentials for financial and energy efficiency reasons, but it also improves safety, in areas where personnel are likely to come into contact with very hot or cold surfaces. Insulation can also protect pipes against frost damage and reduce noise emissions.

Why Insulate?

Reasons for the use of insulation generally fall into one of the following categories:

- To save Energy - good Insulation saves money and reduced CO_2 emissions
- To help maintain process temperatures
- To protect site personnel against burns
- To prevent condensation forming
- To protect against frost
- To protect equipment from corrosion
- To provide fire protection
- To provide acoustic insulation

How to achieve:

The range of insulation materials available is large and new products are regularly being developed. A number of different factors must be considered when selecting the most appropriate insulation material/s for your plant, specialist expertise and advice should be sort to aid this.

Example:

A composite company upgraded their steam pipe insulation to include jackets round pipe flanges, valves and fittings. Losses from this area of pipe work accounted for 18% of the sites steam consumption. For a cost of £21000, savings worth £27000 have been made. The payback period was 9 months. The average cost of per insulating jacket was £50.

4.3.2 Space heating & cooling

4.3.2.1 Factory/industrial space heating & cooling

De stratification fans can keep heat within the working area of factories with high ceiling s. The installation of these fans will considerably reduce space heating bills.

Some small and medium sized factories use warm air blowers, however localized radiant heating can be more economical as it heats employees without heating the surrounding air.

A company can think of installing an 'Evaporative Cooling System' in the offices, industrial units, factories or other buildings. Evaporative cooling can be financed through interest free *Carbon Trust Loans, and offers many benefits, including:

- Costs 80 to 90% less to run than Air Conditioning.
- Emits only 10 to 20% of the carbon that Air Conditioning does.
- In appropriate buildings, costs up to 70% less than air conditioning to install.
- Delivers 100% fresh air, not recycled air.
- Gives more cooling as it gets hotter, with no upper limit, unlike Air Conditioning which gives less and eventually fails completely.
- Allows doors and windows to be left open.
- Works equally well in localised parts of a building, to provide spot cooling without extra partitions.


Fig: 1.23: An evaporative cooling system

How to achieve:

The ideal time to upgrade a factories heating is during a refurbishment:
You should look at the way in which heat is generated and circulated around the factory and consider whether radiant heaters would be more economical or de stratification fans would help.

Example:

A factory installed new fans to reduce temperature stratification during the heating season, at a cost of £1850. The fans prevented heat from collecting near the roof and improved the comfort levels of the occupants by stabilizing the temperature. The company realized energy savings of £559 a year. The payback period was 3.3 years.

4.3.2.2 Radiator

Radiators can lose 10% of their heat output through poorly insulate outside walls. A low cost method of reducing heat lost is to fix aluminum foil panels behind the radiators.

This will reflect some of the heat back into the building.

If thermostatic valves (TRVs) are not fitted then some employees may open windows to adjust the temperature of their working environment.Thus heating more air and fuel bills rising.

Fig-1.24: some thermostatic radiators valve

How to achieve:

-Ensure TRVs are fitted in the all new radiators. As it will cost more to retrofit them

-check that TRVs are not set too high and if they are consider fitting locking mechanisms

-where radiators are on outside walls, place a sheet of heat reflecting material behind them to direct heat into the room

-ensure there is free air circulation around all radiators and they are not obstructed by furniture.

Example:

The British library had a common heating system serving both the public reading room and a behind the scenes storage area. TRVs were fitted to radiators in the storage area, to enable the temperature to be reduced to a lower level than was required in the reading area. The payback period was less than three years.

4.3.2.3 Heat pumps

A heat pump is a device for converting low grade heat into usable high grade heat. It can extract heat from ground water, lake water and atmospheric air, and convert it to high grade heat at 35 degree centigrade or above.
For example heat pump can be used to recover low grade or waste ion heat from large refrigeration plant, air compressor or air conditioning units.

The CO_2 emissions reduction potential of 6% will increase in the near future, because both heat pumps and power plants are becoming more efficient as a result of technology developments. While the efficiency of a fossil fuel boiler can never be higher than 100%, the theoretical heat output of a space heating pump is approximately 14 times the energy input. Heat pump technologies can be used in both residential and industrial solutions, competing with fossil fuel boilers and direct electric heating. They can be used just for heating , but can also simultaneously produce both heating and cooling, useful for different parts of a building or in different seasons.

In many industrial processes, heat pumps are applied to recover process waste heat. They are used in dehumidification, distillation and evaporation processes, but also for water heating and combined heating and cooling, many opportunities in the food and chemical industries. One of the largest heat pump installations in the world is integrated in a propylene/propane distillation process at the Shell site, Pernis, in the

Netherlands. This heat pump saves 37 million m3 gas annually, and cuts CO_2 emissions by 90 thousand tonnes.

To emphasise the potential which heat pumps offer, the IEA Heat Pump Centre carried out a large scale assessment of the global environmental benefits of using heat pumps. This analysis concludes that there is a large potential for extending the present environmental advantage of heat pumps over conventional heating systems. This potential is an invitation waiting for realisation, through R&D, the support of governments and utilities, and through market transformations.

How to achieve:

The payback period on heat pump is long. So they are probably not considering unless you have a good use for the high grade heat generated.

If you have a potential application for a heat pump e.g. waste heat from large refrigeration and air-conditioning plant. Then seek a heat pump manufacturer or contractor for further advice whether it is economical to install a heat pump.

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How to achieve:

Reduce air volume being handled to a minimum.

-set the room cooling temperature to 24^{0}C or above.
-use as high a proportion of re circulated as possible
-ensure system running hours are kept to a minimum
-ensure that ducts, evaporators, condensers, and cooling tower are kept clean
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Remember that it is always cheaper to use natural ventilation for cooling.

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How to achieve:

CHP is the most energy efficient method of generating both electricity and heat, particularly for the larger users with efficiencies up to 90%.
As a general rule of thumb you should consider CHP if you have simultaneous requirement for heat and power for at least 4000 hours a year. However a more detailed financial evaluation is needed to determine its viability in your process.

Example:

In early 1993 a 750 kW gas engine CHP unit was installed at Carlsberg. Almost all the heat rejected in the engine cooling and exhaust system is now used to augment the output of the existing boilers-which supply heat to the kilns that are used to dry and stabilize the grain after germination. The unit also supplies some of the site electricity. The projected payback on the CHP scheme was 4 years.

4.3.3 Compressed Air

4.3.3.1 Air intake

General information:

The air entering the compressor should be cool, clean and dry as this will lead to more efficient compression and lower energy use. Wherever possible air should be taken from outside of the building as its temperature is lower and this could increase compressor efficiency by up to 2%.
To minimize the amount of drying needed to produce high quality compressed air, it is also important to site a compressor's air intake well away from sources of water vapor.

How to achieve:

-Where possible air should be taken from outside the building because its temperature will be lower and thus the compressor will work more efficiently.

- A sheltered inlet protected from rain on a north wall is desirable.

- Dust can clog filters and waste energy; therefore ensure they are clean well maintained

-The ducting between the air intake and the compressor should be short straight and generous diameter.

- Make sure that if cooling is being discharged outside, it is well away from the intake

Example:

A company based in Ireland suddenly experience an increase in compressed air costs rising from between £200-£220 per week to over £300 per week. Investigations revealed that the air intake to the main compressor was blocked and that a second compressor was used to meet the demand. When the filter was replaced the costs dropped to under £200 per week.

4.3.3.2 Distribution network

General information:

Compressed air is generally distributed to its various points of use by a pipe work system and a considerable amount of energy will be wasted if this system is not airtight or properly designed. It is essential that all pipes, valves and other pipe work components are adequately sized to prevent over pressure. All systems should be designed for minimum pressure drop.

Sometimes it is necessary to maintain the air supply in one area of pipe work continuously but the remainder of the distribution system can be isolated during nonproductive periods, thus preventing energy wastage due to leaks.

How to achieve:

A ring main system is preferable to feed the spurs, since this will help to balance the pressure throughout the distribution system.

The distribution system should be designed for the maximum pressure drop of 0 .1 to 0 .2 bar at the point of use – during periods of maximum demand.

Air receiver or reservoirs can be installed in the system to handle short periods of high air demand.

Enough valves should be fitted to allow the main branch lines to be isolated, and the compressed air system to be effectively zoned. Electronically controlled isolation valves are preferable to manually operated valves

Example:

In energy survey a company identified that the site's compressed air system was larger than needed. A two stage rationalization program was carried out to remove redundant lines, to divide the distribution network in to zones to minimize leaks and to rationalize overall compressor usage. The total cost was £24500 with cost savings of 12.2% or £11300 per year realized. The payback period was 2.2 years.

4.3.3.3 Compressor sizing

General information:

When companies buy a new compressor, they often buy one with more capacity than is needed. Large compressors are generally more efficient than smaller ones, although a better solution in some instances may be to buy a number of smaller compressors, so that the capacity of the system can be changed to match the load required, this avoids the need to run compressors, very inefficiently, at low load.

The correct configuration for any site will require careful consideration but substantial savings can be achieved. If your current compressor is fairly old you should consider the purchases of more efficient model.

How to achieve:

Compressors should be sized so that generation capacity matches the demand for compressed air as closely as possible. It is not economical to run any compressor for long periods at low loads, due to the electrical motor loses.

For new installations, with multiple compressors, a selection of different sizes of compressors should be considered, so that different levels of compressed air demand can be met, while still ensuring that compressors are running at close to full load.

Example:

In order to increase production capacity by 25 % a textile yarns company needed to increase the capacity of its compressed air system. Following consideration of alternative options, the managers decided that it would be a more cost effective to replace two of their existing compressors with a more efficient larger compressor, rather than to fit another small compressor. The capital cost was higher at £ 44700 but cost saving of £14250 was realized. The payback period was 3.1 years.

4.3.3.4 Leakage

General information:

Compressed air leaks are often overlooked but huge savings can be made if they are found and plugged.

Leaks frequently occur at; air receiver valves, pipe and hose joints, shutoff valves, quick release couplings, tools and equipment. In most cases these leaks are due to poor maintenance and can be fixed relatively cheaply. Any leaks you can hear are costing money as is the blowing of compressed air on to objects, which is particularly wasteful and costly. By monitoring the amount of compressed air used you will be able to identify waste.

A handheld ultrasonic leak detector could be used to identify areas where energy is being wasted.

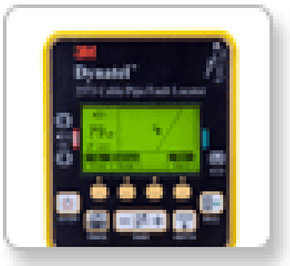

Fig- 1.25: An ultrasonic leak detector.

How to achieve:

-Check for compressed air leakages regularly.

-Encourage machine operators to report leaks.

-Fix all audible leaks immediately.

-Inspect the system during quieter periods

-Tag all leaks and address the worst ones first

-Isolate machines that are prone to leaks.

-Remove unnecessary runs of pipe work

-Divide your compressed air network in zones.

-Smaller leaks can be identified using soapy water.

-Use a suction cleaner instead of blowing dust with compressed air.

Example:

A motor company, Rover, installed a compressed air monitoring system. This system alerted the site engineers to the use a large of compressed air outside of normal working hours, equivalent to 405 production usages. This was due to leakage and was quickly remedied saving £21000 a year.

Source: GPCS 137

4.3.3.5 Recovering heat

General information:

Over 90% of energy used in compressing air is converted into heat. This heat could be recovered and used in hot water or space heating system.

A simple way of recovering heat is to duct the air outlet of the compressor into the factory in winter.

How to achieve:

A simple way of recovering heat is to duct the air outlet of a compressor into the factory in winter and outside in summer.

Other possible uses of the waste heat i.e. warm water or warm air should be considered when designing a compressed air installation and when selecting a site for a new compressor. The cost of linking a compressor to a suitable heat user will vary. But payback of between 1 and 3 years is possible.

Example:

In a year 130 KWh of heat could be recovered (at between 30^0 and 40^0 centigrade) from a 500litre/second compressed air installation served by an air cooled compressor. A site with direct gas fired space heating and operating 48 hours/week, using this heat would produce annual cost savings of around £2000.

Source: GPG

4.3.3.6 Compressor setting

General information:

The sitting of compressors is very important. There are two main options:

-Site all compressors in a central compressor house

-Site a compressor near to each main user.

The best choice depends on the size and volume of compressed air needed. Sitting compressor near to the main users is often more cost effective, because short pipe runs reduce both capital and running costs.

Fig-1.26: A modern portable compressor

How to achieve:

If you want to recover heat from a compressor remember it is much more difficult to move heat over long distances than it is to move compressed air, therefore site your compressor accordingly. If you are not recovering waste heat then compressor should be sited near to the biggest users of compressed air.

Operate your compressed air system at the minimum acceptable pressure. If you have one or two small users that require a higher pressure than the majority of your site consider providing them with local compressors thus allowing the general system pressure to be reduced.

4.3.4 Motive power

4.3.4.1 Power factor

General information:

A low power factor will increase the price you pay for your electricity. Many users of electricity including; motors, welding and lighting, draw more current than is accounted for by the power produced (in watts).

A system drawing excessive wattles current compared with its actual power consumption is said to have a low power factor. This low power factor can be improved by installing power factor correction capacitors.

Always check the power factor of new and running equipment.

Utilities typically charge additional costs to customers who have a power factor below a certain limit, which is typically 0.9 to 0.95. Engineers are often interested in the power factor of a load as one of the factors that affects the efficiency of power transmission.

How to achieve:

By installing power factor correction equipment.

Example:

HIP limited installed power factor correction equipment at a cost of £9350. As a result the average power factor of the site improved from 0.77 to 0.92 to saving about £9300 a year due to 13 % reduction in electricity charges. The simple payback period was 12 months

4.3.4.2 High efficiency motor

General information:

High efficiency induction motors consume less electricity than comparable standard motors for any given load. A typical energy saving when using these motors is around 6% of the motor's running costs. The capital cost is slightly more expensive, but if the motor has high duty cycle then these additional cost can be recovered in less than 12 months.

High Efficiency Motors

High efficiency motors offer a number of potential benefits over standard models. These include lower utility bills and reduced operating expenses through lower failure rates and longer service life.

Fig-1.27: A high efficiency motor

What is a High Efficiency Motor?

Motor efficiency is the ratio of mechanical power output to the electrical power input. This is usually expressed as a percentage. Energy efficient motors use less energy to perform the same amount of work as standard motors. Key design improvements and more accurate manufacturing tolerances are largely responsible for the increase in performance of energy efficient motors.

Key design factors include:

-lengthening of the core and using lower-electrical-loss steel,

-Thinner stator laminations and more copper in the windings to reduce electrical losses.

-Improved bearings and smaller, more aerodynamic cooling fans can also increase efficiency.

-High efficiency motors are generally 2% to 8% more efficient than standard motors.

Benefits of High Efficiency Motors

Motors systems consume around 2/3 of the electrical energy used in UK industry. Improving the efficiency of motors, and the systems they drive, can save substantial amounts of energy and reduce operating costs. High efficiency motors do cost more, but many models can offer a return on investment within two years. The cost of operating a motor in the first year is often several times the purchase price. Reducing operating costs through the purchase of higher efficiency motors can offer a substantial payback. In addition to energy savings, the better designs and improved construction of high efficiency motors can lead to substantial savings of energy and there is a new EU directive on electric motors.

Benefits:

-Longer insulation and bearing lives

-Lower heat output and less vibration

-Extended winding life

-Increased tolerance of overload conditions

-Higher tolerance for increased voltage rates or phase imbalance

-Lower failure rates and extended manufacturer warranties.

When to Buy Energy Efficient Motor

You should consider buying a high efficiency motor:

-For all new installations

-When purchasing equipment packages, such as compressors, HVAC systems and pumps

-When major modifications are made to facilities or processes

- When rewinding older, standard efficiency units that have failed

-When replacing oversized or under loaded motor systems

-As part of a preventive maintenance or energy conservation program.

How to achieve:

High efficiency motors should be considered for all new plants and equipment that will have a high duty cycle (in terms of hour's run/year). If you are planning to retrofit high efficiency motors then check the level of energy savings first, as the payback period can be long in some applications.

Example:

In a metal company five motors were replaced with high efficiency motors at a cost of £670, energy savings of £408 per year were realized and the overall payback period was less than 20 months.

It is worth remembering high-efficiency motors may not always be the best choice, particularly where the motor has a very low usage (perhaps less then 1 hour/day): therefore always use the EU directive on motor efficiency.

4.3.4.3 Variable speed drives

General information:

Where a variable output is required from an electrical machine (e.g. different flow rate rates from a fans or pumps),it is more energy efficient to vary the speed of the machine using a variable speed drive (VSD), rather than to use alternative methods of control, such as throttling the flow by using a valve or damper.

A range of cost effective electronic VSDs are available for both larger and smaller applications for VSDs include:

Pumps

Mixers

Compressor Machine tool

Fans

Conveyors

Fig- 1.28: A Small variable frequency drive

How to achieve:

When purchasing new equipment check what type of motor is fitted, as it is better to initially buy a machine with a variable speed drive than to retrofit one. If old machines are being updated or refurbished then check if it is cost effective to fit variable speed drives to the motor at the same time.

Example:

A Glasgow Infirmary saved £8300 a year by fitting a variable speed drive on a boiler fan. Trials showed that the motors electricity consumptions fell from 20200 KWh a year to 6500 KWh, a 68% reduction. The VSD cost £7100 and the payback period was only 11 months.

4.3.4.4 Controllers

General information:

As the load on a motor falls it becomes progressively less efficient. Motor controllers minimize losses when a motor is part loaded, savings are greatest on motors running at less than 50% of full load.

More sophisticated motor controllers can incorporate soft start circuits which provide additional operational benefits.

Automatic switching systems can be applied to larger items of equipment, these contain load sensors that automatically switch off motors and pumps after a set period of inactivity and they can prevent idle running for example lunch hours, if programmed correctly.

How to achieve:

Suitable applications for motor controllers are those in which electric motors run for long periods at low load, e.g. refrigeration compressors, conveyors or mixers.

New controllers should be considered when purchasing new or refurbishing old equipment.

Retrofitting new motor controllers can be cost effective in some applications, variable speed drives may be a better investment.

Where plants run idle for long periods of time consider installing a load sensing control system to turn plant off automatically after a preset period of inactivity.

Example:

A frozen food store installed motor controllers to all its freezers, realizing energy savings of between 11% and 16% for each unit. The total installation cost for the stores 86 freezer units was £2530 and the payback period was 1.9 years.

4.3.5 Process Lighting

Factory lighting comes in all shape and sizes and the lighting requirements depend on the nature of the manufacturing or assembly process. The lighting level for each area of the factory should be checked to ensure that you are not lighting areas unnecessarily. You should also check the age and type of the fittings, as considerable savings can be made by; replacing older fittings with high frequency fluorescent fittings, with mirrored reflectors, or high pressure sodium or metal halide lamps. Where a dirty atmosphere exists regular, frequent cleaning is essential.

A company installed combined high frequency lighting fittings with daylight control and high quality task lighting and reduced their electricity bill over by 70%. The payback period was 2 years.

4.3.5.1 Lamp

General information:

There are many types of different lamps. The most common being,in decreasing order of efficiency.

-Low pressure sodium for Street lighting

-High pressure sodium for Warehouse etc

-Fluorescent for offices etc

Lighting cost can be minimized by selecting the most efficient type of lamp and light fittings consistent with your aesthetic or color rendering requirement.

The following steps could be taken for energy uses reduction:

-tungsten filament lamp should be replaced by compact fluorescent lamps

-Tungsten spot light should be replaced by tungsten halogen lamps

-standard 38 mm diameter T12 fluorescent tubes should be replaced with 26mm T8 tubes or 16mm T5 tubes in switch start fluorescent fittings.

-when refurbishing warehouse or factory premises consider using high pressure sodium in preference to fluorescent lighting.

-In areas where fluorescent lighting most appropriate specify high frequency ballasts which use 20% less electricity than older types.

How to achieve:

The required luminance for different activities and interiors are given below:

Maintained luminance(lux)	Activity
50	Indoor storage, tank, cable tunnels, walkways.
100	Corridor, changing rooms, bulk stores, auditorium.
150	Loading bays, medical stores, plant rooms.
200	Monitoring automatic process in manufacture, casting concrete, turbine halls,dining rooms, foyers and entrances.
300	Packaging goods, rough core making in foundries, rough sawing, libraries, sports and assembly halls.
500	General offices, engine assembly, painting and spraying, laboratories and retail shops
750	Drawing offices, ceramic decoration, meat inspection.
1000	Electronic component assembly, gauge and tool rooms, retouching paintwork.
1500	Inspection of graphic reproduction, hand tailoring, fine die sinking.
2000	Assembly of minute mechanism, finished fabric inspection.

Table-1.12: required luminance for different activity

Example:

A bacon factory's joint packaging hall was modified to take modern triphospor fluorescent lamps and high frequency control gear. This produce energy savings of 50% reduced maintenance cost by 25 %. The payback period was 18 months.

4.3.5.2 Manual Control

General information:

One of the simplest ways of the saving money in lighting cost to train people to turn lights off when they are not needed. Unfortunately most employees are largely oblivious to the true cost of lighting as they don't have to pay the bills. So a close check should be kept on manually controlled lightings and a switch it off reminder should issued to employees periodically such as their wages slips

How to achieve:

Ways of achieving more efficient uses of lightings includes

-putting up posters

-energy awareness sessions

-Distribution of leaflets e.g. inside wage package

-Make energy efficiency part of the employee code

-include energy management in the supervisor's task

You could also put a main isolation switch near to the exit door. So that last out can switch everything off.

Example:

When light switch are grouped together it is often difficult to know which switch control which group of light fittings.

4.3.5.3 Localized control

General information:

Light switches should allow localized control of lighting so that for example lights near windows can be switched off during daylights hours, and the lighting levels reduce in unoccupied areas in open plan office. Individual switches should also be fitted to control lights that have been fitted for special task such as art work inspection.

Considerable care should be taken to coordinate lighting layout to task positions as poor lighting will affect productivity as well. The lighting y implication of any changes to work layout should be carefully considered.

How to achieve:

Check that sufficient light switches are available to enable your staff to control their own lighting. The use of individual pull cord switches can provide a cheap and effective solution.

In open plan areas label light switches to facilitate their use. Identify any areas of your building that are occupied intermittently and check if lights are on when empty. If so then better control could save your money.

Also check that lightings are turned off when sufficient daylights are available and if not then check it can be switched off easily without affecting other tasks.

The concept is preparing a computerized control panel and energy meter in a room and keep monitoring.Switch of lights in area where no activities in progress, by clicking the switches on the control panel. Notice the energy meter same time.

Example:

A company changed from a general to localized lighting scheme, by modifying existing light fittings to provide the recommended luminance in work areas and a lower luminance in non working spaces. This reduced the factory's lighting bills by 47%.the payback period was 2.25 years.

4.3.5.4 Automatic control

General information:

Automatic control is a good way to minimize lighting costs. There are a number of low cost options:

-Time switches or timers

-Daylight sensitive, photoelectric cells.

-Infrared motion detectors (short range)

-Microwave motion detector (long range)

Comprehensive lighting management system can also be purchased.Either as a standalone or as part of a Building Energy Management System (BMES).

How to achieve:

The most cost effective system will depend on:

-the occupancy pattern of your building

-the main activities in each area of the building

-the amount of natural light availability.
A survey and some research will be needed to gather this data (see under energy management topic).

Example:

A warehouse installed microwave sensors and these automatically turned off the light when it was unoccupied and reduced the percentage of time that the lights were on from 70%-21%.the payback period was 1.8 year.

4.3.5.5 Cleaning

General information:

In offices up to 20% luminance can be lost because of the dust of the light fittings themselves and because of dirt and dust in walls and ceilings. Especially in foundries and in heavy engineering works, the accumulated dirt and dust in the light fittings can reduce the light levels up to 40%. Dirty windows also reduce the light available from the natural source.

How to achieve:

A regular schedule should be established to clean:
-Lamps, shades and fittings.
-Windows
-Walls and ceilings.
Replacing lamps at the same time will reduce labor costs.
-room surface also kept bright and clean.
-Before installing any system wall and ceiling should be paint with bright color.

4.3.5.6 Re lamping

General information:

Fluorescent and discharge lamps deteriorated with time. A program of replacement is often more cost effective than a replace on failure policy.
Standard tungsten filament light bulbs are least efficient form of lighting and should be replaced with compact fluorescent lamps wherever practical.

How to achieve:

In all but the smallest installations, it is sensible to replace lamp as a group, at planned intervals. As a general rule, lamp should be replaced when their output depreciated by around 30%. A light meter can be used to check the light levels.

Similarly it is usually most economical to replace the starter switches on fluorescent lights in groups, in every two lamp lives.

Example:

A company who replaced their light in failure and clean their light fittings at irregular intervals-decided to plan a regular program of maintenance and lamp replacement. By cleaning their light fittings every 2000 hours and replacing lamps every 4000 hours they saved 6.5% of their lighting costs even after the increased maintenance cost was included.

CHAPTER 5

CONCLUSION

5.1 Conclusion

If a business is wasting energy it is causing avoidable pollution, primarily through increased carbon emissions leading to climate change, whilst contributing to the problems associated with dwindling fossil fuel reserves.
But wasting energy also reduces your profitability. For every £1 saved on energy costs, most UK businesses would have to make £10 in sales to make the same £1 of profit. So, for example, wasting just £1,000 a year on energy due to poor energy management would require £10,000 worth of sales to make the equivalent £1,000of profit. The Government's support programmes for energy efficiency and carbon management have proved that most companies can reduce their energy costs by at least 10% through the implementation of simple housekeeping measures and by as much as 30% through the implementation of cost-effective measures. Monitoring & Targeting (M&T) provides the means to identify; where energy is used, where it is wasted and areas where significant saving can be achieved through implementing effective energy savings measures. These energy management tools include a special quick start guide to energy M&T. to help explain how this simple but effective management tool might help the SMEs. By implementing the tools an organisation can make the most cost-effective progress towards a more sustainable future for its energy needs.

The most cost-effective solution for reducing your carbon footprint is to reduce energy use by avoiding unnecessary use and implementing energy efficiency measures. You should include the design of your goods and services and also at your supply chain .Once you have increased your efficiency you should then look to replace fossil fuels with renewable energy sources and/or use cleaner fuel technology such as renewable where it is feasible to do so. Finally, having reduced your carbon emissions through avoiding waste of energy, achieving energy efficiencies and using renewable cleaner sources, you can neutralise the remaining unavoidable emissions through carbon offsetting schemes.

We need to increase awareness and training on energy management issues in the; board room, office and factory process system which are already had been described in the tools. When a company has achieved some success and are benefitting from the energy management program, they then might show interest in implementing an environmental management system program in their premises.

Industrial energy users will be obliged to address their consumption of energy, either through legislation, taxes, or simple economics. This study has identified a lack of knowledge and skills amongst SMEs for them to be able to do this in a timely and effective manner. A support tool has been developed to assist such companies, relying on a minimum knowledge, it should take the company through a number of energy issues and suggest savings based on conservation and/or changing to more efficient equipment. Then the company/industry will be able to incorporate those energy issues, programs, performance to their environmental management system manual if they want to do so. In this way the SMEs can put their contribution to tackling global warming and reduce their carbon footprint as well.

5.2 Strengths and limitations of the tool

The tool works well in some area such as the understanding of the type and nature of the barriers to adopting an EMS, focused on energy management issues, in different areas in a factory and how they could make savings from the management of these issues. However there are some limitations of the tool which is primarily targeted at manufacturing industries and therefore less approachable in some industries. The EU is continuously publishing directives on environment and on energy products and usage. These directives must be implemented by law and so companies must remain vigilant regarding legislation. This tool was developed in 2009/2010 and so is limited to the legislation in force at that time. EU directives are good as they are independent of political parties and expect companies to adopt environmentally friendly technology to manage energy efficiently. The other limitations could be the requirement of some sort of environmental knowledgeable resource person from the company to understand some specific topics.

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7.0 Appendices

7.1 Reports on Internal and External Barriers

No	Author & year	Internal barriers	External barriers	Adoption of EMS
1	Poole M et al (1999)	Severe time limits for non core business work. Baseline cost low so cost savings didn't arise. A major issue is the balance between cost of time spent versus the value of savings. Companies believe they have no environmental issue but all had one issue of importance	Type of EMS training and tools available not applicable for micro firms.	No
2	Goodchild E (1998)	Staff time for implementation (average of 424 staff days) and the time to maintain the system (60 staff days/year) Capital expenditure identified during EMS implementation	High cost of certification to an EMS	Yes BS 7750 and EMAS
3	Hillary R (1998)	Inadequate internal skills in particular to implement the environmental review and the EMS specially in the case of small sites	Variation in approach of accredited environmental verifiers. Cost of verification , SMEs pay more per day for verifiers time than large companies. Small firms pay on average ECU 1085/day and large firms pay 878/day . external assistance require for review and EMS	Yes EMAS and ISO 14001
4	Petts, J et al (1998)	Relevance of some legislation is questioned and there is a strong mismatch between personal beliefs as to the importance of compliance and concern about the environment and perceived		No

		corporate performance		
5	Smith A and Kemp R (1998)	Belief that SMEs impact is low , low awareness of legislative that applies to business especially amongst micro firms. They are likely to belief no benefits arise from improved environmental performance.. low awareness of support organizations source of information. Low awareness of sources of help and associated low use of services. Low interest in adopting EMAS and/or ISO 14001		Yes, attitude to EMSs and case studies on ISO 14001
6	Charlesworth K (1998)	75% of respondents in all sizes of firms, but medium sized firms in particular, felt that time pressure preventing them investigating the possibility of an EMS. Attitudes to EMSs , benefits accrue slowly and cost of implementation are incurred quickly, lack of time to investigate issues about potential cost savings and market opportunities , board/opt team see no need to change. Perceived relevance of ISO 14001 to their business low 20%. Bottom up environmental projects typically lack of resources and often organisation deny responsibility for environmental issues and pass the buck.		No
7	Baylis R (1998)	Just under half had not read ISO 14001, problems with implementation , need to change companies data collection system. Difficulty in understanding the	Problems with implementation. too difficult to satisfy verifiers.	Yes, ISO 14001

		implementation process, environmental aspects identification and significance, lack of training and internal marketing of ISO 14001, cost of implementation, failure to realise savings, doubts about the ongoing effectiveness of systems implemented.		
8	Environmental Technology. Best practice Program (1998)	Companies with fewer than 100are less convinced, more than 50% that improving environmental performance usually improves production efficiency. Small sites 67 % are not convinced that reduced environmental impact can have significant cost benefit.	Economic Climate influences heavily companies and economic factors take priority.	No
9	Merritt JQ (1998)	Low awareness of BS 7750 (54%) and very low awareness of EMAS , 17% . Low designation of responsibility for the environment to an environmental manager, 11%. Low occurrence of EMSs. 6% have introduced some kind of EMS	Lack of understanding of the heterogeneous nature of the sector.	No
10	Abrams S (1998)	Over three quarters think that environment will be the significant competitive issues in the next 5 years. Cost is the biggest barrier to investment new technology. 62% SMEs are not aware of forthcoming legislation	Lack of trade association to support sector	No
11	KPMG (1997)	Perception of EMAS of awareness of benefits, lack of understanding of the being bureaucratic and expensive, lack requirements for environmental statement or the value of reporting, confusion between	Lack of promotion, incomplete institutional framework in certain Member States, lack of clear or strict legislative framework, lack of trade association support, lack of sector specific	Yes, EMAS

		different standards, i.e. EMAS and ISO 14001, fear of increased administrative burden, concern over suspension for minor breaches in compliance.	tools and examples, lack of quality and inconsistent approach of consultants, lack of experienced consultants and verifiers.	
12	Hillary R (1997a)	SMEs focus on production process issues to the exclusion of wider environmental issues, SMEs found writing an environmental policy which conforms to EMAS difficult, implementation was an interrupted processes, the determination of significant environmental effects/aspects proved problematic, lack of knowledge of formalised systems, negative experience with ISO 9000 standards, inconsistent top management support, difficult to achieve auditor independence for small firms, problem of how to define and achieve continual improvement, lack of management time and multi-functional nature of staff more important than financial resources, management instability.	Too many environmental policy requirements in EMAS, EVABT is not widely understood, SMEs found terminology difficult in EMSs, lack of documentation of EMS in SME more challenging for verifiers and certifiers, cost of registration, duplication of effort on part of certifiers and verifiers in relation to assessors, disclosure requirements of EMAS, additional cost of registering to EMAS, verifiers heavily influence audit cycle length, lack of implementation tools, lack of a single authorities body to interpret EMAS was a shortcoming, changing economic fortunes.	Yes, EMAS and BS 7750
13	National Association of Local Authorities in Denmark (NALAD) (1997)	Initial barriers: counter arguments presented by SMEs: "we have little impact on the environment", SMEs are best regulated by command and control framework because there are so many, EMAS is an unknown quantity, Lack of resource and cost, no demand for EMAS, commercial confidentiality problems from the public environmental statement,	Compatibility of ISO 14001 and EMAS, a perceived lack of tools and a lack of time to locate tools, cost of verification, conflicting guidance, poor quality communication of information, inadequate institutional arrangements	Yes, EMAS

		existing controls ensure compliance why do more. Internal barriers: Limited resources resulting in stop/start approach, root cause can be inability to see relevance of all EMAS stages especially documented management systems, isolation of environmental issues from core business, lack of top management commitment, resistance to change, transient workforce and loss of environmental champion		
14	University Bocconi IEFE (1997)	EMS barriers to implementation: lack of technical knowledge and specialised personnel, need for system documentation a concern for small firms and the information and communication aspects area concern for medium-sized firms. Firms not confident on the organisational and managerial aspects of EMAS. Smaller firms are more unstructured and found early stage of EMAS difficult. Time constraints and multiple roles or management team and commercial pressure take priority. The most difficult elements of EMAS: environmental statement, initial environmental review and objectives and programmes. Small firms found these more difficult than medium-sized firms. Analysis of environmental effects and selection of most significant ones. SMEs and small firms in	Inconsistent criteria used by verifiers analysing companies EMS.	Yes EMAS, BS 7750, ISO 14001 and Spanish and Irish EMS standard s

		particular are not convinced of the added value of the EMAS environmental statement.		
15	European Commission DGXXIII (1997)	SMEs have problems with the terminology and the perceived complexity of EMAS and EMSs. Cost of implementation is high. The fact that the audit cycle can be set at shorter than 3 years.	A far-reaching simplification of EMAS is needed as EMAS is too complicated for small enterprises. Incompatibility of EMAS and ISO 14001. Distortion in accredited environmental verifiers market. Lack of an EMAS logo. Lack of marketing potential of EMAS associated with products. Content of the environmental statement is not clear. Lack of central source of information on environmental legislation. Lack of co-operation between competent bodies to ensure common practices and different approaches. Terminology and language used not appropriate for SMEs	Yes, EMAS and ISO 14001
16	Hillary R (1997b)	Reasons for drop out of pilot and EMAS: Lack of human resources or staff diverted onto production issues, change of management, and economic fortunes of SMEs change. Internal barriers: loss of an environmental champion, removal of resources, emergence of legal compliance problems, lack of top management support, low management status of key individual spearheading EMS implementation,	ISO 14001 and EMAS perceived as in competition. Cost of verification and maintenance of registration. Format of EMAS is unappealing and appears bureaucratic. Lack of effective support for the key implementer of the EMS in the company. Lack of one central source of information of environmental legislation. No clear guidance on	Yes EMAS

		bureaucratic nature of quality systems, lack of training and awareness of staff	environmental effects and their significance.	
17	European Commission DG XI (1997)	Lack of human, technical and financial resources. Inability to undertake environmental review of sufficient depth and links with register of significant environmental effects and legislation not clearly understood or achieved.	Lack of accessibility to clear information on legislation, lack of business networks to promote and support EMSs, lack of technical support and grants for EMS implementation. Lack of clarity on cost/benefits of EMSs for SMEs. Lack of information in EMAS on the initial environmental review.	Yes EMAS
18	Baylis R et al (1997)	SMEs general unconvinced or unsure whether an EMS can or does help it meet customer needs, or comply with pollution and/or waste regulations. SMEs unconvinced of the benefits such as market opportunities, cheaper insurance, innovation, and improved workforce morale. SMEs are unaware of the impact they or their products have on the environment and therefore consider an EMS to be inappropriate. Some SMEs are satisfied with the status quo. SMEs make fewer environmental improvements than large companies; in particular they devote little effort to training (6%), awareness raising (5%) or encouraging employee suggestions (4%). SMEs are unconvinced or unaware that environmental	EMS viewed as potential bureaucratic. Customer ambivalence to SMEs environmental performance or satisfaction with current practices and no supply chain pressure.	No, but considers separate steps of EMS

		improvements could reduce costs or that the potential this would have to increase profits would be a reason to make improvements. The majority of SMEs spend less than 5% of their time on environmental management, with just under 20% spending no time in 12 months. Perceived impact on the environment either non-existent or negligible. SMEs don't perceive the growing pressure to tackle the environmental issues as either a threat or opportunity. Short term view taken.		
19	Court P (1996)	Insufficient financial incentive because of the cost of implementation both internally and through use of consultants, amount of management time associated with implementation, inexperienced in strategic planning, lack of internal resources because of limited manpower and technical knowledge and the excess management effort required of already stretched directors and owners	Lack of quality affordable advice, poor image of existing standards, their lack of credibility and the lack of public awareness of the standards meaning that there is very little business benefit from compliance with the EMS standards, no legal obligation	Review of BS 7750, EMAS and ISO 14001
20	The British Chambers of Commerce (1996)	Low awareness of support organisations; low or no importance given to environmental compliance by 37%.	Lack of engagement of small firms in the local decision making process and community	No
21	Elliot et al (1996)	< 20% of smaller firms review their environmental performance using environmental audits. The smaller the business the lower its perception of the effects of environmental	Environmental legislation shapes business perceptions, i.e. the more regulated a company the more awareness it has of its impacts.	Yes, BS 7750

		legislation and their own environmental impact on the environment. Sector variation.		
22	Rowe J and Hollingsworth D (1996)	Low awareness of environmental performance and view held that company had low environmental impact. Lack of time to attend training programmes. SMEs profess ignorance or felt they could not exert influence on impacts. Overall lack of specific usable environmental knowledge		No
23	Environmental Technology Best Practice Programme (1996)	Lack of association between environmental issues and profitability in many sectors, which have largely SMEs.		Yes, in case studies
24	Hillary R (1995)	Belief that impact is very low, and that collective impact of SMEs low. Low awareness of legislative that applies to business especially amongst micro firms. Few seek advice on support services. Perception of some (24%) that there are no positive benefits from pursuing environmental improvements. Most consider they run their business efficiently and management inertia is failing to keep abreast of customers changing requirements.	Low awareness of sources of help and associated low use of services. Attention diverted to business survival issues like gaining loans and late payment of bills. Confronted with ever increasing environmental legislation.	Yes, limited case studies on BS 7750
25	Business in the Environment/Coopers & Lybrand (1995)	Not a significant business case to register for EMAS. Availability of resources determines implementation of an EMS.	Uncertainty surrounding EMS standards, e.g. EMAS, BS 7750 and ISO 14001. Availability of guidance or technical assistance. Cost of	Yes, EMAS, BS 7750 and EMS

			achieving registration. Uncertainty about how an EMS will be valued in the market place, insufficient benefits and external drivers from customers, and regulators.	
26	The Springhead Trust (1995)	Under a quarter believe public awareness to be a threat. Outside resources are not used in staff training and there is a low awareness of local environmental groups and initiatives. Just under a third are not interested in outside free advice.		No
27	Mori (1994)	Barriers are: no pressure or obligation to adopt an EMS, organisation doesn't damage environment, too much work, don't know enough about it/ need more information.	Too expensive and too much work involved in an EMS, registration too expensive, no obvious benefits.	Very limited on BS 7750
28	The British Chambers of Commerce (1994)	Primary motivation to improve environmental performance is to avoid breaches of legislation (56%) dramatically less (2%) receive pressure from customers or considered cost saving (7%). Compliance with legislation brings about changes in management systems and procedures (67%) but has virtually no impact on staff training and awareness (1%). The majority (70%) have no specified person with environmental management responsibilities and have not training or awareness (75%) on environmental management. The majority "do the minimum" (15%) or comply with legislation (64%). 29% are	Few (18%) experience customer pressure to examine their environmental performance. Often help sought is not applicable (30%) with the information being inappropriate to small firms (53%) or too complicated or conflicting (41%).	Yes, BS 7750

		either confused or ill informed on environmental issues.		

7.2 environmental funds compiled by researcher to get interest for environmental issues

Please always see carbon trust announcement.

http://www.grantsforindustry.co.uk/business-grants-and-loans/grants-eco-innovation-or-new-carbon-reduction-technology

Accessed at 21/02/2011

Entrepreneurs Fast Track supported by carbon trust.

http://www.carbontrust.co.uk/emerging-technologies/fast-track/pages/default.aspx

Accessed at 03/03/2011

Utilize Action Grants - West Sussex

http://www.westsussexsbp.org.uk/Detail3.aspx?ChannelID=29&PostingID=251

Accessed at 15/03/2011

Central Scotland Green Network Development Fund

http://www.forestry.gov.uk/forestry/INFD-85BGTL

Accessed at 07/04/2011

Wales Recycled Content Grant Scheme (WRAP) WCG007

http://www.wrap.org.uk/wrap_corporate/funding/capital_grants/recycled_content.html

Accessed at 15/04/2011

WRAP - Rethink Waste Revenue Fund SCO05

http://www.j4bgrants.co.uk/smartasearch/SchemeList.aspx?WCI=htmResults&WCU=SEARCH%3DDS%3DJ4BGRB~pRB%3D4~pCC%3DGBP~pFPI%3D%22434488%22%2CUDATA%3DLISTMODE%3DSEARCH

Accessed at 17/04/2011

7.3 For expert suggestion researcher compiled some address for the SMEs

Carbon Trust International - Home

www.carbontrust.com/

Accessed at 02/04/2001

Energy Saving Trust - **Energy** Efficiency & **Energy** Conservation

www.energysavingtrust.org.uk/

Accessed at 07/05/2011

Envirowise - Sustainable Practices, Sustainable Profits, a Government programme managed by AEA Technology Plc and Serco Limited.

www.envirowise.wrap.org.uk/

Accessed at 15/05/2011

7.4 Climate Change Levy: Changes to rates

Who is likely to be affected?

1. Suppliers and others liable to account for climate change levy.

General description of the measure

2. Legislation in Finance Bill 2007 will increase the rates of climate change levy for 2008-09 broadly in line with inflation. The rates from 1 April 2007, which were increased broadly in line with inflation by Legislation in Finance Act 2006 will be:

Taxable commodity	**Rate**
Electricity	£0.00441 per kilowatt hour
Gas supplied by a gas utility or any gas supplied in a gaseous state that is of a kind supplied by a gas utility	£0.00154 per kilowatt hour
Any petroleum gas, or other gaseous hydrocarbon, supplied in a liquid state	£0.00985 per kilogram
Any other taxable commodity	£0.01201 per kilogram

4. The rates from 1 April 2008 will be:

Taxable commodity	Rate
Electricity	£0.00456 per kilowatt hour.
Gas supplied by a gas utility or any gas supplied in a gaseous state that is of a kind supplied by a gas utility	£0.00159 per kilowatt hour
Any petroleum gas, or other gaseous hydrocarbon, supplied in a liquid state	£0.01018 per kilogram
Any other taxable commodity	£0.01242 per kilogram

Operative date

5. The new rates shown in paragraphs 3 and 4 above will apply to supplies of taxable

Commodities treated as taking place on or after 1 April 2007 and on or after 1 April 2008 respectively.

7.5 Concept and Calculation of degree days

A degree day is a unit of measure for recording how hot or how cold it has been over a 24-hour period. The number of degree days applied to any particular day of the week is determined by calculating the mean temperature for the day and then comparing the mean temperature to a base value of 15.5 degrees Centigrade. The mean temperature is calculated by adding together the high for the day and the low for the day, and then dividing the result by 2. If the mean temperature for the day is, say, 5 degrees higher than 15.5, then there have been 5 cooling degree days.

On the other hand, if the weather has been cool, and the mean temperature is 25.5 degrees, then there have been 10 cooling degree days.

Why do we want or need to know the number of degree days:
It is a good way to generally keep track of how much demand there has been for energy needed for either heating or cooling buildings. The cooler (warmer) the weather, the larger the number of heating (cooling) degree days and the larger the

number of heating (cooling) degree days, the heavier the demand for energy needed to heat (cool) buildings.

1 degree day *=1 day when average temp is 1 degree below 15.5 degree centigrade*

Date	Outside meantemperature in Centigrade	Base value	DailyDD Value
01/09/2009	10	15.5	5.5
02/09/2009	13	15.5	2.5
03/09/2009	12	15.5	3.5
04/09/2009	15	15.5	0.5
05/09/2009	22	15.5	-6.5
06/09/2009	25	15.5	-9.5
07/09/2009	10	15.5	5.5
08/09/2009	9	15.5	6.5
09/09/2009	3	15.5	12.5
10/09/2009	4	15.5	11.5
11/09/2009	12	15.5	3.5
12/09/2009	14	15.5	1.5
13/09/2009	17	15.5	-1.5
14/09/2009	19	15.5	-3.5
15/09/2009	13	15.5	2.5
16/09/2009	15	15.5	0.5
17/09/2009	14	15.5	1.5
18/09/2009	16	15.5	-0.5
19/09/2009	19	15.5	-3.5
20/09/2009	21	15.5	-5.5
21/09/2009	22	15.5	-6.5
22/09/2009	14	15.5	1.5
23/09/2009	13	15.5	2.5
24/09/2009	12	15.5	3.5
25/09/2009	10	15.5	5.5
26/09/2009	-4	15.5	19.5
27/09/2009	13	15.5	2.5
28/09/2009	12	15.5	3.5
29/09/2009	10	15.5	5.5
30/09/2009	3	15.5	12.5
Total dd in September			**77**

Note: Total DD is the difference of 114 heating degree days and 37 cooling degree days.

Now you need to calculate twelve month dd to correlate gas consumption with dd in excel in order to determine the relationship between them.