Department of Minerals and Energy Pretoria

Capacity Building in Energy Efficiency and Renewable Energy

Report No. – 2.3.4-32 (b)

Industrial Energy Management Best Practice Programme for South Africa –

Some advice and guidance on key components and effective action

Sarah Beacock and Louise Kingham
Energy Institute

This Report contains restricted information and is for official use only

June 2005

Department of Minerals and Energy Pretoria

Capacity Building in Energy Efficiency and Renewable Energy

Report No. – 2.3.4-32 (b)

Title: Industrial Energy Management Best Practice Programme for South Africa

Some advice and guidance on key components and effective action

June /2005

Report no. 2.3.4-32 (b)

Issue no.

Date of issue June 2005

Prepared by Sarah Beacock and Louise Kingham, Energy Institute / Doug Tripp, CIET

Checked

Approved

Table of Contents

Table of Figures

Appendices:

Details of Service Provider, Client and Funder

EnerWise Africa has undertaken this assignment in association with Africon Engineering International and the Canadian Institute for Energy Training (CIET). EnerWise Africa, a South Africa based firm, has a broad based experience in energy efficiency related issues and has worked extensively in this field in South Africa. Africon Engineering International, which is one of South Africa's largest and most experienced engineering and professional service firms, has a long history of involvement in infrastructure life cycle, from policy and planning through to design, construction and operation and maintenance, including in the energy sector. CIET is an international training consultancy, with extensive experience in the development of market training solutions for energy management in industrial, commercial and institutional organisations in Canada and abroad.

The EnerWise team was subcontracted to the Consultant, COWI, a leading international consulting group, which operates in the engineering, environmental science and economics fields and is managing the CaBEERE programme on behalf of the Client.

The client and funder, the Danish International Development Agency (DANIDA), has been involved in South Africa in an environmental support programme since 1995, and has during this period assisted a number of activities and projects with both government and civil society structures.

The recipient of this project is the South African Department of Minerals and Energy.

Foreword

In the foreword to the March 2005 Energy Efficiency Strategy of the Republic of South Africa, former Minister of Minerals and Energy Phumzile Mlambo-Ngcuka states:

> *"In South Africa we take energy for granted, with the consequence that our energy consumption is higher than it should be. Whilst our historically low electricity price has contributed towards a competitive position, it has also meant that there has been little incentive to save electricity.*
>
> *…The Industrial and Mining Sectors are the heaviest users of energy, accounting for more than two-thirds of our national electricity usage. Here lies the potential for the largest savings by replacing old technologies with new, and by employing best energy management practices."*

The targets outlined in the Energy Efficiency Strategy include:

- Nationally - final energy demand reduction of 12% by 2015
- Industrial and Mining sectors – final energy demand reduction of 15% by 2015.

The Strategy goes on to state:

> *"The industrial and mining sectors combined are the largest users of energy in South Africa. A relatively high theoretical potential for energy saving exists, in the magnitude of 50% of current consumption in comparison with international best practice, on a sector-by-sector basis. Notwithstanding this, research has shown that a savings potential of at least 11% is readily achievable using low-cost to medium-cost technical interventions. Furthermore, an additional 5%-15% energy saving would be achievable via proven no-cost and low-cost techniques of energy management and good housekeeping. It is considered, therefore, that the prescribed target of 15% is realistic and achievable."*

For decades, South Africans have paid among the world's lowest prices for electricity. However, the country's Electricity Supply Industry (ESI) is undergoing fundamental restructuring in order to address inequities and complexities in the pricing of electricity delivered to consumers, compounded by an impending exhaustion of excess generation capacity. This creates a timely set of opportunities for implementing energy efficiency measures.

1 Key components of a successful Industrial Energy Management Best Practice Programme

Before implementing any best practice programme (BPP) it is important to ensure the presence of two key ingredients:

- wholehearted commitment from the targeted industry sector(s) and
- a clear focus on the goals and outputs of the programme.

Without the first ingredient it will not be possible to achieve the second and without the second there will be no sustainable level of commitment. Thus an integrated approach is essential that focuses on the ‘people’ as well as the ‘technical’ elements.

It is therefore recommended that care is taken in selecting the industry sectors to target in the establishment of a BPP. As well as commitment from the industry leaders it is advisable initially to target major energy users, not only in sector terms but including the ‘market leaders’ or known ‘brands’ in each sector. Commitment from any sector will be easiest to achieve where energy efficiency is likely to make the most impact on costs.

The initial stakeholder meetings between DME and these industry sectors and individual organisations will enable realistic targets and objectives to be set for the programme overall.

The components that can go towards making up the BPP can be selected from the grid given in Figure 1 and will broadly all come within one of four general strands of the programme: industry, people, technology and knowledge base. Although these are shown in a linear fashion in the diagram, there are many interconnecting pathways between the components of each element and there is no suggestion of a specific order of development – for example, case studies and good practice guides may be the last to be developed arising out of successful pilot schemes.

The importance and value placed on each component will be determined by the stakeholders in the BPP at the start of its development. Those shown and described here are simply those that can be found in one or more existing BPPs from around the world.

Whatever components are selected it is important for the BPP to develop and be promoted as a coherent whole. For this an integrated approach is necessary showing how the elements interrelate and clearly demonstrating the relationship between actions and outcomes. All successful schemes have clear parameters as to how a BPP is resourced and operated and for those such as Canada's CIPEC (Canadian Industry Program for Energy Conservation) scheme for example the integration of targets, reporting/benchmarking and audits/assessments assisted in giving a clear linkage between the objectives and the measurement of outputs of the programme.

1.1 Workforce engagement

At the organisational level, experience from BPP schemes in the UK and Canada suggests that people are the key to a successful scheme and particularly one that is to become sustainable. The main points to note here are:

- The importance of commitment from the senior management of the organisation so that any energy efficiency programme is not seen as a one-off initiative or something that will go away
- Adequate resourcing including general staff development and the identification of energy specialists and those within the organisation willing to work as 'energy champions'
- Gaining support at all levels of the company by stressing the importance of energy efficiency to the long-term wellbeing of the company and therefore its employees.

Figure 1 – Master template for the components of an industrial best practice programme

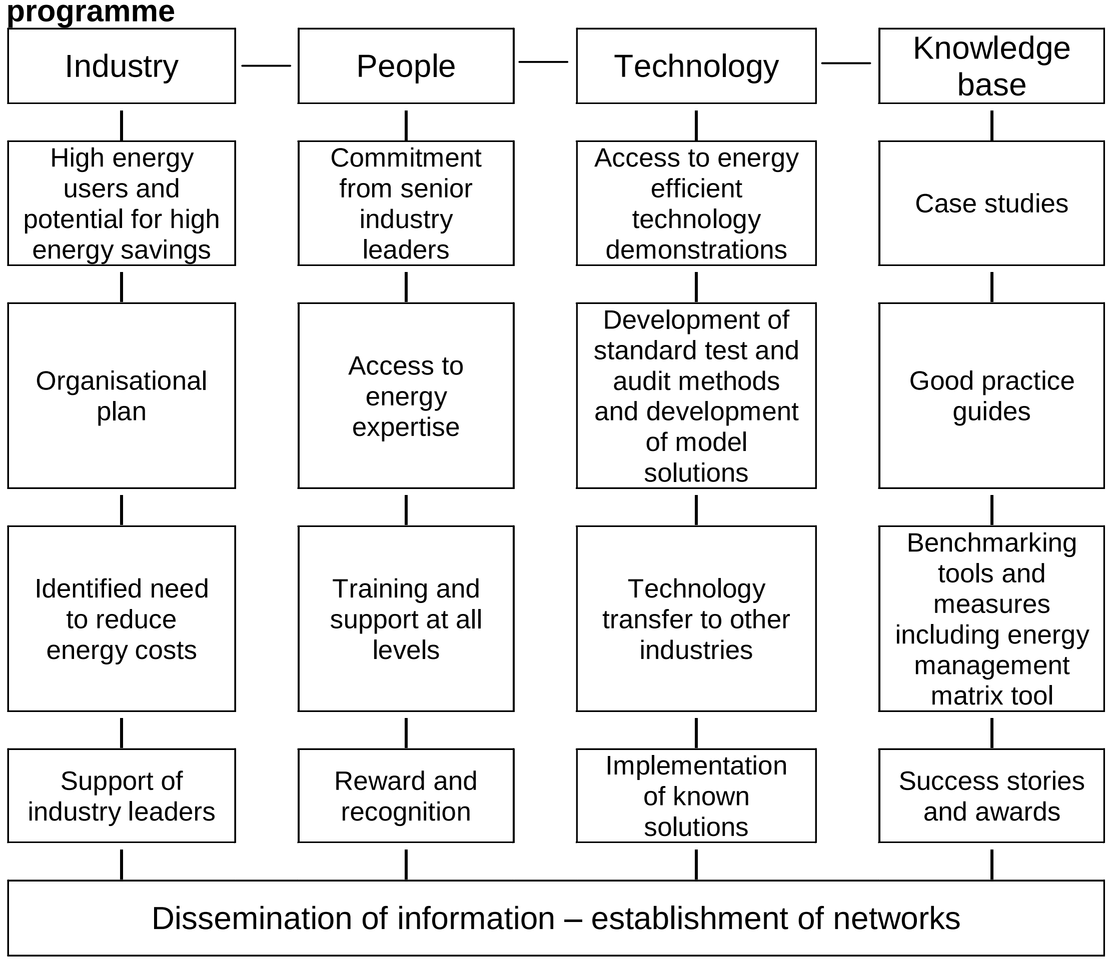

Figure 1 – Master template for the components of an industrial best practice programme

Useful pointers for engaging employee involvement are:

- Making the company's energy policy apparent to all staff
- Promoting an awareness campaign that draws analogies between energy use in the home and at work
- Using constant reminders within the workplace of energy efficient actions – eg light switching etc.
- Setting up an 'energy forum' that ensures a cross section of employees are involved (particularly those who might need convincing)
- Using rewards, incentives and challenges in motivating staff effectively

- Using an Energy Management Matrix to diagnose current perceptions of energy use within the workplace.

1.2 Methodology for company assessment

Having considered the engagement of the workforce at an early stage another key component is the organisational plan. Every organisational plan will be different but a number of stages need to be included to ensure an effective energy management system is put in place. The example used here is from the US's Energy Star programme.

Make Commitment

- Appoint an Energy Manager
- Establish an Energy Team
- Set an Energy Policy

Assess Performance

- Gather Data
- Establish Baselines
- Benchmark
- Analyse Data
- Technical Assessments and Audits

Set Goals

- Determine Scope
- Estimate Potential for Improvement
- Establish Goals

Create Action Plan

- Define Technical Steps and Targets
- Determine Roles and Resources

Implement Action Plan

- Create a Communication Plan
- Raise Awareness
- Build Capacity
- Motivate
- Track and Monitor

Evaluate Progress

- Measure Results
- Review Action Plan

Recognise Achievements

- Internal Recognition
- External Recognition

1.3 Benchmarking tools and measures

There are a number of tools and measures that a successful energy management scheme uses. These include benchmarking tools for specific industry sectors, norms and standards of specific energy consumption, standard testing and auditing methods and the energy management matrix tool as a means of starting an organisation on the way to energy management.

Energy management matrix – Initial assessment of a company's existing energy performance should use a range of energy organisational matrices including an energy management matrix that identifies their starting point – an example is given here from the Sustainable Energy Victoria project in Australia (Appendix A).

The idea is that you plot your current status for each section against the level the organisation is currently at. At a later stage of the project (perhaps one year into implementation) you undertake the assessment again and see what progress the organisation has made until best practice (level 4) has been reached in all categories.

In the UK a self-assessment tool for identifying energy management priorities was encapsulated in a Good Practice Guide (number 306) and which includes a number of energy matrices that form an essential benchmarking tool. They cover energy performance, energy management, financial management, awareness and information, and technical issues and together contribute an overall picture of the organisation's starting point and later progress. They are supplemented by a range of sub-matrices for specific aspects of likely energy waste, loss or inefficiency – for example on boilers or space heating.

Benchmarking tools for specific industry sectors and technologies – these are provided by the UK BPP and cover such areas as industrial buildings, heating, lighting, glass industry etc and are particularly useful for within sector comparisons. It is important to be aware that benchmarking measures your activities against others in the sector or using that technology. However they can give a false sense of security if the overall benchmark is higher that could potentially be achieved with more attention.

Standard testing and auditing methods – these ensure that measurements taken are accurate when taking into consideration variable factors such as seasonal loads and levels of comparability between different types of buildings or fuel types etc (see Appendix B for some examples).

Norms and standards of energy consumption – this type of information will include fuel efficiency booklets, conversion factors etc.

Energy audit – the purpose of an energy audit is to evaluate the efficiency of all building and process systems that use energy. Such an audit will look at current usage patterns as well as opportunities to reduce use. The nature of an energy audit or survey can be anything from a straightforward visual examination of the site to identify initial targets for energy savings to a more detailed study requiring the use of energy consultants and specialists in order to compile a full report. The organisation itself can contribute to an effective audit by early collection and analysis of relevant cost history and usage data including installation details and any servicing and maintenance arrangements. This information, together with the results of the energy audit, need to be maintained as a regular log of energy usage, often within a system know as monitoring and targeting.

Energy monitoring and targeting – M&T is, at its simplest level, a collection of information-handling techniques. It is a key tool in the armoury of the energy efficient organisation and for some, it is the basis on which all good energy management is founded as without accurate measurement of energy consumption and loss it becomes much harder to rein in those losses and implement effective energy saving measures. It requires the analysis of existing consumption profiles, accurate records of occupancy and use as well as regular monitoring of trends and variances. It helps in benchmarking against typical standards and assists in setting targets.

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

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

- Analysis and interpretation. Analysis enables you to turn the data into useful information on which to act. This could involve use of specialist proprietary M&T software or standard PC spreadsheets for many applications.

- Reporting. This means ensuring that the right information reaches the individual with the ability and responsibility to act. Information needs to be timely, concise and delivered in a useful format.

- Action. M&T needs to be geared to the management activities of the company so that action is taken and energy savings achieved.

To illustrate its importance to the BPP, the common energy intensity indicators that are used to characterise industrial energy efficiency (GJ/tonne of production, for example) are fundamentally misleading in that they misrepresent the real relationship between energy performance and production level; indeed, these indicators inevitably present increased production as a means of energy efficiency improvement because of the lower energy intensity that results.

However, M&T provides a basis for going beyond energy intensity to the development of energy performance models that disaggregate total load into base and incremental components, and provide a means of accurately representing efficiency and assessing the impact of operational and technological measures—while filtering out the economy of scale effect.

1.4 Energy expertise

The next key component is the energy expertise and the ability of energy management programmes to draw on appropriate experts and consultants. The BPP will need to consider here whether existing resources in this respect are adequate and sufficiently well trained as well as the need for additional skills and capacity to be developed for the future. Those energy experts who are also able to act as trainers in the field of energy management will be valuable at the early stages of building awareness and commitment from participating organisations.

The DME will here want to consider a way of ensuring that those claiming energy consultancy skills reach an acceptable level of competence to undertake such work so as to retain customer confidence in the BPP. Within the UK BPP this was achieved via the establishment of an independent Register of Energy Consultants operated by the Energy Institute and containing over 350 energy consultants whose skills in various industry sectors and technologies has been independently verified. The Carbon Trust uses the Register to source all its consultants for the free energy audits and assessments that it provides to industry.

1.5 Technology

One of the key aims of any industrial energy management BPP must be to encourage companies to invest in newer more efficient technologies to replace outdated inefficient systems. The provision of expert knowledge of appropriate technologies – either from the consultants or via the manufacturers and suppliers of such technologies – is therefore critical to an effective programme.

Demonstration projects are probably most effective as they allow an instant recognition of the effects of installing new equipment. In order to have most impact on the sector however it is likely that most organisations will require considerable encouragement to take such a step, mainly by having first made low/no cost savings from simpler solutions or from the offer of financial assistance or inducement to invest in such technologies. Useful examples of demonstration projects can be found within the US Industrial Assessment Centres, Norway's Industrial Network for Energy Conservation and the UK's BPP.

The skills of a highly qualified energy consultant are also of value here. Those with an engineering background will be able to provide technical solutions based on existing circumstances for organisations not yet ready for large scale investment. Thus a validation system which recognises a consultant's skills in system design as well as installation and maintenance will add considerably to the overall value of the pool of expertise available to the programme.

In this way technology transfer becomes more effective and is also enhanced when best practice networks begin amongst participating companies and the range of industry sectors and organisation types becomes wider.

1.6 Knowledge and resource base

After some period of operation, the BPP will begin to create a pool of its own resources which are likely to include case studies specific to the South African experience and good practice guides which can be obtained from a number of sources including the Carbon Trust in the UK. Benchmarking information and the implementation of standard test and audit methods will enable the gradual compilation of a database on which to build the future success of the programme.

The format and content of the case studies will be a critical part of ensuring the local success of the programme as being both a means of promoting the success of the scheme as well as prompting other organisations to action. A more detailed proposition on the components of a successful case study and a template for producing one can be found in Appendix C. Also included is a brief case study to illustrate their general application.

Once a resource base has been established, the next step will be to find the best means of disseminating this information as widely as possible. Methods will ideally include press reports of success stories, a website containing free advice and guidance, toolkits, resources and identification of training opportunities. The establishment of networks of the energy professionals engaged in the programme, as well as those operating at the organisational level will assist in promoting best practice as well as keeping the momentum going. A newsletter will be useful where physical networks are hampered by geographical distance and is a good way of providing tangible promotion of the programme. Even advertising should not be ruled out as recent successful campaigns in the UK by the Carbon Trust have shown.

Capacity building of energy awareness, knowledge and expertise are critical to the success of the programme and will again require the involvement of people in being trained and educated in energy efficient principles and techniques. A formal training programme is proposed to be part of the programme and this will encompass explanation of many of the essential components of the best practice programme including their application to real life situations. The training course can be supplemented by various means of ongoing professional development and study. This will require the identification of existing opportunities (perhaps via universities or specialist professional bodies) as well as a future 'needs analysis' (which could be based on the experiences of the UK or Canada in this respect) for identification of additional training and learning opportunities that should be developed.

The IEM training course will focus predominantly on the 'management' (ie non-technical) aspects of the BPP and the DME will also want to consider making provision for the upskilling and validation of energy specialists and possibly the future training of new energy specialists.

A final component of the promotional aspects of the BPP relates to reward of the successful organisations in recognition of their energy efficiency efforts. Here it is recommended that some type of formal award scheme could be instituted which entails an element of celebration and congratulation as well as the obvious rewards of the savings in energy costs. Such a scheme – which could mirror the Energy Efficiency Accreditation Scheme operated in the UK by the Carbon Trust and accredited by the Energy Institute – will be valuable in both rewarding energy efficient organisations and providing an independent corroboration of their energy efficient practices.

1.7 Other factors influencing the effectiveness of a Best Practice Programme

It should be noted that all the elements outlined in the template as possible components of a BPP rely on the willing participation of the organisations being targeted. However there are other means of ensuring energy management practices are adopted whether through some element of ‘carrot’ or ‘stick’. These can include:

- regulations and standards – such as Canada’s Energy Efficiency Regulations
- fiscal policies – taxes, tax rebates, investment tax credits and the use of specific investment bank lending criteria
- agreements and targets – typically voluntary but can be tied to achievement of specific goals or emissions reductions eg CIPEC and the UK’s Energy Efficiency BPP.

On the other side of the financial coin, it is worth considering how much the programme wishing to invest in R&D in order to meet its objectives. R&D can fulfil a number of functions, not only pure research and development in technical progress but also improvements aimed at reducing costs of a new technology and exploring and alleviating the barriers to implementation of a technology.

2 Methodology for the in-country development of these resources

The DME should ideally start by doing its own benchmark exercise in asking the following questions:

- What level of awareness of energy efficiency already exists in industry?
- Who are the energy efficiency experts and how many of them are there?
- Is there a need to build the capacity of experts/consultants in this field?
- What energy efficient technologies are already in place and which are most needed?
- What are the major energy-using industries?
- What training in energy management is currently available and what further development is needed?

The next step is to set up the stakeholder workshops which must include industry, energy experts, technology providers, trainers and a co-ordinating authority (DME appointed) to take responsibility for publicising results and disseminating information effectively. From the workshops it is necessary to identify companies willing to act as pilot schemes for audit and benchmarking as well as undertaking energy management practices ie putting in place an organisational plan, training relevant staff, using experts to undertake surveys and energy assessments, implement improvements and, ultimately, produce case studies.

Organisations may need some form of inducement to take on such a role and the lure of cost savings alone may not be sufficient. The key is to identify the decision drivers for each organisation. For example, those with a high customer profile may opt in for environmental reasons to show their CSR credentials. For others the offer of free or reduced cost access to professional energy use experts may be a key motivator.

It is recommended that existing resources are used where possible and adapted to suit local requirements eg the Energy Management Matrix in Appendix A. The reference list at the end of this paper should provide sufficient sources of standard tools and good practice guides etc.

However it is important that components such as case studies particularly, are local as this will give more meaning to the organisations using them as an aid to their own efforts or simply to persuade them into action. Other important sources may include telephone helplines, fact sheets, online ‘Wizards’, tailored action plans and other items already identified earlier in this paper.

Resources both internal and external to South Africa may be required for elements of the energy expertise and the training (as partly already identified through this project), particularly if such expertise has been limited in number or scope until now.

2.1 Industrial Energy Management Training and the BPP

Some of the questions posed at the beginning of this section have, in fact, been answered already by DME. These relate to the need for capacity building in industry and in the service provider community. In response to the perceived needs, two training courses have been developed and are in the process of being implemented; they are:

- The Industrial Energy Management Training Course (IEMTC);
- The Industrial Energy Auditing Course (IEAC) being developed and implemented in concert with the Canada-funded CBLA Project.

2.2 The IEMTC

The IEMTC addresses several of the key elements of successful BP programmes identified in this document, including:

- Organisational assessment using the Energy Management Matrix;
- Strategic approach to implementation of energy management;
- Methodology for energy assessment and comparative analysis to internal and external benchmarks;

Energy monitoring and targeting (M&T).

It is important to note that the key components of the national industrial energy management strategy articulated by DME align with these elements as well. In particular, M&T is potentially the critical foundational activity upon which the BPP can be built.

The IEMTC provides an introduction to M&T, and further in-depth training to develop a working knowledge could—and, we suggest, should—be developed.

Similarly, the Energy Management Matrix and the subsidiary matrices described in UK Best Practice Guide 306—or versions of them—are foundational tools that serve the purpose of both assessing organisational capacity, and providing a basis for the planning and prioritisation of implementation actions. Again, the IEMTC introduces this strategic planning model, and further in-depth training could be developed.

2.3 The IEAC

Standard methods for industrial energy auditing, and the developed of qualified service providers, are also identified as essential elements of the BPP. The CBLA Project has developed the Industrial Energy Auditing Course to develop auditing capacity in the context of a practical, comprehensive auditing methodology, based in part on methods articulated in Canada.

2.4 Other Training

Technical training that focuses on energy-consuming systems and the efficiency principles that apply to them is available in South Africa. In large measure, the “market-based” training is a product of the SADC Industrial Energy Management Project—a Canada-funded initiative that concluded its work two or three years ago. The so-called “Core Training Programme” has been taken up by various training providers in South Africa.

Other related training is undoubtedly available through South Africa’s educational institutions.

A key need that should be addressed by DME is the coordination of the various training programmes that exist into a cohesive whole such that the capacity building needs of all stakeholders—energy end-users, service providers, utilities, and so on—can be met.

3 Advice on Industry sub-sectors to target

The industries of South Africa are best placed to advise on which sub-sectors are either most in need of an energy management BPP or would produce the 'best' results. Much will depend on the early objectives of the programme – is it to make 'quick wins' or is it to focus on long-term investment? Generally a programme that shows rapid returns for little or no effort will attract the attention of other potential users and will be more effective in getting industry involved in the planning and target-setting process. However, if sufficiently funded, a scheme that encourages long-term investment and longer-term, more substantial goals may gain more serious commitment.

The CIA World Factbook notes that South Africa lacks major arterial rivers and lakes in sufficient number so water conservation is a key issue. Water is often closely linked to energy use so any industry using large amounts of both should be targeted.

Major industry sectors (according to the CIA World Factbook) are mining (world's largest producer of platinum, gold, chromium), automobile assembly, metalworking, machinery, textile, iron and steel, chemicals, fertilizer and foodstuffs so these would be good-sized industries to target. Any trade associations supporting these industries are likely to be well placed to assist in the planning process and the dissemination of information about the programme and will become key partners in persuading their member organisations to become involved. As well as key industry sectors in the South African economy, it may also be worth analysing major import and export industries in order to strengthen local competitiveness and/or reduce reliance on imports.

It is certainly worth bearing in mind where the highest level of energy savings have been made in industries around the world and where there is therefore an existing pool of expertise and information resource. Examples here from UK, Canada, US, Australia, Norway and others would include construction industry materials such as concrete production, glass making, ceramics, baking and food processing, dairies, beverage manufacture, pulp, paper and packaging.

4 References

CIA World Factbook

www.cia.gov/cia/publications/factbook/geos/sf.html

Implementing an energy efficiency programme by Marion Beaver

www.realbusiness.co.uk/showdetail.asp?ArticleID=1784

Fundamental Series – Energy Audits by Bill Younger
www.energyusernews.com/CDA/Article_Information/Fundamentals_Item/0,2637,6421,00.html

The Carbon Trust

www.thecarbontrust.co.uk

Canadian Industry Program for Energy Conservation (CIPEC) – resources

http://oee.nrcan.gc.ca/cipec/ieep/index.cfm

CIPEC Energy Managers Network

http://oee.nrcan.gc.ca/cipec/ieep/learnmore.cfm?Text=N

Canada GHG Registries (formerly VCR Inc.)

http://www.ghgregistries.ca/

US Energy Star program

www.energystar.gov

California Energy Commission – resources

www.energy.ca.gov/process/industry/index.html

US Department of Energy – Energy Efficiency and Renewable Energy – industry topics and resources

www.eere.energy.gov/EE/industry.html

Appendix A – Example of an Energy Management Matrix

The Energy Management Matrix provides an effective way to gain insight into a company's current approach to energy matters. It can then be used regularly to simplify efforts to identify important energy saving activities that can improve the energy efficiency of your company.

Each column of the Matrix deals with one of six crucial energy management issues: energy management policy; organising; staff motivation; tracking, monitoring and reporting systems; staff awareness/training and promotion; and investment. The ascending rows, from 0 to 4, represent the increasingly sophisticated nature of these issues.

Level	Energy management policy	Organising	Staff motivation	Tracking, monitoring and reporting systems	Staff awareness/ training and promotion	Investment
4	Energy management policy, action plan and regular review have commitment of top management as part of a corporate strategy. Energy management fully integrated into management structure.	Clear delegation of responsibility for energy consumption.	Formal and informal channels of communication regularly exploited by energy manager and energy staff at all levels.	Comprehensive system sets targets, monitors consumption, identifies faults, quantifies savings and provides budget tracking.	Marketing the value of energy efficiency and the performance of energy management both within the organisation and outside it.	Positive discrimination in favour of energy saving schemes with detailed investment appraisal of all new building, equipment and refurbishing opportunities.
3	Formal energy management policy, but no active commitment from top management.	Energy manager accountable to energy committee representing all users, chaired by a member of the managing board.	Energy committee used as main channel together with direct contact with major users.	Monitoring and targeting reports for individual premises based on submetering, but savings not reported effectively to users.	Program of staff training, awareness and regular publicity campaigns. Some payback criteria employed as for all other investment.	Cursory appraisal of new building, equipment and refurbishment opportunities.

2	Unadopted energy management policy set by energy manager or senior departmental manager.	Energy manager in post, reporting to ad-hoc committee, but line management and authority unclear.	Contact with major users through ad hoc committee chaired by senior departmental manager.	Monitoring and targeting reports based on supply meter data.	Energy unit has ad hoc involvement in budget setting. Some ad-hoc staff awareness and training.	Investment using short-term payback criteria only.
1	An unwritten set of guidelines. Energy management the part-time responsibility of someone with only limited authority and influence.	Informal contacts between energy manager and a few users.	Cost reporting based on invoice data.	Energy manager compiles reports for internal use within technical department.	Informal contacts used to promote energy efficiency.	Only low-cost measures taken.
0	No explicit policy. No energy manager or any formal delegation of responsibility for energy consumption.	No contact with users.	No information system.	No accounting for energy consumption.	No promotion of energy efficiency.	No investment in increasing energy efficiency in premises/sites.
Based on BRECSU 1993 Energy Management Matrix..						

The aim should be to move up through the levels towards current best practice and, in doing so, develop an even balance across all columns.

Level 0

Energy management is not on the organisation's agenda. There is no energy management policy, no formal energy management structure, no means of reporting, and no specific person in charge of energy use.

Level 1

Small steps towards energy management. While there is no official energy management policy, an energy manager has been appointed. The energy manager promotes an awareness of energy matters via a loose network of informal contacts with those directly responsible for energy consumption. This person also responds to requests for advice on an ad-hoc basis.

Level 2

Energy management is acknowledged as important by senior management but, in practice, there is little active commitment or support for energy management activities.

Level 3

Senior managers acknowledge the value of an energy reduction program. Energy consumption issues are therefore integrated into the organisation's structure. There is a comprehensive information system and established system of reporting. There is also an agreed system for energy management and investing in energy efficiency.

Level 4

Energy consumption is a major priority throughout the organisation. Actual performance is monitored against targets and the benefits of energy efficiency measures calculated. Achievements in energy management are well reported and energy consumption is related to its impact on wider environmental issues. Senior management is committed to energy efficiency.

How to use the Energy Management Matrix

Consider each column individually. Place a mark in each column that best describes where the company is currently located (this can be within or between cells). Join the marks across the columns. This will describe the organisation's approach to energy management, and provide an overall indication of how well balanced energy management is within the organisation.

The peaks represent where current effort is most sophisticated. The troughs indicate where the company is least advanced. Don't be concerned if the 'line' is uneven; this is not unusual and is the case in most organisations.

The Matrix will identify those aspects where some further attention is required to ensure energy management is developed in a rounded, effective way. It will also assist in organising an energy management system.

Appendix B – Some standard testing and auditing methods from the US

Energy Use Index

The Energy Use Index (EUI) is used in the buildings sector, rather than industry; it is expressed in British Thermal Units/square foot/year (BTU/ft2/yr) and can be used to compare energy consumption to similar building types or to track consumption from year to year in the same building. The EUI is calculated by converting annual consumption of all fuels to BTUs, then dividing by the area (gross square footage) of the building. EUI is a good indicator of the relative potential for energy savings. A comparatively low EUI indicates less potential for large energy savings.

By tracking the EUI using a rolling 12-month block, building performance can be evaluated based on increasing or decreasing energy use trends. This method requires a minimum of two years of energy consumption data to establish the trend line.

To calculate BTUs and cost per square foot, the heated (or cooled) area to be calculated must be determined for each building. Blueprints can be used to obtain the dimensions of each floor, or the outside of the building (gross area) can be measured. The total building area is found by multiplying this area by the number of floors. Basement areas and mechanical rooms are not usually included as conditioned areas.

Load Factor

Evaluating use (kilowatt-hours [kWh]), power (kilowatts [kW]), and power factor charges separately can be useful in evaluating the impact of demand and power factor penalties on the monthly electric bill. Rescheduling or alternating run times of larger equipment can lower demand costs. Power factor correction devices can have paybacks of less than two years. Although demand and power factor correction measures save little energy, the significant cost savings and relatively short payback periods make them attractive in the audit analysis.

There is a difference between billing and actual demand on the utility bill. Actual demand is the value registered on the meter and should be used to evaluate power requirements and load factor for the facility. Billing demand is the amount of demand for which the facility is billed. Rate schedules that include a ratchet clause, power factor adjustment, or first block of kW at no charge can cause billing and actual demand to differ.

Load factor (LF) is the relationship between electric use (kWh) and demand (kW). LF is commonly calculated by dividing the monthly electric use by the demand by the number of hours in the billing period. This gives a ratio of average demand to peak demand and is a good indicator of the cost savings potential of shifting some electric loads to off-peak hours to reduce overall demand.

The theoretical maximum load factor for a facility that consumes electricity at a steady rate at the highest demand registered on the demand meter is 1 (one). An LF of 1 indicates that there is no variation in consumption or time of day peaks in demand. Most facilities don't operate 24 hours a day, so load factors will normally be considerably lower than the theoretical maximum. For facilities with high load factors, the only way to reduce demand is by installing more efficient electrical equipment.

A low load factor is a good indication that a facility has demand peaks at some time in the billing period. The causes of these demand peaks need to be identified and controlled.

Operation of nonessential equipment can be restricted during peak demand periods and rescheduled for operation during off peak hours. Many energy management control systems (EMCS) have demand limiting and load shedding capabilities that can help maintain acceptable load factors. The important thing is to monitor the load factor and establish what is normal for each facility, noting any significant changes in the electric use consumption and load factor.

Appendix C – Features of a good case study

- It should be capable of being replicated, ie it should be in a relatively mainstream technology and industry sector, for example refrigeration in the food processing industry, to enable its value to be immediately identifiable.
- It should demonstrate good metrics ie energy costs before and after, energy and cost savings made, payback times.
- It should identify the sources of assistance received eg expertise, training for staff, supporting materials, and where further information can be found eg good practice guides and information on financial assistance etc.
- It should demonstrate ongoing value ie not a one-off exercise but the start of further savings in the future.
- It should clearly demonstrate the value of the partnerships created eg with energy consultants and other stakeholders.
- Initial case studies should show examples of low/no cost measures that are easy to implement as examples of first stage savings.
- A mixture of both large household names and SMEs is important in the case studies.
- Ideally the views of the participating company should be included by way of feedback on how the project went.

Template of a case study

Technology/energy management feature and industry sector

Name of company
- what it does and where it is located

Size of company including
- size of premises
- key activities relevant to the subject of the case study
- relevant energy costs prior to project
- turnover and staff numbers

Identification of problem or project opportunity

Solutions considered and their relative costs/benefits

How decision reached – the financial case including costs, savings and payback

Implementation of the plan – including sources of advice, funding, manufacturers and suppliers

Outcomes

Example of a short Case Study from the Carbon Trust, UK

DHL Aviation Ltd
DHL is the world's largest and most experienced international air express network, with a service reaching 120,000 destinations in more than 220 countries worldwide.

DHL's main UK hub is located at East Midlands Airport and has been certified to the environmental management standard ISO 14001 since 2000. However senior management decided to take further action on energy use and target additional energy savings within their commercial offices. They contacted the Carbon Trust and arranged a two-day site survey, leading to a report for DHL identifying opportunities for energy savings.

DHL managed to reduce their electricity consumption by more than 20% (a saving of over £120,000) and reduced their gas consumption by 42%. DHL adopted the energy saving recommendations from the Carbon Trust and appointed a management energy champion to look at how DHL could save energy throughout their UK offices. Danny Pedri, General Manager of DHL Aviation commented:

"The energy savings we achieved are substantial and the whole process has been very successful - so much so that we are having a further visit from a Carbon Trust consultant. Working with the Carbon Trust has been extremely beneficial and we would recommend other companies to follow suit."