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MARK THROWER MANAGING EDITOR

MODULE TWO

FIRST STEPS IN ENERGY MANAGEMENT

Taking the first steps into energy management

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Energy Management is a relatively new profession. We have always made use of the renewable energy available in our environment – primarily in the form of heat and light from the sun, until early man harnessed energy from wood and other biomass sources millennia ago when discovering fire and how to create and control it. The formal scientific basis of energy management can be traced back to the ancients, but significant steps in establishing thermodynamics as a separate area of study were made in the 17th Century through von Guericke's work on vacuum pumps. In the 18th Century Swedish astronomer Anders Celsius introduced the celsius/centigrade temperature scale, which was further developed in the mid 19th Century by Lord Kelvin to form the kelvin temperature scale. This established 0K (or -273.16˚C) as absolute zero, the minimum temperature that can occur in nature. The abundance of energy from water power - and later from steam power derived from burning coal - were key driving forces in the industrial revolution. The French physicist Carnot developed formulae and methods for defining and improving the efficiency of steam engines, including the Carnot heat engine. His contemporary, Lord Kelvin, identified the laws of thermodynamics and, along with many other contributors, observations and laws relating to the generation, transmission and use of electricity.

While these developments required major advances in science and engineering, energy management could not been seen to exist as a coherent profession until the case for controlling energy consumption, costs in buildings and industry was made.

Lord Kelvin's quote relating to the importance of measurement

"If you can measure that of which you speak and can express it by a number, you know something of your subject; but if you cannot measure it, your knowledge is meagre and unsatisfactory" has been paraphrased in many areas of performance management in the 20th and 21st Century as "If you can't measure it, you can't manage it". The essence of this statement is that the first key step in an organisation's management of any consumable supplies or utilities is to know how much of it they are using.

Managing its energy use is not the core business of the vast majority of organisations. However, improving the efficiency with which energy is used is an invasive process that cuts across all activities, locations and departments. There are many stakeholders that influence how much energy an organisation uses and if their support is not gained, it is unrealistic for the person responsible for the day to day management of energy use to expect to have more than a periphery impact upon energy costs.

"The most important single ingredient for successful implementation and operation of an energy management program is commitment to the program by top management."1

Committed management

Where the senior management team is committed to the energy management programme, it can bring its influence to bear upon all stakeholders, raising the status of energy management objectives to that of other key business objectives.

The energy manager role is a highly diverse one, varying considerably between different organisations – even within the same sector. Energy management is predominantly an engineering profession, with many chartered engineers with energy engineering, building services or process engineering degrees. However, there are also significant financial, management and communication elements to the role and many energy managers come from

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environmental science and management system backgrounds.

An important element of the energy manager's role is to seek the support of top management and to maintain this support. This could affect the content and presentation of the energy management programme. It is also important to take account of cycles, corporate governance committee meetings for large projects or significant changes to ways of working.

Where senior management is motivated to compare the energy performance of the facility to its competitors' facilities, energy benchmarking has an important role to play in securing senior management support. For small sites a single meter on the incoming electricity supply may suffice. However, in the majority of instances, considerable benefit is derived from separately metering all major energy users. In office buildings this would typically include sub-meters for heating boilers, water heaters, lighting, ventilation, computer servers and their air conditioning.

Once the quantity of energy consumed is known, it is essential to establish a means of judging whether it is appropriate. Is too much energy being used, or is it about right? Energy benchmarking is the process of comparing actual energy consumption to an expected norm. The norm may simply be comparison to the previous year's consumption in the previous year, or period, taking account of changes in 'independent variables' such as weather conditions in building energy use and production output for manufacturing applications. However, it can be useful to compare an organisation or its building's energy use with those of others of similar type and use.

Providing they have access to the appropriate metering, building area and production output data, the energy manager can develop benchmarks and league tables for both internal and external comparison. If energy consumption is significantly higher than benchmarks, or other expected values, this should be communicated with senior management and an approach developed to address it.

Good quality energy data and clear communication on its significance are essential for securing senior management support. It is important to note that for many organisations the cost of building energy use may only be 5 per cent or less of total operating costs, or turnover. For large public sector organisations this may be the equivalent to the salaries of many key workers, such as nurses in hospitals and teachers in schools. In the private sector 5 per cent of turnover could be of a similar order to a company's profit margin. In a modest 1 per cent reduction in a company's costs may not appear to be very interesting, but an alternative way of expressing it is that a 20 per cent reduction in energy use could increase profits by a fifth.

Allocation of energy costs to departments, production lines and other cost centres can help to incentivise good energy management practices. This will typically devolve energy management from the central or corporate level to the local or departmental level. However, the benefits and challenges should be considered on a case-by-case basis as there are circumstances where devolving energy budgets does not have the desired impact. The approach typically depends upon the devolved budgets also having sufficient capital and personnel resource to identify viable ECMs and invest in them. Where these resources are not in place, the likelihood of success may be diminished.

Produce policy statement

A good next step for energy management is to produce an energy policy statement, signed by top management. This is usually a simple statement of intent to monitor energy use, set targets to reduce it and to provide financial and personnel resources to support the achievement of the targets. Targets should be achievable, but challenging. The target should be expressed as a per cent or absolute value against a baseline year's energy consumption or carbon emissions. The energy policy statement could be of the order of a page in length, allowing it to be widely distributed and displayed. It is essential that the energy policy statement be produced in consultation with senior management – or even to be authored by them, with an input and advice from the energy manager. Senior management's ownership of the energy policy is an indicator of a likelihood of continued commitment to it in the future.

It is not possible for one person to have all of the skills necessary to design, implement and manage an energy management programme in large or complex organisations. The energy manager must therefore be supported by both internal and external personnel resources – commensurate with the size of the energy bill. For example, in manufacturing environments, the energy manager may have insufficient in-depth knowledge and experience of the manufacturing processes to be able to determine how conditions can be altered to improve both production outcomes and energy performance. The input of a production manager is likely to be essential to identifying an appropriate set of energy conservation measures (ECMs) and successfully implementing them. In organisations with predominance of building energy use, rather than process energy use, the knowledge of maintenance and facilities management managers could be critical to the success of an energy management programme. Where complex approaches to delivery of ECMs are being considered it is likely that external advisors will be required. This may include energy consultants, technology specialists (e.g. for renewable energy technologies, such as photovoltaic (PV) arrays), procurement professionals and lawyers.

Any plan to implement measures to achieve the targets stated in an energy policy should be proportionate to the value that will be derived and the personnel resource available.

The identification of ECMs is a specialist task that usually falls within the skill set of the energy manager. Nonetheless, it is not uncommon for consultants to be employed to carry out energy audits and to develop a register of ECMs.

Starting an energy management programme requires 'putting your best foot forward'. As employees' and other stakeholders' support will be required for an energy management programme to be successful, it is worthwhile publicising the development and start of a programme. The programme should be carefully devised – ideally including staff consultation before it is finalised. The start of the programme could be accompanied by a launch event with internal publicity and - subject to the scale and profile of the programme and organisation – local media outlets. It is important that senior management take a high profile in the process of launching a new energy management programme and their commitment to it is clearly and widely communicated. While senior management's commitment is critical to the success of the programme, it is equally important that the staff are aware of this commitment.

Support other objectives

The choice of ECM projects to feature in the launch process to be implemented will initially affect people's response to the programme. ECMs that support other core business objectives and avoid controversial actions are ideal. Hence reducing energy waste by replacing old equipment with new will usually be better received than switching off heating, turning down lights or reducing fresh air supply rates.

The majority of ECMs can generally be implemented in the same way as conventional refurbishment construction projects. A generic construction contractor may employ specialist sub-contractors for specialist works such as combined heat and power (CHP) and low and zero carbon (LZC) technologies.

Guaranteed energy savings and energy performance contracts (EnPCs) are increasingly in popularity in the UK. They can offer considerable advantages – particularly to organisations that would prefer to fund improvements

in energy performance through future energy cost savings rather than paying upfront. However, they can be both conceptually and contractually complex and there are subtle differences between the many approaches currently on offer. Although it has been in existence for decades, it is still a maturing market and generic construction contractors do not typically have experience of working on a guaranteed energy savings basis. Depending upon how the work is procured, the lack of sector experience can impact upon the competitiveness of bids to carry out work under this form of contract. It is an area where specialist advice is important to ensure that the appropriate procurement route and form of contract are applied.

Investments in ECMs often face more stringent financial criteria than those in core business activities, such as the case for starting a new course in a University, or purchasing new production equipment in a factory. Furthermore, the burden of proof, extent and detail of the business case is usually greater for ECMs than for other investments of similar scale. This may in part be influenced by ECMs achieving reductions in outgoings rather than generating an income. Nonetheless, they typically provide greater returns on investment than standard financial products such as savings accounts and pension funds.

Simple payback period

It is not unusual for organisations to set a simple payback period criterion of three years for ECMs. This means that the capital expended on the ECM should be repaid by the energy cost savings within three years. This represents a 33 per cent internal rate of return, which is of the order of ten times the value that can be achieved in a savings account – and higher than the rate of interest that would be charged for a commercial loan to invest in ECMs. While these barriers of financial criterion and appraisal methods are widespread, they cannot be considered to be best practice. The cost and personnel resource required to make the financial case for straightforward ECMs can be prohibitive and present real barriers to their implementation. These barriers are eliminated and improvement in energy performance is accelerated where senior management supports the financial appraisal being made at a whole estate level. It is also accelerated if Senior Management takes the policy decision to implement ECMs that have been screened in this manner in its facilities without the need for bespoke business cases for each standard installation.

The management system approach can be applied to the improvement of organisational energy performance. Management systems were first developed in an industrial context to improve the quality of manufactured goods. The approach follows a Plan-Do-Check-Act cycle that is intended to lead to continuous improvement in quality outcomes. The International Standards Organisation's (ISO) quality management system energy ISO 9001 is a widely used quality management system that is applied in the majority of countries across the globe. ISO subsequently developed an Environmental Management System (EMS), which has been in use for decades. It is intended to help organisations to manage and improve their environmental performance. For many organisations energy use represents their greatest environmental impact, but energy is seen as just one of many aspects to be managed under ISO 14001. The British Standards Institute developed an Energy Management System (EnMS) BSI 16001, which it has subsequently replaced with ISO 50001, a later, similar standard that BSI, along with other standards organisations and stakeholders helped the ISO to develop.

A formal management system, such as ISO 50001 can help companies make enormous strides forwards in their energy performance. However, for the smallest enterprises with limited personnel resources and very small energy bills of hundreds of pounds per year, there may be little scope for developing a full energy management system approach. Nonetheless, for organisations in these circumstances, the first steps of good quality data and reporting and senior management commitment expressed in an energy policy remain equally important.

Establishing an EnMS is not to be taken lightly. While the benefits are reliable, the personnel resources are not to be underestimated and without senior management commitment, it is no more likely to achieve ambitious targets than a less formal approach. However, for companies and public bodies that embark on this approach, a further consideration is whether or not to have their management system scrutinised by an independent, external third party. This step formalises the EnMS and allows the organisation to register it as externally verified. This is a significant aid to the organisation's ability to communicate its energy and environmental credentials to its stakeholders and, subject to the organisation and the energy cost savings being of sufficient scale to justify external verification costs, once an EnMS approach has been embarked upon, the cost and effort of third party verification is usually worthwhile.

Four steps to energy efficiency success

Plan

A Board level representative should have responsibility the development of the EnMS, The policy should be communicated to all staff in the organisation – and particularly those that manage major energy using equipment and services. An energy management team should be established to achieve these. They will also have responsibility for identifying ECMs.

Do

The objectives and targets stated in the Energy Policy should form the basis of the development of a programme to improve energy performance. This should include procedures and work instructions for activities that will save energy. Day to day operation of the policy and management system should be led by the Energy Manager, with a team commensurate with the size of the organisation and its energy spend.

Check

A process of internal audits should be carried out to check whether or not the EnMS is operating according to plan. Compliance with energy legislation, industry standards, customer requirements and other formal aspirations are important drivers for an EnMS and the internal audits should prioritise these areas, whilst ensuring that energy performance improvement targets are met.

Act

A management review should be carried out annually to ensure that audit findings have been acted upon and that the EnMS is adapted to meet any unforeseen circumstances and continues to achieve improvements in energy performance. Where appropriate the energy policy, programme and procedures should be modified to support the continuous improvement ambition.

Refgerences

1. Guide to Energy Management", 7th Edition, The Fairmount Press, 2012 Barney L Capehart, Wayne C Turner, William J Kennedy

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ENTRY FORM

First Steps in Energy Management

Please mark your answers on the sheet below by placing a cross in the box next to the correct answer. Only mark one box for each question. You may find it helpful to mark the answers in pencil first before filling in the final answers in ink. Once you have completed the answer sheet in ink, return it to the address below. Photocopies are acceptable.

QUESTIONS

Q 1. What is the Celsius scale?
- ☐ Temperature
- ☐ Pressure
- ☐ Weight
- ☐ Astronomical units

Q 2. Which scale has 'absolute zero' as its minimum point?
- ☐ Celsius
- ☐ Kelvin
- ☐ Guericke
- ☐ Carnot

Q 3. How important is top management commitment to the success of an energy management programme?
- ☐ Critical
- ☐ Moderate
- ☐ Low
- ☐ Irrelevant

Q 4. Which current standard address Energy Management Systems (EnMS)
- ☐ BS 16001
- ☐ ISO 14001
- ☐ ISO 9001
- ☐ ISO 50001

Q 5. What type of management system does ISO 9001 address?
- ☐ Environmental Management
- ☐ Energy Management
- ☐ Quality Management
- ☐ Calibration & Comparative Checking

Q 6. Which step should come first:
- ☐ Energy Policy Statement
- ☐ Starting an Energy Management Programme
- ☐ Starting a Staff Energy Awareness & Motivation Campaign
- ☐ Third Party Verification of Energy Savings

Q 7. Who should sign the energy policy statement?
- ☐ Energy Manager
- ☐ Environmental Manager
- ☐ Quality Manager
- ☐ Managing Director

Q 8. What internal rate of return is commonly achieved by investments in ECMs capable of achieving a 15 per cent reduction in energy use?
- ☐ 4.8 per cent
- ☐ 8.4 per cent
- ☐ 48 per cent
- ☐ 84 per cent

Q 9. What is a Carnot Heat Engine
- ☐ A theoretical model for peak efficiency in steam production and use
- ☐ A coal-fired traction engine
- ☐ A water-power manufacturing process
- ☐ An early means of electricity generation

Q 10. Which of the following is the well know management system cycle for continuous improvement?
- ☐ Plan-Measure-Manage-Review
- ☐ Plan-Do-Check-Act
- ☐ Measure-Manage-Check-Act
- ☐ Act-Manage-Measure-Plan

Please complete your details below in block capitals

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