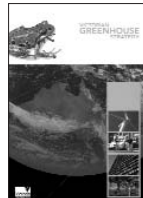


MODULE 4
DEVELOPING AN ENERGY
MANAGEMENT SYSTEM



The *Energy and greenhouse management toolkit* is a Victorian Government initiative developed in partnership by EPA Victoria and the Sustainable Energy Authority Victoria, and funded through the Victorian Greenhouse Strategy.

EPA Victoria

EPA is a Victorian State Government statutory authority established to enable the safe clean and sustainable environment that Victorians seek. Based on a philosophy that prevention is better than cure, EPA Victoria takes an integrated approach to delivering its mission by providing environmental leadership, promoting public awareness and working with all sectors of the community. It also provides best practice guidelines and standards, together with regulation and policing where required.

For further information visit www.epa.vic.gov.au

Sustainable Energy Authority Victoria

The Sustainable Energy Authority Victoria (SEAV) is a State Government statutory authority. SEAV's objective is to accelerate progress towards a sustainable energy future by bringing together the best available knowledge and expertise to develop leading-edge initiatives which provide Victorians with greater choice in how they can take action to significantly improve energy sustainability.

For further information visit www.seav.vic.gov.au

Victorian Greenhouse Strategy (VGS)

Climate change is an issue which impacts on the whole community, including individuals, business and all levels of government. If a truly sustainable solution is to be achieved, all members of the community must play their part. The VGS will facilitate the establishment of partnerships, and build capacity throughout the community for greenhouse action. The development of the VGS has benefited from extensive public consultation and is a significant first step on the long road to addressing the threat of climate change.

For further information visit www.greenhouse.vic.gov.au or call the Department of Natural Resources and Environment Customer Service Centre on 136 186.

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Energy and greenhouse management toolkit



Module 1
Overview



Module 2
How to comply with the SEPP (AQM) energy and greenhouse requirements



Module 3
Calculating energy use and greenhouse emissions



Module 4
Developing an energy management system



Module 5
Best practice design, technology and management



Module 6
Cost effective and feasibility analysis



Module 7
Where to get help



CDs
Energy Smart Tracker
Green Power business guide

Introduction

Responsible use of valuable energy resources of coal, oil and gas is critical in our commitment to the environment. The enhanced greenhouse effect is now seen as a key environmental issue on a national and international level. Energy efficiency is therefore seen as a primary means to reduce the emission of greenhouse gases.

Businesses can benefit significantly by moving towards energy management practices. Effective energy management does more than reduce costs and increase profitability; it can drive the whole business to improved performance through its effect on production, operations, maintenance and environmental issues.

Energy management can be incorporated into existing business systems to provide an integrated approach to business sustainability. It is strongly recommended that, where practicable, energy management be incorporated into safety, quality (including ISO 9000) or environmental management systems (including ISO 14001).

This module is designed to be used either as a guide to developing and implementing a tailored energy management system for your organisation, or as a resource to evaluate how your existing systems are faring in relation to energy.

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.

Table 1: Energy Management Matrix

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 sub-metering, 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.

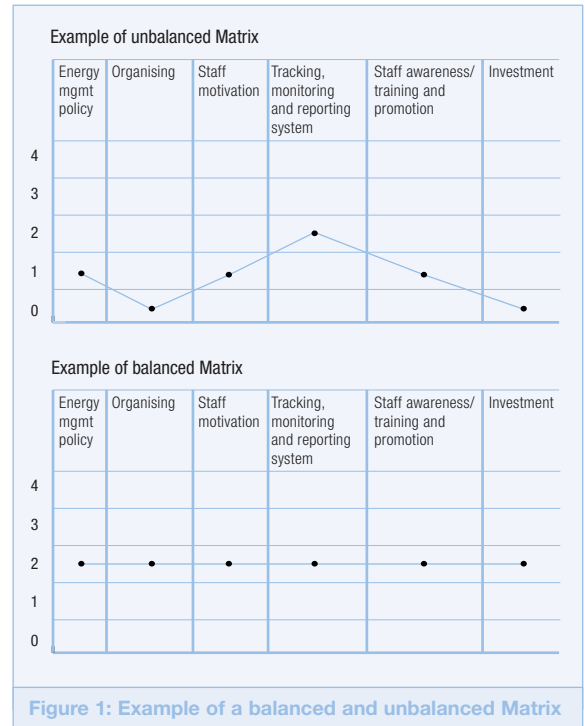
LEVEL 4

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 (see Figure 1).



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.

Energy management system overview

An energy management system comprises a set of well-planned actions aimed at reducing a company's energy bills and increasing productivity. Energy management is a process of continuous improvement and is more effective when its policies and procedures are reviewed annually.

When commencing a structured approach to energy management, experience shows there is a clear sequence of events that brings the best results. Any organisation, whether introducing energy management for the first time or upgrading its existing efforts, needs to be aware of this and adapt its activities accordingly.

ORGANISE MANAGEMENT RESOURCES

Once commitment from senior management is achieved, establish a clear accountability for energy management with appropriate allocation of financial and staffing resources as well as reporting procedures.

APPOINT AN ENERGY MANAGER AND IMPLEMENTATION TEAM

An energy manager is responsible for the overall coordination of the strategy and reports directly to senior management. An enthusiastic team of people to assist the energy manager with implementation of the energy management system will also need to be appointed.

PREPARE A CORPORATE ENERGY MANAGEMENT POLICY WHICH INDICATES ENERGY REDUCTION TARGETS

An energy management policy will include general aims and specific energy cost reduction targets, timetables and budgetary limits, the methods to be employed and the organisation of management resources.

ESTABLISH AN ENERGY USE MONITORING AND REPORTING SYSTEM

A system should be established to collect, analyse and report on your organisation's energy costs, consumption and where energy is used.

IDENTIFY ENERGY SAVING OPPORTUNITIES THROUGH AN ENERGY AUDIT

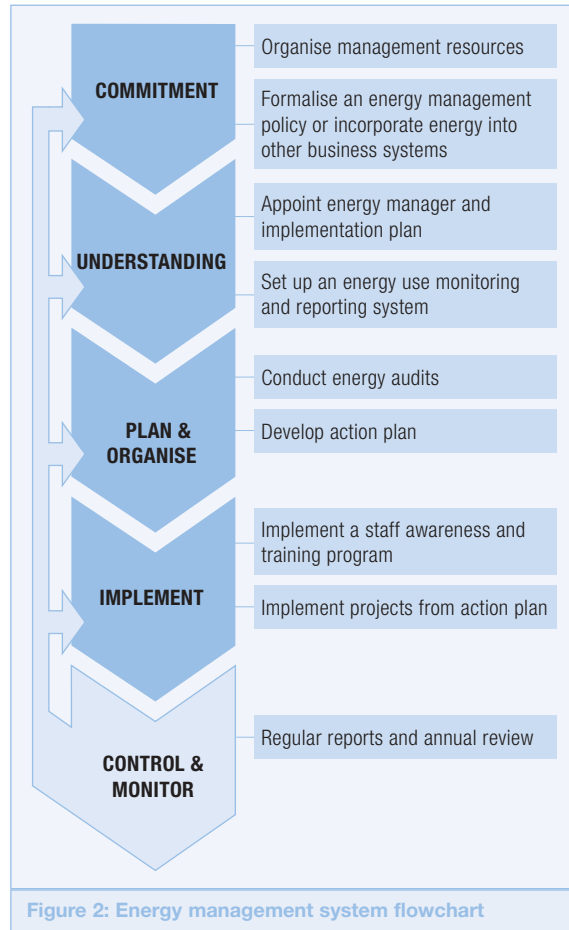
An energy audit establishes where and how energy is being used, and the potential for energy and cost savings. An audit will include recommendations for actions that result in energy and cost savings.

PREPARE A DETAILED ACTION PLAN BASED ON AUDIT FINDINGS AND BUDGETS

The targets for energy savings need to relate to specific areas of your organisation and the action plan should include a project implementation timeline and state any funding and budgetary requirements.

IMPLEMENT A STAFF AWARENESS AND TRAINING PROGRAM

A high level of staff awareness is needed for an energy management system to succeed. Many ideas and



solutions come from staff, so it is important to provide opportunities for their input. Staff may need training in energy saving practices and use of equipment.

IMPLEMENT PROJECTS

Implement the projects in order of priority as set out in the action plan. The progress of individual projects will need to be closely monitored to ensure they stay within budget and achieve the energy target within the specified timeframe.

REPORT AND REVIEW RESULTS

Review energy consumption regularly. Report results and progress to management and staff on a regular basis.

ANNUAL REVIEW

An energy management strategy will be more effective if its results are reviewed annually and the action plan revised. The review should at least detail actions undertaken during the year and projects and implementation plans for the next 12 months.

Organise management resources

Once senior management has made a commitment to energy management it is important to define and document all roles, responsibilities, authorities and the interrelating functions that affect the energy performance of the company, as well as the appropriate allocation of financial and staffing resources.

Demonstrated top-down support is an important part of changing attitudes and operating practices. Management commitment, and the appointment of an energy manager, are the first steps to improving the energy performance of a company.

Energy manager

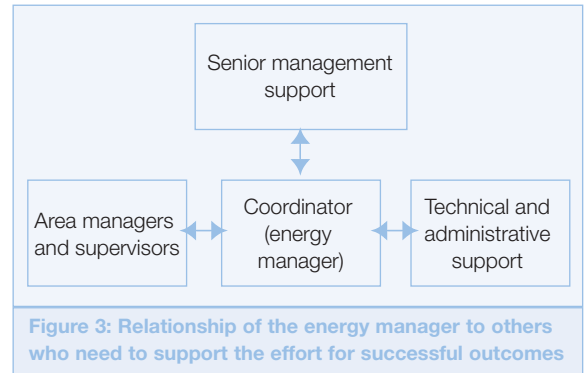
An energy manager's role is to manage both the company's current energy needs and its future energy strategy in an environment where supply and price fluctuations can have a significant impact on business performance. In general terms, an energy manager is part strategist, part project manager and part change manager. They will be able to focus both on the technical aspects of their work, and on issues of communication and involvement.

The energy manager will be someone who is interested in new developments, and who will want to assess and test new ideas and new ways of solving problems. They will also be someone who can plan and take a long-term view, especially as savings accrue in both long and short timeframes. They should be good communicators, with a solid understanding of how to introduce change in complex environments.

The energy manager will be a multi-skilled individual with:

- an in-depth understanding of the company as well as its internal and external environments;
- good consultation, negotiation and liaison competency;
- sound knowledge of production and site services;
- solid general technical background and preferably engineering experience; and
- project management experience, especially in new systems implementation.

The position of energy manager is not outside mainstream management career paths. For example, energy managers can be directors or line managers through to capable, enthusiastic supervisors.



The successful energy manager will eventually know more about inflows, outflows, production and service delivery processes than most managers in the company.

A major part of the energy manager's role is also managerial—negotiating assistance and support, motivating staff, canvassing opinion and providing feedback on ideas, and working with senior management to develop policy and strategy.

As a change manager, the energy manager undertakes the task of introducing change to attitudes and behaviours that may be deeply embedded in the company's culture. The role involves influencing and persuading, planning change and implementing it positively. To ensure good results it is important to position the energy manager in the company so that they are not isolated.

KEY FUNCTIONS OF AN ENERGY MANAGER

Managing energy consumption within a company requires a number of functions to be performed. These include:

- developing policy;
- monitoring and reporting energy consumption;
- researching and identifying best practice energy management;
- implementing programs and policies to achieve energy savings;
- securing the support of management and staff; and
- influencing new works policies, tender specifications and construction briefs.

RESPONSIBILITY FOR ENERGY MANAGEMENT

The nature of the company will have an impact on the way various functions are performed by the energy manager. The following are some factors to consider:

- size of the company;
- assets managed (e.g. factories, warehouses, office buildings, people, transport, equipment);
- number of sites; and
- complexity of operations.

SELECTING AN ENERGY MANAGER

Key selection criteria for an energy manager include:

- high-level communication skills, including liaison, negotiation and consultation skills;
- proven experience in project management;
- an understanding of energy costs and the structure of the energy industry;
- familiarity with engineering systems and energy efficiency technologies;
- a demonstrated capacity to learn new skills and integrate new knowledge into existing work activities; and
- knowledge and experience of change management.

Other relevant skills, knowledge and experience include:

- experience with implementing and promoting complex, multi-output energy management systems;
- motivation and willingness to undertake further training and skill acquisition;
- commitment to ecologically sustainable development and reduction in greenhouse gas emissions;
- ability to use word processing, spreadsheet and database packages; and
- an understanding of operations and other areas such as safety, quality, finance and environment issues.

HOW MUCH TIME DOES IT TAKE?

The size of the company's energy bill and the potential savings give the best indication of how much time should be devoted to energy management.

A SUCCESSFUL ENERGY MANAGER

A successful energy manager should undertake the following steps.

1. Link energy into key management systems, e.g. ISO 14001, greenhouse reduction programs, quality systems or occupational health and safety systems.
2. Gain control over the way energy is used. Ensure it is being purchased in the most economical way and promote good housekeeping and waste reduction.
3. Measure and monitor energy performance, and compare it with previous years as well as internal and external benchmarks.
4. Report energy performance simply and clearly to line managers and supervisors. Report energy performance to senior management in a format that is integrated into other planning and business reporting processes. Ensure investment requests are backed by data and a realistic business plan. Take credit for achievements.
5. Involve staff—seek their input and ideas. Share the credit for achievements with those who have contributed to them. This will motivate, create enthusiasm and further achievement.
6. Promote achievements to senior management and publicise success to staff to ensure ongoing support and enthusiasm for the energy management system.

Depending on the size and activities of the company, the energy manager may be more than one person. In large multi-site companies there may be a number of people with responsibilities, together with a coordinating committee. However, research by the Sustainable Energy Authority shows that the best results are usually gained when the person or team entrusted with the task of improving energy performance are given clear and dedicated accountabilities that are matched by resources, especially time. The role of the energy manager will, in some ways, evolve as an energy management system develops within the company.

OUTSOURCING ENERGY MANAGEMENT

External consultants may perform some energy management functions. For example, technical consultants can undertake energy audits. Specialists may also be engaged to perform particular tasks, such as tracking and monitoring energy use.

Energy performance contracting may also be useful to fast-track and provide external funding for energy projects. See *Module 6* for details on energy performance contracting.

Implementation team

A team of enthusiastic people is needed to assist the energy manager throughout the process of implementing a new energy management system. Clear terms of reference must be defined for the implementation team. These people will form the main resource for getting the message out to the rest of the company. It is therefore vital that senior management supports their efforts.

This group should be retained after the implementation stage to coordinate and regularly assess the energy management system. The team may include:

- a senior manager;
- people who have shown an interest and whose assistance will be of benefit to the smooth introduction of the energy management system;
- a representative from each key function or area so that all parts of the company are represented and participating;
- the financial manager;
- the production manager(s);
- the quality and occupational health and safety managers; and
- communications or training staff.

An implementation team should:

- provide guidance and advice to the energy manager;
- provide assistance in drafting an energy management policy and an action plan;
- assist in the dissemination of information and program progress reporting;
- assist in the promotion of the energy management initiatives; and
- provide general support to the energy manager.

Energy management policy

After senior management has committed itself to an energy management system which reflects the company's corporate goals, it is time to integrate energy management goals into existing policy statements or focus on developing a stand-alone energy management policy. An energy management policy is not necessarily the invention of a new policy document, but rather the integration and/or review of existing policy statements to include energy management. This is then supported by new strategies for energy management, decisionmaking and improvement planning.

REASONS FOR AN ENERGY MANAGEMENT POLICY

There are several reasons why a company benefits from the integration or adoption of a formal, written energy management policy.

- A clear statement will give a sense of purpose, enhancing your chances of success.
- Senior management can judge the performance of its strategy against an agreed set of targets.
- Energy reduction matters are more likely to be understood and accepted throughout a company if they have the support of senior management.
- Activities will be more successful if adequate resources are allocated to energy management.
- It is an opportunity to put in writing the responsibilities and accountabilities for energy consumed by the company.

An energy management policy establishes an overall sense of direction. It sets goals regarding the level of energy responsibility and performance required by the company, against which all subsequent actions will be judged. If the company's commitment to energy reduction is left to operate on an unofficial basis, it can be derailed or its impact lessened by changes in management personnel or energy management staff. A written energy management policy will safeguard your company's decision to manage energy consumption.

DEVELOPING AN ENERGY MANAGEMENT POLICY

The energy manager and implementation team need to devise an energy management policy that suits the particular organisation's corporate culture and meets the company's activities and priorities.

SAMPLE ENERGY MANAGEMENT POLICY

Part 1: Statement

Declaration of commitment

A1 Industries produces xxx widgets per year for component makers (company background information). As part of our environmental strategy, we are committed to responsible energy management and will practise energy efficiency throughout all our premises, plant and equipment, wherever it is cost-effective.

Policy

Our policy is to control energy consumption to:

- avoid unnecessary expenditure;
- improve cost-effectiveness, productivity and working conditions;
- protect the environment; and
- prolong the useful life of fossil fuels.

Objectives

Our long-term objectives are to:

- buy fuels at the most economic cost;
- use fuels as efficiently as is possible;
- reduce the amount of pollution, particularly greenhouse gas emissions, caused by our energy consumption; and
- reduce, wherever possible, our dependence on fossil fuels through the use of renewable energy.

Immediate aims

To gain control over our energy consumption by reviewing and improving our purchasing and operating practices.

Part 2: Responsibilities and processes

Responsibilities

- Nominate person responsible for tracking and monitoring energy consumption.
- Nominate person responsible for expenditure.
- Nominate person responsible for coordinating energy management activities.
- Nominate members of the implementation committee and their roles.
- Nominate person/committee responsible for formulating and implementing energy management policy.
- State that the energy manager will be located in the section(s) most relevant and supportive to the current phase of energy management.

Structure

The energy manager will make a monthly report to the line manager on energy management activities and, through the line manager, will make a quarterly report to the Energy Management Committee.

Lines of communication

Formal communication on matters relating to the control of energy consumption by end users or budget holders will be directed through the energy manager who will, where appropriate, bring it to the attention of their line manager, other senior managers, and to the Energy Management Implementation Committee (include an organisational chart).

Part 3: Energy management plan

Resources

The number of staff employed in energy management (indicate actions to be undertaken by designated personnel), their mix of skills, and the amount of investment (10% of our annual expenditure on energy) correspond with the demands of these activities.

Review

All energy management activities will be subject to periodic assessment and annual review in preparation for inclusion in the annual budget.

Action plan

During the coming year, the following energy management activities will be undertaken, in order of priority (list activities).

However the energy manager is more likely to gain widespread acceptance for the policy if everyone who is affected in some way contributes and is involved in its development.

The document may be collated and drafted by the energy manager but it should be vetted and amended by an interdepartmental committee or other appropriate forum. Departmental representatives should be invited to participate at the policy creation level and again if any reviews take place.

Where policy statements or environmental management systems incorporating ISO 14001 already exist, your energy management statement needs to be included.

Consultation is the key to a successful energy management policy. Never give the impression that the policy is being imposed. The aim is to build a far-reaching commitment to the energy management policy.

POLICY DETAILS

A formally documented energy management policy expresses your energy management aims, and can consist of three parts.

An official and public statement of the company's commitment to achieve energy management objectives and protect the environment

- Summary of core business to provide context.
- A statement of policy intent, endorsed by management.
- A statement of objectives, separated into short- and longer-term goals.

Clear specification of delegated responsibilities, monitoring and reporting procedures

- A list of designated personnel, their responsibilities and accountabilities for actions outlined, specified by name and position.
- Systematic procedures for recording, evaluating and controlling energy consumption on an ongoing basis, with regular reviews held by management to ensure improvements are identified and implemented. It is suggested that senior management conduct a performance review at least once a year.
- Existing energy using equipment will need to be reviewed, opportunities for cost-effective investment assessed, as well as the performance of designated members of staff being appraised. Incorporate

energy efficiency into new services, expansion projects, and when property and processes are being refurbished or renovated. This provides an opportunity to save on capital costs.

- A system for reporting energy performance figures to employees and shareholders through staff meetings, annual reports and other reporting avenues, along with a description of the energy management committee's structure and membership.
- Details of the nominated committee representative for each department, and specification of internal and external lines of communication.

A plan to guide energy management practices and provide continuity

- The plan should include setting energy cost reduction targets, timetables and budgetary limits to achieve these aims, allocation of appropriate resources and annual review procedures.

The sample energy management policy (page 7) is provided as a guide to help with developing a policy. Your company's energy management policy will need to be tailored to your company's specific needs.

RATIFYING THE ENERGY MANAGEMENT POLICY

When your policy statement has been written, it is imperative that it be formally adopted and ratified within your company. Senior management needs to endorse the energy management policy at Board level or equivalent. Without this, the policy may not receive the managerial support it needs to succeed.

The policy can then be distributed to all parties within the company that have an interest in its implementation. If necessary, meetings should be held to discuss the policy and its ramifications. The aim is to give everyone a share in the policy, and to build good relations between the energy management team and other members of the company who can influence the intentions of the energy management policy.

Energy auditing

An ideal way of identifying energy saving opportunities in your business is to conduct an energy audit. An energy audit also quantifies current energy use and equivalent greenhouse gas emissions, and makes recommendations for energy efficiency improvements. Its scope can vary widely and can include an entire building or plant, or energy use associated with a specific process. An energy audit provides the baseline of your organisation's current energy use.

The work undertaken during an audit may include:

- investigating the usage of all types of energy consumed and energy using equipment within the building, complex or plant;
- identifying the energy usage of all major heating and cooling applications and its percentage against total energy use;
- identifying cost-effective measures to improve the efficiency of energy use;
- estimating the potential energy savings, indicative budget costs and payback periods for each recommended action; and
- reviewing energy management strategies, including monitoring systems and evaluation process.

An energy audit can be conducted by the energy manager who has been trained and has expertise in carrying out energy audits, or by hiring an energy-auditing consultant.

AUDIT TYPES

Australian Energy Audits Standard AS/NZ 3598:2000 defines three levels of audit.

Level 1 audit

A Level 1 audit, sometimes called an overview, allows the overall energy consumption of the site to be evaluated to determine whether energy use is reasonable or excessive. It provides initial benchmarks of the site so that the effect of energy measures can be tracked and evaluated. It may be in the form of a desktop study, however the information given to, or gathered by, the auditor needs to be sufficient to enable the overall level of efficiency of the site to be determined.

A Level 1 audit is expected to give an overview which provides rough orders of savings and costs. Accuracy of figures would generally be within $\pm 40\%$.

Level 2 audit

A Level 2 audit identifies the sources of energy to a site, the amount of energy supplied, and what the energy is used for. It also identifies areas where savings may be

made, recommends measures to be taken, and provides a statement of costs and potential savings.

A Level 2 audit is an energy use survey which is expected to provide a preliminary assessment of costs and savings. Accuracy of figures would generally be within $\pm 20\%$.

Level 3 audit

A Level 3 audit provides a detailed analysis of energy usage, the savings that can be made, and the cost of achieving those savings. It may cover the whole site or may concentrate on an individual item, such as a single industrial process or one of the services. The auditor may often employ a specialist to carry out specific parts of an audit or may need to install local metering and logging.

The report from a Level 3 audit often forms the justification for substantial investment by the owner or an energy performance contractor. Detailed economic analysis with appropriate level of accuracy is required.

A Level 3 audit is expected to provide a firm estimate of savings and costs. Accuracy of figures would be within $+10\%$ for costs and -10% for benefits.

PREPARING FOR AN AUDIT

Before commencing an audit, it is recommended that you compile a comprehensive set of existing site and energy data. The data that needs to be provided includes:

- site plan and building drawings, and inventory of major plant and equipment;
- 24 months of electricity, gas and fuel accounts (see *Module 3* for information on calculating energy use); and
- activity and/or production levels, for example the number of widgets per month, kg of product per day or product volume in litres per week.

Once you have completed this assessment, you will have a greater insight into your organisation's energy use. Then decide whether you need to undertake further studies or hire an external auditor.

Table 2: Indicative energy audit costs

Company size	Level 1 energy audit	Level 2 energy audit	Level 3 energy audit
Small size company (e.g. less than 200 MWh p.a. electricity consumption)	\$500 to \$1 000	\$1 000 to \$3 000	\$3 000 to \$10 000
Medium size company (e.g. greater than 200 MWh p.a. but less than 3000 MWh p.a. electricity consumption)	\$1 000 to \$2 000	\$2 000 to \$5 000	\$5 000 to \$25 000
Large size company (e.g. greater than 3000 MWh p.a. electricity consumption)	\$2 000 to \$5 000	\$5 000 to \$25 000	> \$10 000

In addition, it is important to:

- arrange with area managers to liaise directly with the auditor; and
- ensure staff are aware of the audit and ask their suggestions on improving the energy efficiency or reducing energy consumption in their area. Invite the auditor to liaise with operational staff.

COST OF AN ENERGY AUDIT

Table 2 provides indicative costs of the three levels of energy audit for small, medium and large companies.

USING ENERGY AUDITORS

Most energy auditors have technical qualifications as well as the expertise and experience to quickly undertake a comprehensive appraisal of a site's energy use.

An audit consultant can assist the energy manager by giving independent advice and commenting critically on energy-related practices within an organisation.

It is critical to the success of developing a system that the consultant is hired at the right time in the process—too late or too early can be counterproductive. For example, if an audit is conducted after a premises has been refurbished, the energy saving recommendations may be too expensive or impossible to implement.

For information on finding, selecting and engaging a consultant refer to *Module 7*.

RESULTS OF AN AUDIT

The results of an energy audit need to be compiled into a clear and concise energy report. A detailed report structure is outlined in AS/NZ 3598:2000. Some of the key elements include:

- executive summary with recommendations in a priority order, and estimates of their implementation costs and payback periods;
- relevant plant and process data;
- equipment data with measurements or estimates of the energy consumption for individual plant items;
- actual energy consumption records;
- energy use analysis in graphical form;
- details of energy efficiency improvements;
- comparison of actual consumption with analysis of estimated results from recommended actions; and
- recommendations to include energy management strategies such as monitoring systems and review process.

ACT ON REPORT RECOMMENDATIONS

To make an energy audit worthwhile, the recommendations from the audit report need to be incorporated into your energy management action plan.

The types of initiatives that could come from an audit report include:

- changes to operational procedures;
- review of maintenance as it affects efficient use of energy;
- modification or replacement of existing plant and/or equipment;
- further in-depth studies of potential to reduce energy use of particular plant or processes; and
- a commitment to ongoing training and information dissemination to increase awareness among staff.

Action plan

An energy management action plan guides a company's efforts to improve energy efficiency. It represents a commitment to saving energy. It creates a management and operational system through which energy efficiency objectives and requirements can be developed, monitored and realised.

The scope and detail of the plan will depend upon the resources available, especially time. The plan should focus on low cost, energy saving practices and procedures as well as energy saving technologies, especially when there are opportunities for an upgrade, maintenance or other changes to plant and equipment.

It is important to know how to assess energy saving opportunities and prioritise them, and then how to draft an action plan. An action plan will list the best opportunities in priority order, and will identify resources, budgets, and financial returns for each activity. It will also have a timeline.

The planning and coordination of any energy management action plan relies on data that accurately and comprehensively monitors trends in energy use.

It is important to assess the current energy status of the company before developing an action plan. This initial review is most often done as part of an energy audit and is the means by which a company establishes its current position with regard to energy use.

IDENTIFY ENERGY SAVING OPPORTUNITIES

- Consult all employees for energy saving ideas, especially the people 'at the coal face'. They will have an accurate understanding of energy flows and use and will be in a good position to make suggestions.
- Consult internal engineering sources for existing projects 'in the bottom drawer', and for a better understanding of the options and possibilities.
- Gather any existing energy audits and other reports and list all recommendations. Review these for relevant projects that can be included in the action plan.
- Arrange for new audits or studies.
- Process equipment suppliers may be able to provide energy efficient options for existing equipment, as well as more efficient new equipment.

Energy saving opportunities usually fall into three broad categories.

Reduction of obvious waste

Staff should be able to contribute ideas on minimising waste in their area. Good housekeeping practices can be boosted through a staff newsletter or by promotional events. Many of these ideas will be low cost or no cost activities such as simple changes to work procedures and practices.

Areas to tackle first include such things as steam and compressed air leaks, equipment running for no purpose, unnecessary heating and cooling of conditioned spaces, excessive lighting levels, incorrect thermostat settings, etc. Tackling these areas will create a sense of achievement and get some early runs on the board. The value of achieving some immediate success is important for staff motivation and commitment.

When developing an action plan, it is recommended that low cost/no cost activities are implemented along with major projects. Smaller projects collectively can save a considerable amount of energy, money and greenhouse gas emissions, as well as enhance the overall results of the energy management system. Demonstration of worthwhile energy savings from small projects can facilitate the uptake of larger projects.

Improvements to equipment

Equipment changes to reduce energy consumption could include improved control equipment, newer more energy efficient burners, high efficiency motors,

variable speed drives, improved insulation, more efficient lighting, etc. These initiatives will generally yield more significant energy savings, but will involve some cost.

Many small equipment changes are not costly and can happen early in the program. For example, replacing standard fluorescent tubes with more efficient triphosphor tubes is a quick and easy means of implementing energy savings.

New processes or equipment and waste heat recovery systems

These areas may yield both spectacular energy savings and productivity gains, but almost always require high levels of capital investment. They can be more difficult to evaluate than obvious waste and may require outside assistance to quantify the costs and benefits.

Refer to *Module 6* for information on financial evaluation of projects.

PREPARING AN ACTION PLAN

Once the review of potential energy savings activities has been undertaken, the company is in a position to make decisions regarding priorities. A plan for future action is then developed. This need not be a stand-alone process. For many companies it is far more effective to integrate energy planning into the general strategic planning of the business and its operations.

The action plan needs to be manageable in size and clearly structured so that it provides clear information, and can be easily used as a key document in the development of the energy management system. In preparing the action plan, you need to identify energy concerns and problem areas and, if possible, prioritise these and other potential impacts and describe the weaknesses of existing energy management practices.

Make sure priorities are assigned to the various energy management activities and a structured timeline is built and used. Activities like developing a basic understanding of energy use patterns, awareness raising, and housekeeping improvements will be early actions. Once you understand energy use and the control actions required, you need to involve others. Make sure your timeline accommodates this need. Activities and projects requiring significant funding, as well as developing reporting formats, will take a little longer and need planning. Make sure activities needing prerequisite actions are actually done after these prerequisite activities.

The implementation team is the key to propagating the action plan and its activities.

The following activities will help with preparing an action plan:

- consult staff involved in finance, purchasing and management across the company;
- consult internal technical experts and, if necessary, external experts;
- arrange for training and awareness raising of energy management;
- ensure managers are aware of the importance of the planning process for energy management. This will secure their input on appropriate priority of the tasks including housekeeping and reporting; and
- consult company procedures for presenting your planning proposal. Seek support from the implementation team, particularly the senior manager on the team. They will help you present the plan for approval in a way likely to garner maximum support.

Information to include

The following information may be included in your action plan.

- Summary of historical data (e.g. using an initial energy review of the whole facility which can be used to establish the baseline for the development of the energy management system).
- The purpose and scope of the plan.
- An executive summary outlining the key information on projects (e.g. potential energy savings and paybacks, greenhouse gas emissions, quality improvements, monitoring of process, savings in maintenance).
- Priorities for action (e.g. issues requiring urgent action, issues where no immediate action is required but there is a need for longer-term improvement, and strategically important areas for future development).
- The process or means of achieving the objectives and target(s).
- The timeframe and resources required.
- Allocation of responsibilities.
- Evaluation processes to assess the effectiveness of the program, including an annual review.

SAMPLE ACTION PLAN

ACME Manufacturing energy projects action plan

Following a Level 2 energy audit of the site, the recommendations from the consultant's report have been reviewed and an action plan developed which has been approved by management after presentation to the CEO and Board. Funding has been approved for all projects to be completed before 30 June 2003. Projects will be coordinated by the Energy Manager, and supported by implementation team members.

The table below summarises the actions, responsibilities and timeline.

ACME Projects						
Project	Emissions savings t CO ₂ -e/annum	Cost savings \$/annum	Project cost \$	Payback years	Person responsible	Completion date
Completed Projects						
Better use of ice tank	0	4 000	1 000	0.25	NF	Feb 2002
Low cost/No cost Projects						
Steam ejector modifications	40	12 000	6 000	0.5	GD	Aug 2002
Cooling tower fan thermostats	26	1 530	1 200	0.8	GD	Aug 2002
Heat recovery for CIP	64	19 000	28 000	1.5	SM	Aug 2002
Power factor correction	0	13 000	15 000	1.2	GD	Aug 2002
Others						
Boiler economiser	69	20 000	40 000	2	GD	Jan 2003
Convert to natural gas when available		700 000	Unknown	Unknown	CEO	c. 2004
Totals	199	769 530				

PRESENTING THE ACTION PLAN

Once your plan of action has been drafted, it will need to be presented to management for approval. It is important to use a format suitable for your company's planning procedures.

IMPLEMENTING THE ACTION PLAN

Implementation of the action plan will take time. The process will vary markedly between companies, depending on such things as the size of the company, resources available, management commitment and existing energy saving practices. The establishment period for an effective energy management system may vary from six months to three years.

Revise and review

As the implementation process proceeds, the action plan may need to be revised and updated. Regular reporting to line managers will help monitoring and revision of the progress. Resource requirements will also need to be reviewed periodically to ensure they are adequate. Make sure reporting is included in your action plan. Evaluation of activities and annual reviews are essential for the ongoing success and an integral part of the continuous improvement process. An annual review should be included in your action plan and results built into the plan for the following year.

An annual review of the energy management system will require you to:

- review and evaluate progress over the past 12 months;
- note any changes in the strategic plans for your company;
- evaluate any new projects and ideas from staff or external experts; and
- develop a new action plan for the next 12 months after considering the above.

PROMOTING THE ACTION PLAN

It is important to ensure that the energy management action plan becomes widely known and understood throughout the company. Once the action plan statement is developed there is an ideal opportunity to raise awareness of what is happening.

The main objective is to motivate staff so they become part of the implementation. Best results for the effective implementation of an energy management action plan are usually obtained if employees are involved at all stages in the process. Cooperation is more easily obtained if awareness sessions are conducted at the earliest opportunity so employees can prepare for the introduction of

the energy management system and appreciate their own involvement. Use the employees who have been involved in developing the action plan to build awareness with their work colleagues.

There are a number of ways to raise awareness of the energy management system and action plan.

- Develop an identity for the implementation team within the company by adapting a name or logo. This raises the profile of the team and the implementation strategy.
- Launch the action plan internally. The launch could be part of an open day or similar event. Peak interest groups that may be associated with local energy or environmental issues could be invited.
- Publicise the plan in the company magazine or newsletter together with additional information on the approach that will be taken towards energy management.
- Produce the plan in poster format and display it prominently.
- Discuss the plan in team and management meetings.

Tracking and monitoring energy use

To discover where your company can save energy, you will first need to examine its energy profile—what it costs, how much energy is used, and where it is used. Gathering energy use data, together with information about your operations, will form a baseline of your company's current energy use, which can then be used to measure the success of future improvements.

Establishing tracking and monitoring systems for energy use provides evidence of what energy is used at a given time. This information can be an effective tool for reporting information to managers and major users.

For the energy manager, analysing energy consumption will provide a base to ensure your company's energy resources are used to their maximum advantage. It is an essential element of an effective energy management plan. Tracking and monitoring will help to:

- confirm savings from any existing efficiency investments and identify new opportunities for savings;
- set up a database for cost control and benchmarking (possibly with other similar companies); and
- check billing accuracy.

Tracking and monitoring are separate activities and have different purposes.

Tracking energy consumption by recording bulk energy use information, e.g. from billing records, gives an overview of energy use patterns. Results of tracking are used to inform everyone on-site of energy use, preferably against production or other index, benchmark or metrics.

Monitoring implies closer measuring of energy use, which can include the whole site, particular areas or just a single item of plant. Results of monitoring inform the energy manager and other relevant parties of problems and possible solutions to wayward energy use.

Tracking energy use allows tight budgetary control over a company's energy consumption, which can reduce waste and establish a level of energy efficiency. However, cost controls alone will not show whether energy is being used efficiently or how it can be used more efficiently. For proper control over energy use it is necessary to have information on energy inputs and flows across the entire company to establish a baseline of energy use.

See the section Reporting and communication to assist with distilling the important energy use information gathered during tracking and monitoring, and with distribution around the site. Only then can energy use be effectively managed in a manner similar to other operating resources.

An energy information system can be a simple tracking system, where energy bills are your data source. Basic calculations can be made using a personal computer

with standard spreadsheet software to analyse the data.

On the other hand, the information system can be a complex multi-site computer-based monitoring system with sub-metering for each production area, different floors, or other subdivision of the business, fully integrated into the plant control system. Data can be read online as events occur.

DATA ANALYSIS USING ENERGY SMART TRACKER

Energy Smart Tracker was developed by the Sustainable Energy Authority Victoria to assist businesses to record and monitor energy consumption and greenhouse gases, and to minimise energy costs.

The program produces basic benchmarks that will help set targets for consumption and scope of total energy use. It displays graphs on seasonal trends, production peaks, energy consumption, energy cost and greenhouse gas emissions for each type of energy.

A CD containing the software is included in the *Toolkit*.

There are also other more sophisticated software packages on the market.

TRACKING ENERGY USE

To get a picture of your company's energy use patterns you should collate historical data. This can be a very simple process. Use energy accounts from the past 24 months to establish the annual total consumption and cost for each utility. Use a spreadsheet to record the forms of energy used (e.g. gas, electricity etc.), consumption and cost.

BENEFITS OF TRACKING ENERGY USE

- Transparent energy costs.
- Allows a system for checking the accuracy of bills.
- Better information for analysis of energy consumption trends.
- Less time wastage as accurate information is obtained quickly.
- Financial information can be used to make strategic decisions regarding operating activities.
- Information to justify and support a strategy for achieving improvements through target setting.
- Impartial and accurate reporting, which enables senior management to assess and control energy consumption and costs.

BENEFITS OF MONITORING ENERGY USE

- Gives better information for analysis of energy consumption.
- Provides technical information needed to make strategic decisions regarding operating activities.
- Identifies inconsistencies in operating and shutdown procedure.
- Provides a system for checking the accuracy of bills.
- Gives information to identify out-of-specification control systems.

Once you have recorded this information you can then express the different forms of energy as a percentage both in terms of consumption and cost.

Refer to *Module 3* for information on understanding and assessing data from your energy bills.

With a clear picture of how much energy your company consumes, and where it is used, you can then assess where savings can be made. Remember, if you can't measure it, you can't manage it.

BENCHMARKS

Benchmarks vary greatly and depend on the nature of the business. Benchmarks can be across an industry sector and allow comparison of the whole business. An example would be \$/litre for a chemical plant. A particular chemical plant would be able to see how it compares to the industry norm.

A benchmark can also be developed internally for use over time. This ties in with tracking energy use and provides a means to quantify energy costs and consumption against production. This type of benchmark can be developed from units of energy per widget produced, per sales, per production days, per commodity input, per indicator product, or against whatever constitutes a good month's performance. Benchmarks can also be developed per number of employees or per building area.

Factories or production facilities may have high energy use as part of the production process. These businesses will have a low energy 'overhead' and a large component of energy consumption per unit of production. Office and warehouse space will have a high energy 'overhead' and so the best benchmark will be per square metre/hour.

For commercial buildings, such as offices, shops, hotels and department stores, specific energy consumption is usually expressed as energy used per unit of floor area serviced, that is MJ per square metre. The Property Council of Australia has published *Energy guidelines 2001* providing guidelines for typical building elements. The guidelines include a method of establishing energy targets for building design and operation.

MONITORING ENERGY USE

Monitoring is the process of measuring and analysing data from a more detailed source such as a smart meter. It is the basis of a disciplined approach to energy management that ensures that your company's energy resources are used to their maximum economic advantage. Monitoring is one of the key tools the energy manager has to keep a closer eye on the performance of plant and equipment as well as total energy consumption patterns.

SAMPLE ENERGY USE REPORT

Electricity and gas use at Widget Manufacturing for a month is on target or lower than the same month in previous years as shown below.

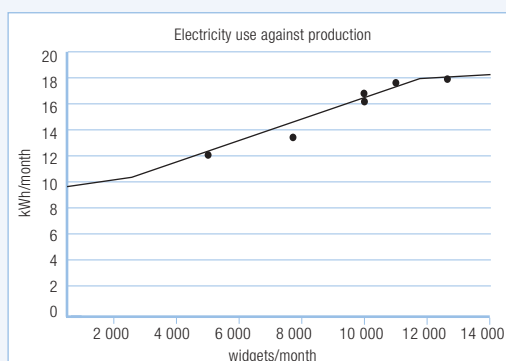


Figure 4: Electricity consumption per widget
(Note that the target regression line indicates production targets below the line are good months, while above the line are poor months.)

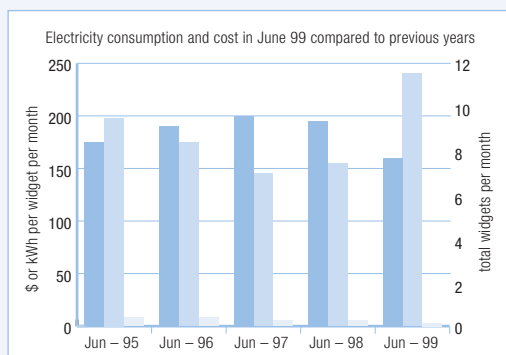


Figure 5: Specific electricity consumption and cost for this month in previous years
(Note that total production is shown on the centre bar, while electricity consumption per widget is the left-hand column and cost per widget is on the right. A column for total cost would complement the total consumption.)

A similar plot can be shown for natural gas consumption.

Extra production has resulted in lower energy cost per widget this year. The poor month in Figure 4 is January when production is low. Maintenance and tooling set-up maintain significant energy use during this time, leading to apparent inefficiency.

SAMPLES OF ELECTRICAL LOAD PROFILES FROM MONITORING

The manufacturing plant load profile in Figure 6 identifies three problems:

- Thursday and Friday have a higher than normal peak demand;
- there is a compressor still cycling during off-peak shutdown overnight and on weekends; and
- off-peak load during the week is higher than during the weekend.

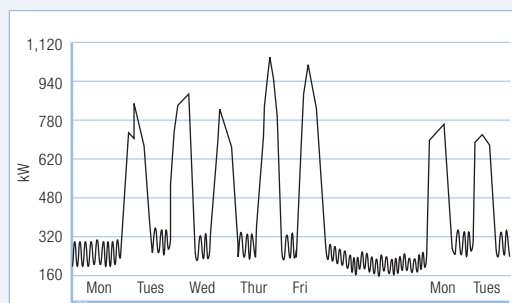


Figure 6: Manufacturing plant load profile

Load profile plots can be arranged on a daily time scale (x-axis, horizontal) and overlaid. In Figure 7 the weekend days have been overlaid for August 1999 and show abnormal loads on 7 and 14 August. The energy manager can follow up with production or maintenance people to see if there is a valid reason for equipment to be on, or take corrective action to ensure better control in the future.

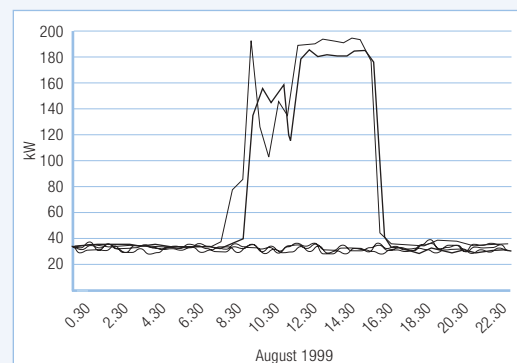


Figure 7: Load profile as daily time scale

Energy monitoring can be done in a range of ways. By negotiation, your energy retailer will be able to supply you with energy use data from your electricity smart meter on a regular basis. Gas meters can be adapted to give a pulse output that is compatible with a data logger. Electricity smart meters can be installed as sub-meters and read locally by electronic download, and dedicated monitoring equipment can be used to monitor electricity use. Your billing smart meter data may be available via the Internet—several retailers are posting smart meter data on the Web with access via password.

Effective monitoring of energy use can go one step further. The energy used by each functional group in the company could be logged separately, so energy costs can be assigned accurately to departmental managers. Agreed levels of energy use should be established. Fair targets should be established in consultation with energy users. When energy is

RULES OF THUMB FOR EFFECTIVE TRACKING AND MONITORING

- Record only the most relevant variables.
- Record historical data from the past 24 months at least.
- Ensure measurements are accurate enough to be useful.
- Ensure recordings are regular and frequent enough to pick up any relevant highs and lows, and are compatible with the rate at which control actions occur.
- Plot the ratio of peak and off-peak electricity.
- Plot actual versus charged demand (electricity).
- Record relevant associated data simultaneously (e.g. production rate).
- Monitor large plant items individually.
- Install sub-meters to measure energy use by areas with separate accountability.
- Hold regular meetings with departmental budget controllers and report on energy savings in their area and potential areas of improvement.

used mainly for heating and cooling buildings, levels usually take account of seasonal variations in the weather. Similarly, in a manufacturing operation, allowances are made for variations in the level of production or changes in the product mix, which directly affect performance.

Production metrics, benchmarks or indices serve as yardsticks for controlling energy use and assessing performance.

When benchmark levels for current performance have been defined and accepted in practice, targets can be set for improvements in the efficient use of energy. However, targets (e.g. aiming to reduce the amount of energy consumed during the coming period by a given percentage) should be set in consultation with those managing and working in particular areas rather than being imposed from above. Improvements may involve changes in operating practices, modifications to existing plant or buildings, or capital investment in more energy efficient plant or buildings.

Key information on energy use can then be built into operating reports along with costs and other information on performance such as material use, levels of output, losses and yields.

Load profile graphs

Load profile graphs are a key tool available to the energy manager, giving a great insight into actual operating events and practices. They can be invaluable for identifying problem areas, and may help the energy manager explain irregular energy consumption patterns to production managers and so on.

Load profiles can identify when energy is used. Anomalies such as the plant turning on too early can be identified and time clocks can be altered to save electricity. Any variation in base-load use from day-to-day needs to be investigated as it may indicate unnecessary equipment use or poor shutdown procedure. See Figures 6 and 7.

Reporting and communication

If your energy management action plan is to succeed, communication with individuals, groups, the entire company and the public is an essential part of the task.

IDENTIFY YOUR AUDIENCE

Before communicating your energy management activities, identify your audiences both inside and outside your company. This will make the job of raising the awareness of the program much easier. Internal communications and reporting energy use usually takes place on a regular basis with:

- senior management;
- department heads and budget controllers;
- members of the implementation committee; and
- members of staff.

An organisational chart is useful to identify who you need to report to, and to note what kind of report each person will require and how often.

External communications may take place with:

- regulatory authorities and other government agencies;
- shareholders;
- the local community and schools;
- your customers;
- the general public; and
- industry groups.

TARGET YOUR INFORMATION

After you have identified your target audiences, ask yourself, 'What does this individual or group of people need or want to know and why?' Only when this information is established can you plan the style and

Table 3: Internal reporting process sample chart

To whom	General manager	Production area managers	Energy manager	Staff/major users
What to report	Summary against production + totals: <ul style="list-style-type: none"> ■ % (bulk) ■ consumption ■ greenhouse benchmark 	Summary against production + totals: <ul style="list-style-type: none"> ■ % (for area) ■ consumption ■ greenhouse ■ benchmarks 	Detail consumption Profiles/patterns Trends Other diagnostics	Summary: <ul style="list-style-type: none"> ■ greenhouse ■ overview/savings (similar to general manager—simple format) ■ energy saving tips for home and work
Why	Strategic planning Budgeting Staffing Resource allocation Management	Feedback to/from shop floor staff Control Analysis Assessment	Planning Management	Motivation General information Generate feedback
Format	Quarterly report Annual report Monthly reports Staff presentation	Quarterly reports	Committee/staff	Bulletin noticeboard Feature article in staff newsletter

content of your communication strategy, e.g. letters, reports, memos, group discussions, debates and problem-solving sessions.

Keep briefings short and simple, focusing your message on the key information. Use ordinary language rather than technical jargon. While developing the report information and format, work through a sample with a couple of key people in your target audience and encourage and accept constructive comment.

For example, a senior manager may want to know how energy efficiency improves profits or enhances the company's competitiveness. A chart showing monthly energy and cost plotted against consumption and cost for the previous year could be used to compare with the current period.

Each company needs to develop a reporting process that reflects the needs of the organisation. It may be a simplified version of Table 3. The secret to a successful reporting process is to keep it simple and straightforward.

There is an opportunity for your company to reap considerable public relations benefit from communicating what your company is achieving with its energy saving activities to the general public. To raise your company's profile consider:

- articles in the local newspaper or daily press;
- marketing brochures;
- feature stories in trade journals or magazines;
- entering awards;
- community television or radio;
- commercial media coverage;
- sponsorships; and
- the Internet.

Motivating and training staff

The value of encouraging participation and cooperation by staff and management in using energy wisely should not be underestimated. Many barriers to change in energy management are people issues rather than technical ones. Ongoing motivation and education are keys to the success of your energy management system.

Keeping staff involved in energy management activities and raising individual awareness of greenhouse issues can generate real benefits, including:

- encouraging participation and environmental responsibility—the more support, the more effective your energy efficiency initiatives will be;
- helping dispel the misconception that energy saving measures result in loss of amenity; and
- boosting staff morale and pride, as people are made to feel part of a solution.

Effectively implementing an energy management system may mean changing company processes. The successful implementation of change at this fundamental level of operations may catalyse a broader cultural change in the organisation. Whether or not everybody expects or wants this to eventuate, it is helpful to know that it can happen anyway.

GETTING THE BEST RESULTS

Introducing energy efficiency into an organisation involves influencing people's attitudes and behaviours.

To be effective in changing behaviours and attitudes, it is important to understand the culture of your company and develop strategies to complement it. Organisational culture can be divided into four broad styles as outlined in Table 4. Use the table to help you identify some of the characteristics of your company.

Table 4: Organisational culture styles

	Entrepreneurial	Team	Hierarchical	Market
Characteristics	Innovation and growth Planning short term Tolerance of uncertainty Outward-looking Charismatic leadership Accountability operates through personal contacts Suit prime movers motivated by variety and task	Participation and cooperation Planning long-term achievement Tolerance of uncertainty Inward-looking Unobtrusive leadership Accountability operates through meetings and discussions Suit facilitators who are motivated by collaboration	Structure and control Planning long term Preference for certainty Inward-looking Conservative leadership Accountability formalised in rules and structures Suit coordinators motivated by stability and control	Productivity and achievement Planning short term Preference for certainty Outward-looking Leadership based on performance High degree of delegation Suit achievers motivated by autonomy and personal accountability
Strategy	Gain CEO's patronage Concentrate on major users	Set up energy efficiency committee to devise energy management policy Appoint energy representatives to invite people in implementing policy	Ensure energy management clearly located in structure Establish procedures for accountability and reporting Set up information system to monitor consumption and report faults	Identify cost centres responsible for managing own energy Devise routine procedures for reporting back to users

STEPS TO MANAGING THE CHANGE PROCESS

Many researchers have analysed effectively managed change processes and broken them down into identifiable stages. The following is a suggested sequence of stages in managing change processes.

1. Creating a vision

A vision needs to state, very briefly and in simple terms, where the company is heading and why it is a desirable outcome. It might be useful to extract a 'vision statement' from your energy management policy.

2. Involving and motivating people to make changes

This is a core issue underlying any initiative requiring people to alter their habits and make fundamental changes to their patterns of behaviour and attitudes.

3. Forming an implementation team

A strong implementation team is needed to plan, implement and sustain changes. Neither one strong key figure nor a weak committee will achieve success in implementing widespread change. A dedicated, carefully chosen and trustworthy team, which, in turn, is wholly supported by senior management, is central to the success of the energy management system.

4. Communication

The key to communicating in this change process is simplicity. Complicated, jargon-filled communication will only confuse, bewilder and isolate people. The simpler and more concise the communication, the more people will understand and participate.

5. Empowering employees

Widespread participation is integral to company cultural change—it enhances the change vision and makes implementation easier and more effective.

Involving staff where possible, incorporating their suggestions for improvement, utilising them in roles of responsibility and communicating with them regularly, particularly when there's good news about results, is essential. Staff should be rewarded and praised, collectively and individually, for good work. Consequently, employees will feel a sense of ownership of the program.

6. Achieving short-term wins

As well as looking at longer term goals in the change process, it is also important to focus on smaller, more immediate achievements. A short-term win is an achievement that boosts staff confidence in the change process (making their effort seem worthwhile),

and gives the people responsible a chance to relax and enjoy their achievement. Short-term wins also relate the achievements back to the original vision, quiet the cynics and resisters, and ensure support from management.

7. Consolidating achievements and progressing

While short-term wins should be celebrated, there is always the risk of being swept away in the achievement of a small feat, thus losing the urgency of change and falling back into complacency. It is important that focus remains fixed on the long-term change vision. A clear policy statement will help keep the longer term goal in focus.

8. Securing changes in the culture

Culture is a very powerful factor influencing human behaviour. Once it has been changed it is important to anchor it firmly into the company's values and norms. In changing culture, it is important to note that behaviours and attitudes must first be altered and proved successful before cultural change can be implemented. Checking regularly that people still feel comfortable providing feedback, problems or ideas can be helpful.

INVOLVING YOUR WHOLE COMPANY

A successful energy management system that incorporates best practice flows from the involvement of the whole company, including:

- CEOs, Board and senior management in endorsing policies and procedures and providing support;
- line managers managing energy use for their division or section and supporting the energy manager's initiatives; and
- staff providing ideas on how to minimise energy waste and implement on-the-ground strategies.

ENERGY MANAGEMENT TRAINING

The purpose of organisational training is to teach your workforce new skills. However, in the case of energy management, training is not so much to educate staff in technical matters, but is more to do with building an awareness of energy issues and creating motivation.

The aim of training is to raise the profile of energy management and convince your organisation's different groups that energy efficiency is a worthwhile ambition.

Training must be tailored to suit the needs of your organisation. Some groups of employees will have a greater influence upon energy consumption than others. Senior managers, departmental managers and plant operators will require a different training approach than process workers and administration staff.

Table 5: Some typical options for energy training

Option	Example	Advantages	Disadvantages
Tailor-made training run on-site using internal trainers	Series of lunchtime classes for middle managers	Cost-effective Tailored to site, job functions and training needs	Lack of exposure to ideas from outsiders
Short open course at a training centre	Four-day course on electrical energy efficiency	Can be targeted to individuals with identified training needs	Some of the course may be irrelevant Trainees must sell ideas when they return to work
On-the-job training	Course for engineers on installation of new equipment	Practical, cost-efficient, tailored to individuals receiving one-on-one training	Informality and lack of structure can lead to omissions
Academic course	Masters degree in energy management	In-depth training, formal recognition of success	Limited practical experience Costs can be high

The training program

Based on the UK Energy Efficiency Office model, there are six steps in an energy management training program.

1. Analysing training needs

This step identifies who needs to be trained and what their training requirements are. As a result of the analysis, the organisation will have an understanding of what form the training program should take. The analysis can be conducted either in-house or by a training consultant.

It is important to tailor courses that meet the specific needs of energy decision-makers in your organisation. Staff who control or manage energy use will need a training course that is geared to their responsibilities.

A matrix of job functions against possible course content will act as an initial guide on who requires what. The matrix also provides an insight to the roles within the organisation with the highest degree of influence on energy use.

2. Developing learning objectives

Goals should be set for training to be effective. Trainees must have a clear understanding of what will be required from them as a result of training.

3. Outlining training content

The content of the training program needs to reflect everything the trainees must learn in order to achieve the objectives.

4. Selecting appropriate training methods

Some typical options for energy training are outlined in Table 5.

5. Conducting training

How training is conducted will depend on the trainees' background, the aims of the course, and the materials and methods. The trainer's preferred style will also have an impact.

6. Evaluating learning

There are various means to evaluate the effectiveness

of a training program. Some methods available are:

- energy use monitoring—a reduction in energy use is one way to identify the effectiveness of energy efficiency training;
- action plans—trainees complete an action plan towards the end of a course. For example, 'list five practical measures that you will take to save energy in your department';
- tests—these can provide quantitative feedback on what the trainees have derived from the course. However, skills and attitudes do not lend themselves to this type of testing; and
- other methods—course evaluation sheets completed by the trainees at the end of the course, and observation by managers of trainees' behaviour and attitudes once back at work.

Continuous improvement

An energy management system should be seen as a process of continuous improvement. The performance of a system should be regularly evaluated against the company's energy management policy, objectives and targets.

The continuous energy management process should:

- identify all areas of opportunity for improved energy performance via detailed consultation with staff;
- note areas where improvements can be made in your next planning cycle;
- facilitate developing and implementing an action plan;
- reward achievers; and
- check the effectiveness of the energy saving measures, periodically document any changes in procedures resulting from process improvement, and make comparisons with objectives and targets.

Energy management continuous improvement is consistent with ISO 14001 principles.

AN OVERVIEW OF ISO 14001

ISO 14001 is an international voluntary standard pertaining to environmental management systems (EMS).

An EMS is a tool that provides organisations with a method to systematically manage their related environmental activities, products and services. It helps an organisation achieve its environmental obligations and performance goals. An EMS follows a Plan–Do–Check–Act cycle, and is a model that can be used by a wide range of organisations from manufacturing facilities to service industries and government agencies. Many organisations have chosen to adopt an EMS based on ISO 14001.

An EMS does not establish additional environmental compliance requirements or any performance levels but instead provides the framework for a company to meet its environmental goals and objectives. ISO 14001 requires an Environmental Policy to exist which is fully supported by senior management, and outlines the policies of the company, not only to the staff but to the public. The Policy needs to clarify compliance with Environmental Legislation that may affect the organisation, and stress a commitment to continuous improvement.

Those companies that have witnessed assessments of quality control systems under ISO 9000 will know that the policy is frequently discussed during the assessment. The Environmental Policy is different. It provides the initial foundation and direction for the management system and will be more stringently reviewed than a similar ISO 9000 policy. The Policy must be publicised in non-technical language so that it can be understood by the majority of readers. It relates to the sites within the organisation encompassed by the Management System and provides an overview and description of the company's activities on the site.

The company will declare its primary environmental objectives, those that can have most environmental impact. In order to gain most benefit, these will become the primary areas of consideration within the improvement process and the company's environmental program. The EMS provides further detail on the environmental program. It establishes procedures, work instructions and controls to ensure that implementation of the policy and achievement of the targets can become a reality. Communication is a vital factor, enabling people in the organisation to be aware of their responsibilities and the objectives of the scheme, and to contribute to its success.

As with ISO 9000, the EMS requires a planned comprehensive periodic audit to ensure that its operation is effective, is meeting specified goals, and that the system continues to perform in accordance with relevant regulations and standards.

In addition to the audit, there is a requirement for management review of the system to ensure that it is suitable (for the organisation and the objectives) and effective in operation. The management review is an ideal forum to make decisions on how to improve for the future.

Energy management checklist

This checklist will help determine if best practice energy management is being achieved in your organisation.

- Energy management policy ratified
- Energy manager with job description appointed
- Energy team formed and meeting regularly
- Energy audit conducted
- Energy use (\$, kWh) being monitored and reported
- System to identify energy saving projects and put into plan
- Action plan developed
- Investment in energy saving projects
- Progress against plan being monitored
- Strategic training commenced
- Regular reporting and review of system
- Annual review planned

Standards

Australian Energy Audits Standard AS/NZ 3598:2000

ISO 14001: International voluntary standard pertaining to environmental management systems

ISO 9000 and ISO 9001: International voluntary standards pertaining to quality management systems

Further information

For further information on energy management systems, and information on a wide range of energy and greenhouse topics, refer to *Module 7*.

Appendix 1

Energy savings checklist

Use this checklist to identify energy saving opportunities for inclusion in your action plan. It is recommended that you consult staff for ideas and inform them of any changes to their area, prior to implementation.

BOILERS AND STEAM SYSTEMS

- Check for use of most appropriate fuel type.
- Check and optimise boiler excess air level to practical minimum.
- Check potential for automatic excess air control on boiler.
- Optimise boiler sizes and scheduling for expected load (winter/summer).
- Check cleanliness of boiler (tube fouling/scale), water treatment systems and feed water source.
- Check steam supply pressure.
- Observe boiler control cycle.
- Check blowdown cycle amounts and times.
- Check potential for flue dampers in boilers.
- Check insulation of boiler.
- Check for steam leaks from boiler over pressure valves.
- Check potential for economisers to preheat feed water/make-up water.
- Check feed water/hot well vertical separation.
- Check condensate, feed water and deaerator temperatures.
- Check insulation of condensate, feedwater and deaerator tanks.
- Check insulation of feed water lines and fittings.
- Check water treatment records.
- Check exhaust from condensate, feed water and deaerator tanks.
- Check potential for pressurised condensate return system.
- Check potential for blowdown waste heat recovery system.
- Check for steam leaks in distribution system.
- Check for failed steam traps.
- Check condensate return levels (calculate percentage).
- Check insulation of condensate return lines and fittings.
- Check insulation of steam lines and fittings.
- Check potential for utilisation of flash steam.
- Check potential to convert from steam to hot water for heating.
- Check potential to convert from central plant to satellite plant.
- Check potential to change from calorifiers to direct heating systems.
- Check domestic hot water temperatures.
- Check heating water temperatures.
- Check for potential waste heat recovery from incineration.
- Check cogeneration potential.

HEATING AND COOLING OF BUILDINGS

- Check adequacy of ceiling insulation and install or upgrade as necessary.
- Select most appropriate system (e.g. radiant for most factory heating applications).
- On large factory and warehouse doors, fit 'Rollfast' doors or clear plastic strips as appropriate to prevent heat gain/loss.
- Set heating thermostats to 18°C in winter and 23°C in summer.
- Use time clocks to control system operation and minimise plant operation.
- Ensure filters and systems are correctly maintained to reduce system pressure loss.
- Minimise air infiltration leakage from airconditioned space.
- Ensure shades are closed when sun is shining on windows.
- Discourage the use of personal radiators and fans.
- Investigate use of evaporative coolers for large space areas.
- Check zoning of airconditioning system.
- Ensure zone thermostats are not competing.
- Use fresh air economy cycles.

- Conversion of constant volume dual duct or terminal reheat systems with backward inclined or airfoil fans to variable air volume (VAV), using variable speed drives (VSD) so that only air volume needed to meet actual load is delivered.
- Assess fan performance of VAV systems. If vanes and dampers are more than 20% closed on a peak load day, the fan speed may be reduced.
- Fit VSD's to fan drives on existing VAV systems that currently use inlet vanes or outlet dampers for air volume control.
- Use VSD's on fan drives—save up to 50% on energy use.
- Recover low-grade heat for space heating purposes.
- Use building thermal inertia and let chilled water temperatures rise in airconditioning systems during periods of peak electricity load to reduce peak demand. Also consider ice storage.
- Check whether chiller plant unit may be retrofitted with electronic TX valve.
- Check all chilled water lines are adequately insulated.

COMPRESSED AIR SYSTEMS

- Optimise compressor sizes and scheduling for expected load.
- Regularly check the compressor run time—determine efficiency and compare with best ever efficiency after system installation/refurbishment.
- Investigate the use of a VSD compressor.
- Retrofit low-flow blowdown nozzles on compressed air systems.
- Relocate compressor intakes for lowest intake temperature.
- Ensure compressed air tools operate efficiently and that their air hoses are adequately sized.
- Only use air motors when necessary.
- Ensure compressed air is not over-dry.
- Minimise system water build-up.
- Check system's air pressures are the lowest practical for the application and use pressure regulators where appropriate.
- Check compressed air lines for leaks and repair any leaks found.

- Check potential sequencing of compressors to operate most efficient compressors for total system air requirement.

LIGHTING SYSTEMS

- Ensure lighting levels comply with requirements of AS 1680.
- Check effect of lighting on air conditioning running costs.
- Only power factor corrected luminaries to be used for renovations and new installations.
- Regularly clean and service luminaries.
- Change incandescent bulbs to fluorescent tubes.
- Change standard 40W fluorescent tubes to 36W high-density triphosphor tubes.
- Replace standard fluorescent ferro-magnetic tube ballasts with electronic ballasts.
- Consider delamping, voltage reduction, motion detectors, light sensors, time switches, multiple switching, better reflectors and better skylighting.
- Fit windows with blinds/shadecloth/external shading to minimise sunlight penetration and glare.
- Ensure lighting is switched off when areas are unoccupied—fit extra zone switches if needed.
- Discourage use of extra low voltage lights due to total cost, frequent replacement and effect on airconditioning costs.

REFRIGERATION EQUIPMENT

- Insulate distribution system and end use storerooms.
- Retrofit electronic expansion valves to reciprocating water chiller sets.
- Has the system been changed to run with hydrocarbon refrigerants?
- Improve chilled circulation/heat transfer.
- Adjust suction temperature to maximise efficiency and maintain product temperature.
- Maintain defrost on all fan coils.
- Increase utilisation of cold room space by closing off unused section.

HOT WATER SYSTEMS

- Use instantaneous hot water urns where practicable.
- Minimise hot water requirements and allow for local boosting in areas such as kitchens.
- Ensure separate boilers are installed for domestic hot water and space heating.
- Ensure domestic hot water pumps are switched off out of hours.
- Set hot water storage tank thermostats at around 65°C (but not more than 70°C).
- Install or upgrade insulation on hot water lines.

PLANT DRIVES

- Ensure appropriate drive is used (i.e. direct drive, v-belt, notched belt, flat belt, etc.).
- Check belt drives are neither too loose or over tensioned.
- Replace oversized motors.
- Optimise pump/fan flow rates for required duties.
- Use variable speed, or at the least multi-speed motors, on condenser water pumps, cooling tower fans and air-cooled condenser unit fans. Or use a sequential approach. Either way, drives should be controlled by condenser water temperature or condenser leaving air temperature.
- Check potential use of high efficiency motors.

FURTHER INFORMATION

For further information on these topics, refer to the case studies and information sheets provided in *Module 5*, and to the SEAV website www.seav.vic.gov.au

