Australian/New Zealand Standard™

Energy audits

Standards Australia

STANDARDS NEW ZEALAND
Paerewa Aotearoa

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee EN/1, Energy Auditing. It was approved on behalf of the Council of Standards Australia on 21 July 2000 and on behalf of the Council of Standards New Zealand on 27 October 2000. It was published on 6 November 2000.

The following interests are represented on Committee EN/1:

Australian Gas Association
Australian Greenhouse Office
Australian Institute of Energy
Australian Institute of Refrigeration Air Conditioning and Heating
CSIRO Energy Management Unit
Department of Industry Science and Resources
Electricity Supply Association of Australia
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This Standard was issued in draft form for comment as DR 98566.

Australian/New Zealand Standard™

Energy audits

Originated as AS 3598—1990.
Jointly revised and designated AS/NZS 3598:2000.

Jointly published by Standards Australia International Ltd, GPO Box 5420, Sydney, NSW 2001 and Standards New Zealand, Private Bag 2439, Wellington 6020

ISBN 0 7337 3576 2

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EN/1, Energy Auditing, to supersede AS 3598, *Energy management programs—Guidelines for the preparation of an energy audit brief.*

The objective of this revision is to assist energy users to decide what level of audit is appropriate for their needs, providing a guide when commissioning energy audits and a uniform basis for preparing and comparing energy audit proposals. It also aims to establish best practice for energy auditors, support the establishment of energy management programs and contribute to the quality of existing energy and other management systems.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

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FOREWORD

Energy efficiency has a direct impact on business operating costs and affects the bottom line of every business in Australia and New Zealand. Production and use of energy also has a significant impact on the environment.

Reform of the Australian and New Zealand energy market is also creating significant opportunity for government and business to realise energy cost savings through price competition between suppliers.

It is essential that government and business manage energy effectively in order to —

(a) conserve fossil fuel resources;

(b) reduce emission of greenhouse gases, which contribute to global warming; and

(c) achieve operational and cost efficiencies which impact on business profitability.

An energy audit is best undertaken as part of an energy management program.

Energy audits and surveys are investigations of energy use in a defined area or site. They enable an identification of energy use and costs, from which energy cost and consumption control measures can be implemented and reviewed.

Organizations will gain direct financial benefit from effective energy management. They may also achieve recognition by the community, including potential customers, as an environmentally responsible corporate citizen.

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard

Energy audits

1 SCOPE

This Standard sets out minimum requirements for commissioning and conducting energy audits which identify opportunities for cost effective investments to improve efficiency and effectiveness in the use of energy.

This Standard covers three levels of audit, as follows:

(a) Level 1.

(b) Level 2.

(c) Level 3.

See Figure 1 and Section 6.

2 OBJECTIVE

The objective of this Standard is to —

(a) assist energy users to decide what level of audit is appropriate for their needs;

(b) provide a guide for energy users when commissioning energy audits;

(c) provide a uniform basis for preparing and comparing energy audit proposals;

(d) establish best practice for energy auditors to provide effective and ethical service;

(e) support the establishment of an energy management program by specifying pre- and post-audit activities for the energy user organization, and suitable reporting;

(f) requirements for the audit; and

(g) contribute to the quality of existing energy and other management systems, e.g. financial, environmental, operational or occupational health and safety management.

3 APPLICATION

This Standard is intended for use primarily by energy users when defining the scope of an audit and may be applied, throughout Australia and New Zealand, to the public, commercial and industrial sectors, and to a range of premises from complex industrial sites or commercial buildings to a single small building.

The Standard will be of assistance also to energy auditors, and may serve as a useful reference document for anyone interested in the field of energy management best practice.

4 DEFINITIONS

For the purpose of this Standard the definitions below apply.

4.1 Energy

The fuel, electricity and heat consumed within the site, building or industrial process. Energy sources can be non renewable and renewable, e.g. wind, solar, biomass.

4.2 Energy management program

A program to achieve and sustain efficient and effective use of energy including policies, practices, planning activities, responsibilities and resources that affect the organization's performance for achieving the objectives and targets of the Energy Policy.

4.3 Energy intensity

The energy use per unit of activity. For example, in a building it could be the kWh of energy used per m^2 of floor space; in a process it could be the MJ of energy used per unit of production.

4.4 Energy user

The person or organization responsible for the energy used on the site, building or industrial processes and for commissioning an energy audit.

4.5 Energy policy

A concise statement by the organization of its intentions and principles in relation to its overall energy performance, which provides a framework for action and assists in the setting of its environmental objectives and targets.

NOTE: The energy policy should be integrated with the organization's broader policies.

4.6 Energy management

All activities of the organization's overall management functions, which contribute to the achievement of objectives and targets of the Energy Policy.

NOTE: There may be no formal energy policy in place. The energy policy might be no more than a simple undertaking to minimize the cost of energy. Nonetheless, there is always some level of energy management, even if it is just switching off (most) lights at the end of the day.

4.7 Energy performance indicator

The application of energy intensity measures in a way that enables comparison between different buildings, processes, geographical locations and performance trends over time.

4.8 Energy monitoring

The regular recording and review of energy consumption and cost, and the principal variables that could affect this, such as production rates, occupancy or climatic condition.

4.9 Greenhouse coefficient

The arithmetic conversion factor which converts the amount of energy consumed to a measure of greenhouse warming, expressed as CO_2 equivalents.

NOTE: These can vary across Australia and New Zealand and the relevant values used should be confirmed with the Australian Greenhouse Office or New Zealand Ministry for the Environment respectively.

4.10 Site

An energy consuming asset including a building or industrial process or plant.

4.11 Benchmarking

The use of energy performance indicators to compare the energy use of the site under review with similar sized sites performing the same function and, thus, establishing whether energy consumption is high, reasonable or clearly efficient.

5 REFERENCED AND RELATED DOCUMENTS

5.1 Referenced documents

The following documents are referred to in this Standard:

AS
4121 Code of ethics and procedures for the selection of a consultant

AS/NZS
ISO 9000 Quality management and quality assurance Standards (all parts)

ISO 14004 Environmental management systems—General guidelines on principles systems and supporting techniques

Energy Efficiency Victoria—Energy Management

5.2 Related documents

Attention is drawn to the following related documents:

BS
8207 Energy efficiency in buildings

8211.1 Part 1: Energy efficiency in housing

NZS
4218 Energy efficiency—Housing and small building envelope

4220 Code of practice for energy conservation in non-residential buildings

4243 Energy efficiency—Large buildings

Energy Audits and Surveys —CIBSE AM5:1991

Energy Management Guide, Aspects of Energy Management—General Information Report 12, May 1995, BRECSU

Energy Appraisal of Existing Buildings, RICS Feb 1993

6 ENERGY MANAGEMENT PROGRAM

Energy audits, and energy saving opportunities identified in audits are best implemented in the context of an energy management program which operates, and is formally recognized, as an integral part of the overall and ongoing management activities of the organization.

The energy management program may operate in different ways in different organizations. For example, it might be specified as an outcome of the organization's 'Quality System', referred to in ISO 9000 series, or it might be specified as a required outcome of the organizations 'Environmental Management System' referred to in ISO 14000.

The energy user is advised to have in place an energy management program at least equivalent to the program recommended in the document *Energy Management* by Energy Efficiency Victoria, before any audit is undertaken.

The organization's energy management program should include setting up the management structure for the program, formally appointing an energy manager, developing an energy management policy, involving all staff in the program, and having a system for monitoring energy bills. It should be in place before commissioning an energy audit.

The energy management program should be implemented as part of an environmental management system, if such exists.

NOTES:

1 See Appendix A for an outline of an energy management program, which is based on *Energy Management* by Energy Efficiency Victoria.

2 Appendix B lists the benefits of an energy management program.

7 AUDIT TYPES

7.1 General

This Standard defines three levels of audit (see Clauses 6.2, 6.3 and 6.4, and Figure 1 as follows.

(a) Level 1.

(b) Level 2.

(c) Level 3.

The energy user may decide on a single level of audit, or may start with Level 1 audit and use the results to decide whether to progress to one of the other levels. The content of, and time spent on, an audit will vary depending on the size of the site and the annual cost of energy use.

Savings may be identified and recommended in the report at any level of audit. However, the accuracy of the cost and savings figures shall be stated.

7.2 Level 1 audit

A Level 1 audit, sometimes called 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.

NOTE: 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 ±40%.

7.3 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.

NOTE: 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 ±20%.

7.4 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.

NOTE: 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.

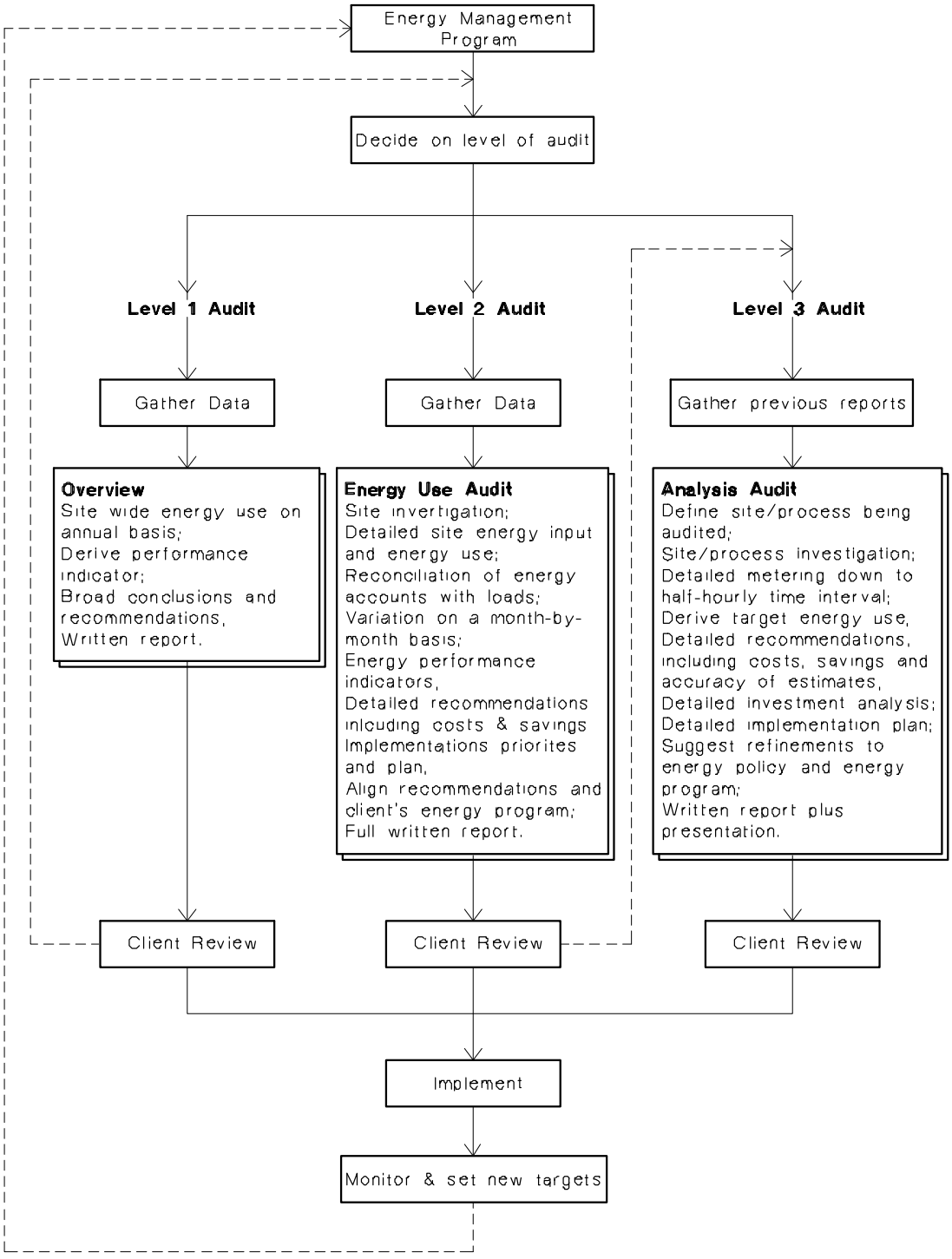

FIGURE 1 ENERGY AUDITS

8 SELECTION OF AUDITORS

An auditor should have demonstrated experience, relevant to the type of site, when carrying out any energy audit in accordance with this Standard and should possess appropriate professional indemnity insurance. The process outlined in AS 4121 should be used to select the consultant.

The auditor should nominate one or more individuals who will be responsible for conducting the audit. The work should be performed by, or under the direct supervision of, the nominated individual or individuals.

9 FREQUENCY OF AUDITS

A Level 1 audit should be undertaken each year as part of the review of an energy management program.

An appropriate higher level of audit should be undertaken every 3 to 5 years or whenever there is—

(a) proposed and recent significant change in site use or process;

(b) site development or refurbishment;

(c) proposed and recent revision of working practices;

(d) substantial changes in energy price or its availability;

(e) a significant increase in the energy performance indicator for the site; or

(f) introduction of new technology.

10 MONITORING

Monitoring should be done continuously as part of the energy user's energy management program, as it provides essential information on energy performance. Such monitoring enables fine tuning of the overall program targets and enables the user to accurately implement any necessary intervention.

An energy audit will establish energy performance indicators prior to any major capital investment or other significant change. Continuing monitoring should then establish what effect the changes are having on the energy performance indicators.

11 MEASUREMENTS

11.1 Availability

Energy consumption measurements are usually made by the supplier for billing purposes. This data should be made available to the energy auditor by the energy user. Depending on the type of meter used, the supplier may also hold more detailed information such as load profiles. If more detailed information is not available from the supplier, the auditor may install sub-metering for this purpose, depending on the level of audit and nature of site.

NOTE: Sub-metering may already be installed as part of an energy management program.

Measurements of physical dimensions of buildings, units of production, and the like, are generally supplied by the energy user with verification, as appropriate, by the energy auditor. These measurements should be consistent with industry norms and should clearly state what they represent.

11.2 Format

The monitored data that is maintained by the energy user should be presented in an easily assimilated form; for example, graphs or charts that reveal changes of energy use over time. The data should be reviewed regularly and any change in the pattern of energy use over time should be investigated, possibly by an energy audit.

12 THE ENERGY USER'S ROLE AND RESPONSIBILITIES

12.1 Pre audit

12.1.1 *Choice of audit level*

The energy user shall define the level of audit required, taking into account the following:

(a) Specific issues to be addressed by the audit.

(b) Complexity of site.

(c) Total budget available for the audit and subsequent implementation.

12.1.2 *Information to be provided*

The energy user shall either provide the following information to the auditor or include the sourcing of it in the auditor's scope of work:

(a) Level of energy audit required.

(b) Details of the client's representative on site for the auditor to contact.

(c) Date when completed audit report is required.

(d) Details of activities at the site; for example, occupancy, production levels and times of use.

(e) Major specific issues at the audit site, which may have prompted the energy audit, or which are required to be addressed by the audit report.

(f) Findings from any previous audits.

(g) Basic information about energy management activities at the site.

(h) Previous 24 months energy billing history.

(i) Site energy load profiles.

(j) Short- or long -term plans for the site which may affect recommendations.

(k) The required basis for financial evaluation.

(l) Basic site plans indicating the useable floor space of the audit site buildings.

(m) Engineering services diagrams.

(n) Site access restrictions.

Additionally, for Level 2 and Level 3 audits the following information shall be provided:

(i) More detailed information about the organization's energy management program; and details of the implications of this audit for the organization's energy management program.

(ii) More detailed architectural drawings and specifications.

(iii) Activity levels relating to energy use for each building (i.e. building occupancy).

(iv) A copy of the most recent accounts.

(v) Meter and sub-meter readings, and their locations within the site.

(vi) Current maintenance schedules for the main plant and equipment.

(vii) Plant and equipment nameplate data and operational schedules.

12.1.3 *During the audit*

The energy user should arrange for appropriate site access and meetings as required.

12.2 Post audit

The energy user should carry out the following after the audit report has been completed and handed over:

(a) If a level one audit has been completed, the energy user may decide whether to progress to one of the other levels.

(b) Produce an action plan that outlines, by priority, the tasks and costs involved in implementing each measure, the allocation of these tasks, and the timetable for their implementation.

NOTE: This action is critical for effective implementation of energy audit findings.

(c) Consult staff representatives, building occupants and other interested parties who are to be involved in the introduction of measures in the action plan and whose collaboration will be vital to its success.

(d) Regularly monitor the results of measures implemented and review the action plan as required.

13 AUDIT REQUIREMENTS

13.1 General

The energy audit may vary in its range and depth of study. As a minimum, it shall include the following elements, which shall be read in accordance with any specific requirements outlined in Clause 12.2:

(a) Examination of energy consumption and sources.

(b) Consideration of building fabric, site services, their controls and major energy-using processes.

(c) Consideration of occupancy, site use and environmental conditions and requirements.

(d) Analysis of energy performance in relation to size of site and activities carried out within it considering its location and climate.

(e) Review of energy management policy and procedures inclusive of staff resources, any monitoring or target setting together with any planned or future investment.

(f) Identification and recommendation of measures to implement energy and financial saving opportunities.

13.2 Specific

NOTE: A summary of the typical deliverables required under each level of audit is given in Appendix C.

13.2.1 *Level 1 audit*

A Level 1 audit does not necessarily require a site visit, although this can be organized if requested by either party. The requirements of this Clause shall be read in conjunction with the requirements of Clause 12.1.

A Level 1 audit shall include the following:

(a) Liaison with the auditor’s contact on site to ascertain the following:

  (i) Building construction type and fabric.

  (ii) Type and configuration of services.

  (iii) Appropriate unit of production and its quantity (e.g. net lettable area for office space, number of students for a school, number of beds for a hospital).

(b) Determination of total consumption of all fuels for the 24-month period before the audit (ascertained from billing data provided by the energy user). If this data is unavailable, the auditor shall estimate the consumption(s) based on the installed loads, clearly stating the relevant assumptions in the report.

(c) Evaluation of load profile data, if available.

(d) Preparation of monthly or seasonal energy consumption profiles (i.e., kWh/month, MJ/month,) of all fuels for the previous two years. preparation of appropriate energy performance indicators (e.g., kWh/production unit, $/production unit, kWh/$m^2$, MJ/$m^2$, $/$m^2$, kWh/student, MJ/student, $/student) and compare with industry norms, if available.

(e) A tariff analysis of all forms of energy being used at the audit site.

NOTE: In New Zealand and, to a lesser degree, Australia, conducting such an analysis may involve excessive levels of research and reporting which would be outside the intent of this Clause.

(f) Identification of potential for reduction of energy consumption and cost at the site with regard to the above tasks, and provision of recommendations for further action, which may include staff training, capital works, maintenance, substitution of fuels, tariff changes and a higher level energy audit.

(g) Preparation of a report in accordance with Section 14, which shall include any findings and recommendations arising from carrying out tasks as described above. The report should also include the sources of data and the accuracy of estimations.

13.2.2 *Level 2 audit*

The requirements of a Level 2 audit shall be read in conjunction with the requirements of Clause 12.1.

A Level 2 audit shall include the following:

(a) The tasks specified for Level 1 audit.

(b) Meeting with the auditor's contact on site and carrying out an inspection of the audit site observing energy usage patterns, plant and equipment operation and maintenance, and building fabric.

(c) Analysis of the site's energy use, identifying the sources of energy, the amount of energy supplied, and detailing what the energy is used for. The analysis should identify important factors affecting energy use such as hours of operation.

(d) Preparation of energy consumption targets and indicators (e.g. kWh/m^2, MJ/m^2, kWh/student, MJ/student) of energy end use throughout the audit site (e.g. lighting, HVAC, domestic hot water) which compare actual, predicted, and post audit target levels. Where desegregated energy consumption data are not available to determine these indicators, an estimate of the indicators based on observed loads, including the relevant assumptions of the report.

(e) Provision of an itemized list of recommendations to reduce energy consumption and cost, which shall include both capital works and general management options.

Any capital works recommendations shall include the following:

(i) A clear description of the work program involved in implementing each recommendation.

(ii) Predicted annual energy and cost savings for each recommendation.

(iii) Predicted cost of implementing each recommendation.

(iv) Comparison of benefits and costs.

General management options, which would facilitate more efficient energy use, should include the following:

(A) Provision of energy sub-meters to facilitate ongoing sub-monitoring as both a management tool and to verify savings.

(B) Changes to maintenance and operating practices.

(C) Modifications and/or additions to existing plant.

(D) Alternative fuels.

(E) Alternative tariff structures.

(F) Alternative staffing arrangements.

(G) Staff training and involvement in energy management practices.

The recommendations shall be listed in order of priority using simple payback, benefit to cost ratio or other appropriate criterion. Categorization of the recommendations shall be as required by the energy user or where none exists by one of the following:

(1) Those easily implemented at little or no cost.

(2) Those requiring capital expenditure with a payback period of less than 3 years.

(3) Those requiring capital expenditure with a payback period of 3 years or more.

(f) A report, prepared in accordance with Section 14, which shall include any findings and recommendations arising from carrying out tasks as described above.

(g) A briefing of the energy user (if required).

13.2.3 *Level 3 audits*

The requirements of a Level 3 audit shall be read in conjunction with the requirements of Clause 12.1.

A Level 3 audit shall include the following:

(a) The tasks specified in Level 1 and Level 2 audits.

(b) In addition to regular and detailed dialogue between the auditor and audit site staff, the following formal meetings:

(i) *1st Meeting* (following appointment of the auditor)—to review current energy usage levels, finalize the project methodology and timing, and arrange access to the site.

(ii) *2nd Meeting* (following the tabling of the final report)—at which the auditor makes a presentation to the energy user detailing recommendations and the suggested implementation plan.

(c) Provision of a detailed analysis of the site or process to determine where, when and how energy is used. This should include, but not be limited to, evaluation of the audit site's building operation and services, plant and equipment operation, control systems, maintenance schedules, hours of operation and analysis of staff working hours, including cleaners. Identification between predicted energy use and actual energy use.

(d) Obtaining copies of drawings and other documentation required to fulfil the requirements of this Clause. Such documentation shall be returned to the audit site upon completion of the audit.

(e) Preparation of hourly consumption profiles of all fuels used over a period of 7 days.

(f) Provision of all meters, instruments and equipment necessary to meet the intent of the audit, and ensuring their accuracy.

(g) A report, prepared in accordance with Section 14, which shall include any findings and recommendations arising from carrying out tasks as described above.

(h) Recommendations, which shall be defined in sufficient detail to enable quotations to be invited without further external assistance.

NOTE: Recommendations for work that is on a scale large enough to warrant going to tender may require additional preparation of tender documents.

(i) A presentation to the energy user.

14 AUDIT REPORT REQUIREMENTS

The extent of information reported will reflect the level and scope of the audit undertaken. The final report shall include any specific elements, in accordance with Section 13, and as a minimum, the following:

(a) Executive summary highlighting major findings, recommended implementation plan and implementation costs for both capital works and general management options, and predicted savings.

(b) Table of contents.

(c) Description of audit site and services.

(d) Observations on operation of audit site building(s), process and plant.

(e) Data on existing energy consumption, including profiles (weekly, daily and hourly). Where available, profiles should be reviewed.

(f) Analysis of energy usage data including energy performance indicators and their comparison with industry norms.

(g) Relevant engineering, environmental and financial calculations.

(h) A prioritized list of recommendations, including implementation costs, predicted savings and financial evaluations such as payback or internal rate of return.

(i) Where required, data tables in accordance with Appendix D.

(j) A tabulated summary (a typical example is given in Appendix C).

APPENDIX A
OUTLINE OF AN ENERGY MANAGEMENT PROGRAM

(Informative)

A1 GENERAL

An energy management program is a program of well planned actions aimed at reducing an organization's energy bills while offering comfort improvements for users and reducing detrimental environmental impacts.

NOTE: If an example of an energy management program is given, it should be accompanied by a brief explanatory note outlining its context and relevance to this energy audit Standard.

Energy management involves —

(a) devolving responsibility for energy bills to those with the authority and capacity to change the way energy is used;

(b) providing resources where required;

(c) collecting and analysing existing energy use data;

(d) undertaking an energy audit to determine where, and how efficiently, energy is used;

(e) implementing energy saving measures; and

(f) regularly reporting the savings that have been achieved).

There are two central energy management strategies as follows:

(i) *Energy conservation*—the avoidance of wasteful energy use and the reduction in demand for energy-related services (e.g., if you don't need it, turn it off).

(ii) *Energy efficiency*—the reduction in consumption of energy for current operations (e.g., if you need it, do it more efficiently).

Appropriately applied energy management strategies will lead to reduction in the costs of delivering goods and services, and improvement in the quality of services provided.

The success of the program will depend on—

(A) full commitment from all staff in the organization, ranging from senior management down;

(B) an effective reporting system with accountability of line managers for energy used; and

(C) an effective staff awareness and training program.

An energy management program is seen as a continuing process. It will be more effective if it is reviewed annually, and revised as necessary.

Paragraphs A3 to A9 outline the strategies that should be deployed when setting up an energy management program.

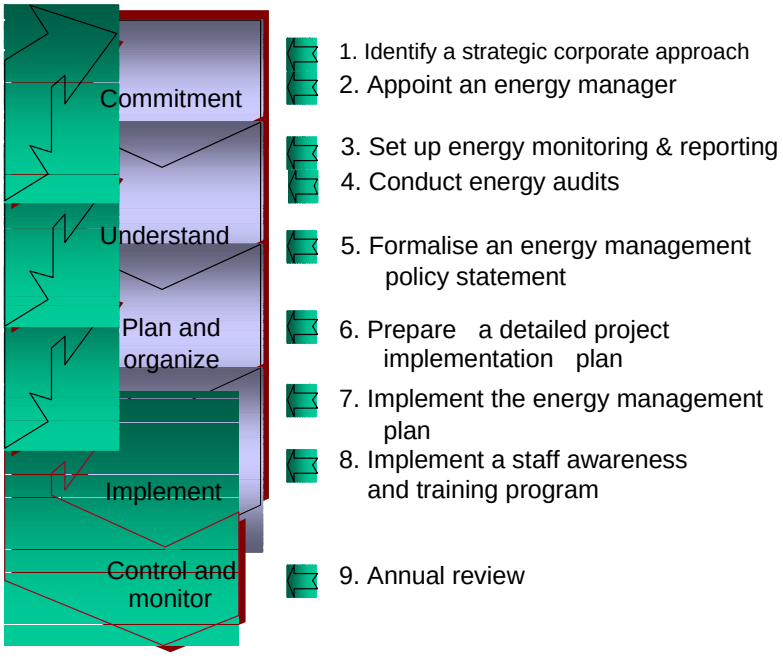

FIGURE 2 ENERGY MANAGEMENT—CONTINUAL IMPROVEMENTS

A2 ADOPTING A STRATEGIC CORPORATE APPROACH

The starting point in energy management is adopting a strategic corporate approach to energy management. Clear accountability for energy management needs to be established as well as the allocation of appropriate financial and staffing resources and initiate reporting procedures. A corporate statement of commitment should be prepared and promulgated, as an energy management program requires commitment from the whole organization in order for it to be successful.

A3 APPOINTING AN ENERGY MANAGER

The energy manager, who should be a senior staff member, will be responsible for the overall coordination of the program and will report directly to senior management. Energy managers do not necessarily need to have a technical background, but they do need to be familiar with the organization's activities and have good support.

A4 SETING UP AN ENERGY MONITORING AND REPORTING SYSTEM

Successful energy management requires the establishment of a system to collect, analyse and report on the organization's energy costs and consumption. This will enable an overview of energy use and its related costs, as well as facilitating the identification of savings that might otherwise not be detected. The system needs to record both historical and ongoing energy use, as well as cost information from billing data, and be capable of producing summary reports on a regular basis. This information will provide the means by which trends can be analysed and tariffs reviewed.

A5 CONDUCTING ENERGY AUDITS

An energy audit establishes both where and how energy is being used, and the potential for energy savings. The body of this Standard provides details.

A6 PREPARING AN ENERGY MANAGEMENT POLICY STATEMENT

A written energy management policy will guide efforts to improve energy efficiency, and represents a commitment to saving energy. It will also help to ensure that the success of the program is not dependent on particular individuals in the organization.

An energy management policy statement includes a declaration of commitment from senior management of the general aims and specific targets relating to —

(a) energy consumption reduction (electricity, gas, petrol, oil, etc.);

(b) energy cost reduction (by lowering consumption and negotiating lower unit rates);

(c) timetables;

(d) budgetary limits;

(e) energy cost centres; and

(f) organization of management resources.

A7 PREPARING AND UNDERTAKING A DETAILED PROJECT IMPLEMENTATION PLAN

A project implementation plan should be developed as part of the energy audit, and should be endorsed by management. The plan should include an implementation time-line and should state any funding and budgetary requirements. Projects may range from establishing or changing operational procedures to ensure that plant and equipment use minimum energy, negotiating electricity supply arrangements, through to adopting asset acquisition programs that will reduce energy consumption. An overall strategy could be the introduction of energy management projects of least cost to the organization, which will achieve maximum financial benefits.

A8 IMPLEMENT A STAFF AWARENESS AND TRAINING PROGRAM

A key ingredient to the success of an energy management program is maintaining a high level of awareness among staff. This can be achieved in a number of ways, including formal training, newsletters, posters, publications, and incorporating energy management into existing training programs. It is important to communicate program plans and case studies that demonstrate savings, and to report results annually.

A9 ANNUAL REVIEW

An energy management program will be more effective if its results are reviewed annually. The energy management policy and strategies should be reviewed in light of the results achieved thus far, as this will form the basis for developing an implementing a plan for the next 12 months.

APPENDIX B
BENEFITS OF ENERGY AUDITS

(Informative)

B1 GENERAL

The rationale behind conducting energy audits is to provide information needed to establish or improve the energy management program as well as provide a baseline against which to compare the results of any management initiatives.

The direct benefits of conducting energy audits include financial, operational and environmental benefits.

B2 FINANCIAL BENEFITS

Financial benefits may accrue from low, medium or high cost investment measures and can be realized in several ways, not necessarily dependent on the level of investment. The benefits are as follows:

(a) Reduced expenditure on energy; e.g., by reducing consumption or changing tariff or fuel type.

(b) Reduced maintenance costs; e.g., following improved utilization of plant and optimization in operation.

(c) Savings in other costs; e.g., water charges, where demand is reduced.

(d) Reduced capital expenditure; e.g., where increased efficiency avoids the need for additional plant or supply capacity or makes possible accurate sizing of any replacement plant.

(e) More productive use of labour where measures release staff for other duties; e.g., automated control systems.

(f) Increased productivity where working conditions are improved; e.g., improved temperature levels, airflow, etc.

B3 OPERATIONAL BENEFITS

In addition to direct cost benefits, further benefits can be achieved by optimizing the operation of a building, process or plant. Ultimately, these may well have financial implications. The information made available to management on energy costs and use could in itself be found invaluable in asset planning and decision making. Measures can also lead to improved working practices or conditions.

B3.1 Management information

Information becomes available as energy audit and survey progress. It may be used to decide on immediate action or for longer-term planning. Information could be in the form of the following:

(a) Benchmarking against similar types of building, which can be useful in establishing priorities for action.

(b) Recommendations for future opportunities, perhaps requiring major investment or additional study. It may be possible to set a program for the introduction of new technology or to adopt the best current practices for controlling energy use.

(c) Suggested operational changes that might result in improved plant reliability or availability. Benefits could arise from reduced maintenance or increased productivity.

(d) Estimates of projected energy consumption needed when setting budgets for energy purchase, or estimating the cost of providing a specific service.

(e) Long-term options involving major refurbishment or influencing future policy on design and operation. A strategy may also be developed with the flexibility to cope with changes in the building use or choice of energy type.

(f) A plan for developing a more effective approach to energy management, including building staff ownership and identifying budget requirements.

B3.2 Working conditions

Measures can be implemented in a way that improves the quality of the working environment, but not necessarily reducing energy costs, as follows:

(a) Comfort might be improved by draught-proofing, insulating the building fabric, resetting controls, providing additional controls or installing alternative systems. Changes in the temperature, humidity or lighting levels may be desirable. Productivity can be increased because the occupants are more satisfied with the working environment.

(b) Closer control of space conditions can be essential to the effective operation of buildings or equipment and could result in higher standards of quality and safety.

B4 ENVIRONMENTAL BENEFITS

Environmental benefits that arise from using energy more efficiently may include —

(a) reduction of CO_2 and other emissions both from the site itself and upstream of energy suppliers that can be harmful to the environment;

(b) reduction of environmental impacts related to transmission, delivery or transport of energy;

(c) reduction of regional and national energy demand;

(d) conservation of natural resources particularly fossil fuels and other non-renewable fuels; and

(e) promotion of the organization as environmentally responsible.

B5 MEASURES

B5.1 Zero or low cost investment measures

Zero or Low cost investment measures could include —

(a) general good housekeeping, ‘switch-off’ campaigns, avoiding wasteful practices;

(b) adjustment of existing controls to match actual requirements of the process or occupancy;

(c) change of fuel purchasing tariffs or better selection of fuel where there is a dual-fuel capability;

(d) rescheduling of activities, planning to take advantage of tariff structures, and changing the use of building space; and

(e) installation of low cost items such as, thermostats, time-switches and sections of pipework insulation or draught proofing.

B5.2 Low to medium cost investment measures

Low to medium cost investment measures involve capital expenditure and could include —

(a) installation of new or replacement controls, which not only control energy costs but also increase quality and productivity, improve comfort, reduce waste and result in other operational benefits;

(b) insulation or refurbishment of roofs, walls, windows and floors to reduce heat loss, prevent draughts or reduce solar gain, as appropriate; and

(c) installation of additional metering and facilities to monitor energy use.

B5.3 High cost investment measures

High cost investment measures would have a comparatively large capital expenditure and could include —

(a) replacement or upgrading of plant and equipment, e.g. boilers, chillers, water heaters and lighting, to improve efficiency and reduce energy, maintenance and other operating costs;

(b) installation of a building energy management system to control and monitor building services and site energy flows; and

(c) major changes in the methods of generating heat or power, e.g., decentralization of boiler plant, introduction of a combined heat and power scheme, cogeneration.

APPENDIX C
SUMMARY OF TYPICAL ENERGY AUDIT DELIVERABLES

(Informative)

Deliverables	Level 1	Level 2	Level 3
Verbal report	Yes	Yes	Yes
Abbreviated report	Yes	No	No
Full analysis and report	No	Yes	Yes
Metering	No	Desirable	Yes
Formal presentation to senior managers	No	If requested	Yes
Provision of an itemized and prioritized list of recommendations to reduce energy consumption	Short list of high priority actions	Yes	Detailed evaluations
Level of detail of recommendations for implementation	Recommendations for further action, if relevant	Recommendations with brief description of necessary works	Detailed recommendations that will allow design and documentation to proceed
Analysis of 24 months' bills and comparison with benchmark	Yes	Yes	Yes
Preparation of monthly or seasonal energy consumption profiles	Yes	Yes	Yes
Preparation of energy consumption targets and indicators	No	Yes	Yes
Site visit and commenting on major wastes	No	Yes	Yes
Tariff analysis	Yes	Yes	Yes
Listing of major uses	No	If relevant to audit	Yes
Model of energy use	No	If requested	Yes
Daily load curves for site	No	Yes	Yes
Daily load curves for major plant	No	If requested	Yes
Measurement of light levels	No	Yes	Yes (if relevant)
Monitoring of temperatures and other key parameter	No	No	Yes
Detailing key aspects of building fabric	No	Yes	Yes (if relevant)
Implementation specifications	No	If requested (post audit activity)	If requested (post audit activity)
Tariff negotiations with utilities	No	If requested (post audit activity)	If requested (post audit activity)
Bill monitoring for 18 months after report handover	No	If requested (post audit activity)	If requested (post audit activity)

APPENDIX D

DATA TABLES FOR USE IN ENERGY AUDIT REPORTS

(Normative)

(To be completed by the energy audit contractor at the end of the full audit)

On satisfactory completion of the energy audit, the 'End of Audit' Tables D1, D2, and D3 shall be used by the auditor to provide a record of performance measures and energy saving opportunities in the energy audit report to enable energy management options to be assessed more effectively, and calculation of savings at a future date.

AUDITOR DETAILS:

Name of Auditor: .....

Nominated Individual: .....

Date of Audit Commencement: .....

Phone No.: .....

ENERGY USER DETAILS:

Name of Audit Site: .....

Address of Audit Site: .....

Name of Site Audit Manager: .....

Phone No.: .....

TABLE D1

SUMMARY OF ANNUAL ENERGY USE

ergy form	Unit of measure	Annual consumption	Energy conversion factor (Unit to GJ)	Greenhouse coefficient energy to CO_2 equivalent	Energy total		Annual greenhouse emissions		Annual cost total	
					GJ	%	Tonnes	%	$	%
	GJ		1							
	KWh		0.0036							
	Litres		0.0342							
	Litres or		0.0384							
	Tonnes		45.7							
	Litres or		0.0386							
	Tonnes		45.5							
	Litres or		0.0266							
	Tonnes		50.3							
	*		*							
	Litres		0.0376							
gh sulphur)	Tonnes		42.9							
w sulphur)	Tonnes		· 44.5							
	Tonne		· 19.7							
	Tonnes		· 28.5							
(Please specify)										
						100				100

pplier for units supplied and conversion factor, also Australian Greenhouse Office and New Zealand Ministry for the Environment for Greenhouse gas factors .

TABLE D2

PERFORMANCE INDICATORS

ation of nergy	Energy consumed (relevant UoM*)		Energy intensity parameter (e.g. floor space, occupancy, unit of production)	Energy intensity (e.g. kWh/unit of production)		Greenhouse gas emission intensity (e.g. kg CO_2/unit of production)		Energy cost intensity (e.g. $/unit of production)	
	Current	Target		Current	Target	Current	Target	Current	Target
ng									
g									
ation									
g									
port									
ng s y)									

= Unit of Measure, such as kWh, MJ, litres, etc.

TABLE D3

ENERGY AND COST SAVING OPPORTUNITIES IDENTIFIED

ations	Report ref.	Major fuel type involved	(b) Estimated annual savings			(c) Estimated implementation cost. $$	(d) Simple payback period[(c)/b(i)]
			b (i) $	b (ii) GJ	b (iii) tonnes CO_2		
	Total						

ecommendations to be listed in order of priority of implementation. (Where alternative recommendations are given in the report, the energy auditor's preferred mmendation only to be stated here.)

d) All cost implications arising from necessary maintenance or operating changes, to be allowed for within (b) and (c) in calculating (d).

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ISBN 0 7337 3576 2

Printed in Australia

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