
Energy audits — Requirements with guidance for use

*Audits énergétiques — Exigences et recommandations de mise en
oeuvre*

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is Technical Committee ISO/TC 242, *Energy management*.

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Introduction

The purpose of this International Standard is to define the minimum set of requirements leading to the identification of opportunities for the improvement of energy performance.

An energy audit comprises a detailed analysis of the energy performance of an organization, equipment, system(s) or process(es). It is based on appropriate measurement and observation of energy use, energy efficiency and consumption. Energy audits are planned and conducted as part of the identification and prioritization of opportunities to improve energy performance, reduce energy waste and obtain related environmental benefits. Audit outputs include information on current use and performance and they provide ranked recommendations for improvement in terms of energy performance and financial benefits.

An energy audit can support an energy review and can facilitate monitoring, measurement and analysis as described in ISO 50001, or it can be used independently.

This International Standard allows for differences in approach and in terms of scope, boundary and audit objective and seeks to harmonize common aspects of energy auditing in order to enhance clarity and transparency.

The energy audit process is presented as a simple chronological sequence, but this does not preclude repeated iterations of certain steps.

The main body of this International Standard covers the general requirements and framework common to all energy audits that can be supplemented by equivalent national audit standards. For auditing of specific types of facilities, processes or equipment, refer to the relevant international, national and local standards and guidelines, some of which are referenced in the Bibliography.

In this International Standard, the following verbal forms are used:

- “shall” indicates a requirement;
- “should” indicates a recommendation;
- “may” indicates a permission;
- “can” indicates a possibility or a capacity.

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Energy audits — Requirements with guidance for use

1 Scope

This International Standard specifies the process requirements for carrying out an energy audit in relation to energy performance. It is applicable to all types of establishments and organizations, and all forms of energy and energy use.

This International Standard specifies the principles of carrying out energy audits, requirements for the common processes during energy audits, and deliverables for energy audits.

This International Standard does not address the requirements for selection and evaluation of the competence of bodies providing energy audit services, and it does not cover the auditing of an organization's energy management system, as these are described in ISO 50003.

This International Standard also provides informative guidance on its use (see [Annex A](#)).

2 Normative references

There are no normative references.

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3 Terms and definitions (standards.iteh.ai)

For the purposes of this document, the following terms and definitions apply.

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audit objective

purpose of an *energy audit* (3.3) agreed between the *organization* (3.13) and the *energy auditor* (3.5)

3.2

boundary

physical or site limits and/or organizational limits as defined by the *organization* (3.13)

Note 1 to entry: The boundary of an energy management system can be different from the boundary of an *energy audit* (3.3).

Note 2 to entry: The energy audit can include one or more boundaries.

EXAMPLE The whole site and all energy using systems; the boiler plant; the vehicle fleet.

3.3

energy audit

systematic analysis of *energy use* (3.12) and *energy consumption* (3.7) within a defined *energy audit scope* (3.4), in order to identify, quantify and report on the opportunities for improved *energy performance* (3.10)

Note 1 to entry: "Energy audit" is the normal expression in English. There are other expressions for the same concept, e.g. "diagnosi" in Italian and "diagnostic" in French.

3.4

energy audit scope

extent of *energy uses* (3.12) and related activities to be included in the *energy audit* (3.3), as defined by the *organization* (3.13) in consultation with the *energy auditor* (3.5), which can include several boundaries

EXAMPLE Organization, facility/facilities, equipment, system(s) and process(es).

Note 1 to entry: The energy audit scope can include energy related to transport.

3.5 energy auditor

individual, or team of people, conducting an *energy audit* (3.3)

Note 1 to entry: Energy audits can be conducted by the *organization* (3.13) using internal resources or external resources, such as energy consultants and energy service companies.

Note 2 to entry: An energy auditor, whether internal or external, needs to work with internal personnel relevant to the defined *energy audit scope* (3.4).

[SOURCE: EN 16247-1:2012, 3.2, modified — The expression “group of people or body” has been deleted and substituted by “or team of people”.]

3.6 energy balance

accounting of inputs and/or generation of energy supply versus energy outputs based on *energy consumption* (3.7) by *energy use* (3.12)

Note 1 to entry: Energy storage is considered within energy supply or energy use. If included in the *energy audit scope* (3.4), an energy balance needs to include energy storage and feedstock variation, as well as wasted energy, or energy content in material flows.

Note 2 to entry: An energy balance reconciles all energy, goods and products that enter the system *boundary* (3.2) against the energy, goods and products leaving the system boundary.

3.7 energy consumption

quantity of energy applied

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[SOURCE: ISO 50001:2011, 3.7]

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3.8 energy efficiency

ratio or other quantitative relationship between an output of performance, service, goods or energy, and an input of energy

EXAMPLE Conversion efficiency; energy required/energy used; output/input; theoretical energy used to operate/energy used to operate.

Note 1 to entry: Both input and output need to be clearly specified in quantity and quality, and be measurable.

[SOURCE: ISO 50001:2011, 3.8]

3.9 energy flow

description or mapping of processes for transfer of energy or conversion of energy within the defined *energy audit scope* (3.4)

3.10 energy performance

measurable results related to *energy efficiency* (3.8), *energy use* (3.12) and *energy consumption* (3.7)

[SOURCE: ISO 50001:2011, 3.12, modified — Notes 1 and 2 have been deleted as they are specific to energy management.]

3.11 energy performance indicator

quantitative value or measure of *energy performance* (3.10), as defined by the *organization* (3.13)

Note 1 to entry: EnPIs could be expressed as a simple metric, ratio or a more complex model.

[SOURCE: ISO 50001:2011, 3.13]

3.12

energy use

manner or kind of application of energy

EXAMPLE Ventilation; lighting; heating; cooling; transportation; processes; production lines.

[SOURCE: ISO 50001:2011, 3.18]

3.13

organization

company, corporation, firm, enterprise, authority or institution, or part or combination thereof, whether incorporated or not, public or private, that has its own functions and administration and that has the authority to control its *energy use* (3.12) and consumption

Note 1 to entry: An organization can be a person or a group of people.

[SOURCE: ISO 50001:2011, 3.22]

3.14

relevant variable

quantifiable parameter impacting *energy consumption* (3.7)

EXAMPLE Ambient weather indicators; operating parameters (indoor temperature, light level); working hours; production throughput.

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4 Principles

4.1 General

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An energy audit is characterized by reliance on a number of principles. These principles help to make the energy audit an effective and reliable tool in support of management decisions and controls, by providing information on which an organization can act in order to improve its energy performance.

Adherence to these principles provides a consistent approach to an effective energy audit that would enable energy auditors, working independently from one another, to reach similar conclusions in similar circumstances.

It is essential that energy auditor(s) are familiar with applicable health and safety requirements throughout the audit process.

The organization selects the energy auditor(s) based on the expected energy audit scope, boundaries, audit objectives and their competencies.

4.2 Energy auditor

4.2.1 Competency

Application of the following principles by the energy auditor is fundamental to the success of the energy audit.

The energy auditor shall have the knowledge and skills necessary to complete the defined energy audit scope. Competence can be shown by:

- a) appropriate education, skills, experience and/or training considering local or national guidelines and recommendations;
- b) relevant technical skills specific to the energy uses, scope, boundaries and audit objective;

- c) knowledge of appropriate legal and other requirements;
- d) familiarity with the energy uses being audited;
- e) knowledge of the requirements of this International Standard, national and local energy auditing standards;
- f) (for a team member designated as lead energy auditor) having the skills to manage and provide leadership to the energy audit team: a lead auditor should have managerial, professional and leadership skills in order to manage a team.

NOTE 1 Where there is a single auditor, he/she is considered to be the lead auditor.

NOTE 2 Where a national or local energy auditor certification scheme, or equivalent, is available, certified energy auditors can be considered. Some schemes can be technology specific.

NOTE 3 The energy auditor is encouraged to demonstrate continual professional development to maintain and improve auditing knowledge, technical skills and personal attributes. Continual professional development could be achieved through means such as attendance at meetings, seminars, conferences, technical training, work experience, self- study, coaching, or other relevant activities.

4.2.2 Confidentiality

The confidentiality of the audit deliverables shall be agreed upon by the organization and the auditor prior to the start of the energy audit. Energy audit information shall not be used inappropriately for personal gain by the energy auditor, or in a manner detrimental to the legitimate interest of the organization.

NOTE This concept includes the proper handling of sensitive or confidential information.

4.2.3 Objectivity

The energy auditor shall act independently and in an impartial manner. Conflicts of interest (personal, financial or other) shall be identified and disclosed to the organization in a timely manner.

If the organization intends to carry out an energy audit using internal personnel, every effort should be made to remove bias and encourage objectivity.

4.2.4 Access to equipment, resources and information

For completion of the energy audit based on the defined energy audit scope and boundaries, access is required to:

- a) the organization, facility/facilities, equipment, system(s) and process(es);
- b) personnel (engineering, operations, maintenance, etc.), their equipment vendors, contractors and others to collect information pertinent and useful to the energy audit and analysis of data;
- c) other information sources, such as drawings, manuals, test reports, historical utility bill information, monitoring and control data, electrical equipment panels and calibration records.

4.3 Energy audit

The energy audit shall be conducted according to the following principles:

- a) the audit is consistent with the agreed energy audit scope, boundary and audit objective(s);
- b) the measurements and observations are appropriate to the energy uses and consumption;
- c) the collected energy performance data are representative of the activities, processes, equipment and systems;

- d) the used data for quantifying energy performance and identifying improvement opportunities are consistent and unique;
- e) the process of collecting, validating and analysing data is traceable;
- f) the energy audit report provides energy performance improvement opportunities based on appropriate technical and economic analysis.

NOTE Appropriate analysis is consistent with the energy audit scope and sufficiently detailed to allow for effective decision making.

4.4 Communication

The energy auditor and organization shall establish communication channels and methods necessary to facilitate the audit in a timely manner. Clear lines of communication are essential for the energy audit team, among the team and with the organization, in a timely manner.

4.5 Roles, responsibilities and authority

The energy auditor(s) and the organization shall determine their respective roles, responsibilities and authority prior to the start of the energy audit.

NOTE [Annex A](#) provides guidance on the typical roles and responsibilities during an energy audit.

5 Performing an energy audit

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5.1 General

The energy audit process consists of the following stages, as illustrated in [Figure 1](#):

- a) energy audit planning ([5.2](#));
- b) opening meeting ([5.3](#)) and data collection ([5.4](#));
- c) measurement plan ([5.5](#));
- d) conducting the site visit ([5.6](#));
- e) analysis ([5.7](#));
- f) energy audit reporting ([5.8](#));
- g) closing meeting ([5.9](#)).

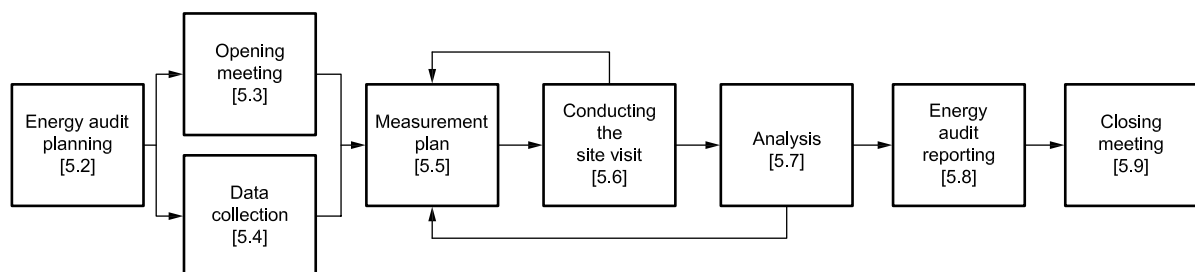


Figure 1 — Energy audit process flow diagram

5.2 Energy audit planning

Energy audit planning activities are essential to define the energy audit scope and the objective(s), and to gather preliminary information from the organization.

In order to develop the energy audit scope and ensure that an effective energy audit is conducted, the following shall apply.

a) The energy auditor and the organization shall agree on the following:

- 1) the energy audit scope, boundaries and objective(s);
- 2) needs and expectations to achieve the audit objectives;
- 3) the level of detail required;

NOTE 1 [Annex A](#) provides guidance that might be useful at the planning stage, including indicative types of audit.

- 4) the time period to complete the energy audit;
- 5) criteria for evaluating and ranking opportunities for improving energy performance;

EXAMPLE 1 Return on investment; potential energy saving over time; life cycle costing; incremental cost analysis for replacement with more energy efficient equipment.

NOTE 2 Opportunities for improving energy performance can include non-energy benefits.

- 6) time commitments and other resources from the organization;
- 7) relevant data to be made available prior to the start of the energy audit;

EXAMPLE 2 Drawings; plant layout; historical energy consumption; utility bills when appropriately verified; equipment manuals and other technical documentation, including planned measurement and/or inspections to be made during the energy audit.

- 8) expected deliverables and report format;
 - 9) whether a draft of the final report should be presented to the organization for comment;
 - 10) the organization's representative responsible for the energy audit process;
 - 11) the process for agreeing on any change in the energy audit scope.
- b) The energy auditor shall request information to establish the energy audit context, including, as applicable:

- 1) regulatory requirements or other variables affecting the energy audit;
- 2) regulatory or other constraints affecting the scope or other aspects of the proposed energy audit;
- 3) strategic plans that may affect the organization's energy performance;

EXAMPLE 3 Asset management plans; changing product mix; expansion plans; planned projects; outsourcing facilities management or equipment maintenance.

- 4) management systems, such as environmental, quality, energy management or others;
- 5) factors or special considerations that may change the energy audit scope, process and conclusions;