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Energy audits —

Part 1:
General requirements with guidance for use

ISO/TC **301**

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Foreword

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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 document 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).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 301, *Energy management and energy savings*.

This first edition cancels and replaces ISO 50002:2014, which has been technically revised.

The main changes are as follows:

— the terms and definitions have been aligned with ISO 50001:2018;

— new principles have been added;

— decarbonization options have been included in improvement opportunities (renewable energy and achievement of net zero);

— energy auditor competencies have been clarified.

A list of all parts in the ISO 50002 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

0.1 Background

An energy audit comprises multiple yet interlinked activities and processes ranging from establishing the scope of the energy audit, collecting and measuring the appropriate data, analysing the energy performance of an organization, building(s), equipment, system(s) and/or process(es), site observations and using the information to draw conclusions about energy performance improvement actions (EPIAs). The intended result of energy audits is to use a structured and planned process to identify and prioritize EPIAs, which will help reduce wasted energy and can obtain related environmental benefits.

Audit outputs include information on current energy use and performance, and they provide ranked recommendations for improvement that are relevant and practicable. The benefits of carrying out an energy audit include:

— reduced energy consumption;

— economic and financial benefits;

— reduced CO_{2e} emissions and greenhouse gas (GHG) reduction arising from energy use;

— related environmental benefits (e.g. air quality, water reduction);

— distribution of energy use and GHG emissions among various energy systems;

— benchmarking of energy use;

— assessment of energy performance of specific energy systems;

— other benefits (e.g. production efficiencies, maintenance, training).

0.2 ISO 50002 series

The ISO 50002 series was revised with ISO 50002:2014 and EN 16247-3:2022 as the starting point. It 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 ISO 50002 series includes the following parts:

— This document provides the principles and defines the common set of requirements for conducting energy audits for buildings, equipment, processes, systems, transport and other applications needed to identify opportunities to improve energy performance. The energy audit process is presented as a simple chronological sequence, but this does not preclude repeated iterations of certain steps.

— ISO 50002-2 provides guidance for using this document when conducting an energy audit of a building or a portfolio of buildings.

— ISO 50002-3 provides guidance for using this document when conducting an energy audit involving processes. This applies to any process that converts an input of an organization into saleable outputs such as a manufacturing process or industrial process.

The ISO 50002 series benefits organizations, energy auditors, and stakeholders worldwide by providing clarity and consistency for designing, developing, conducting and reporting energy audits. Specifically, the use of the ISO 50002 series:

— enhances the credibility and transparency of energy auditing activities;

— promotes a common understanding and expectations between the organization and the energy auditors on the energy audit processes and the roles and responsibilities of each parties;

— facilitates the development and implementation of EPIAs that provide credible and tracible analysis;

— facilitates the ability to track performance and progress of the energy audit activity;

— facilitates the design of energy audit services by organizations providing energy auditing services;

— supports sustainable development and the actions needed to achieve a low-carbon economy.

The applicability of this document to other International Standards is given in Annex B.

0.3 Using this document as part of an ISO 50001 energy review

An energy audit can be used as part of an ISO 50001 energy review or part of other associated organizational initiatives (e.g. environmental management, sustainability, net zero initiatives). It can also be conducted independent of the organization's other initiatives.

Some organizations implementing an ISO 50001 energy management system can require additional support to implement the technical elements of an ISO 50001 energy review. Using this document as part of an ISO 50001 energy review enables the organization to:

— organize, plan and resource the energy review activities;

— ensure that the activities are carried out by competent energy auditors;

— be able to monitor and track its progress.

Clause B.1 gives additional guidance on how to structure an energy audit as part of an ISO 50001 energy review.

If an energy audit is going to be part of a wider EnMS, the energy auditor can be required to have competence in ISO 50001.

Energy audits —

Part 1:
General requirements with guidance for use

1 Scope

This document specifies:

— the principles of carrying out energy audits;

— the process requirements for carrying out an energy audit in relation to energy performance;

— the roles and responsibilities of the organization and the energy auditor;

— deliverables for energy audits.

It gives guidance on determining and/or evaluating the competence of the energy auditor.

This document is applicable to any organization regardless of its size, complexity, geographical location, organizational culture or the products and services it provides, irrespective of the quantity, use or types of energy used.

This document does not apply to selecting and evaluating the competence of bodies providing energy audit services.

It also does not apply to auditing an organization's energy management system (EnMS), as this is described in ISO 50003.

Additional documents provide information guidance on applying the energy audit process to buildings (see ISO 50002-2), processes (see ISO 50002-3) and other applications or uses.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
audit objective
purpose of an *energy audit* (3.4) agreed between the *organization* (3.18) and the *energy auditor* (3.6)

3.2
boundary
physical and/or organizational limits as agreed between the *organization* (3.18) and the *energy auditor* (3.6) for the purpose of conducting an *energy audit* (3.4)

EXAMPLE A process, a group of processes, a site, multiple sites under the control of an organization, an entire organization.

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

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

[SOURCE: ISO 50006:2023, 3.1.2, modified — "virtual" deleted and "as agreed between the organization and the energy auditor for the purpose of conducting an energy audit" replaced "as defined by the entity for a stated purpose". Example added. Notes to entry replaced.]

3.3
energy
electricity, fuels, steam, heat, compressed air and other similar media

Note 1 to entry: For the purposes of this document, energy refers to the various types of energy, including renewable, which can be purchased, stored, treated, used in an equipment or in a process, or recovered.

[SOURCE: ISO 50001:2018, 3.5.1]

3.4
energy audit
systematic analysis of *energy use* (3.16), *energy balance* (3.7) and *energy consumption* (3.9) within a defined *energy audit scope* (3.5) and time frame, in order to identify, quantify and report on the opportunities for improved *energy performance* (3.12)

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 "diagnóstico" in Portuguese.

Note 2 to entry: In industry, "energy audits" and "energy assessment" are both commonly used terms. An assessment deals primarily with examining adherence to a set of concepts and principles and evaluating the outcome through both quantitative and qualitative data. In contrast, the focus of an audit is primarily on procedures and processes that are to be followed.

3.5
energy audit scope
extent of *energy use* (3.16) and related activities to be included in the *energy audit* (3.4), as defined by the *organization* (3.18) in consultation with the *energy auditor* (3.6), which can include several *boundaries* (3.2)

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

Note 1 to entry: The energy audit scope can include *energy* (3.3) related to transport.

3.6
energy auditor
individual or team of people conducting an *energy audit* (3.4)

Note 1 to entry: Energy audits can be conducted by the *organization* (3.18) 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* (3.5).

[SOURCE: EN 16247-1:2022, 3.2, modified — "or team of people" replaced "group of people or body", Note 1 to entry deleted.]

3.7
energy balance
accounting, by energy type and/or *energy use* (3.16), of energy input and energy output of an energy-using system, considering energy storage and energy loss

Note 1 to entry: Energy storage is considered within energy supply or energy use. If included in the *energy audit scope* (3.5), 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* (3.3), goods and products that enter the system *boundary* (3.2) against the energy, goods and products leaving the system boundary.

3.8
energy baseline
EnB
value providing a basis for comparison of *energy performance* (3.12)

[SOURCE: ISO 50006:2023, 3.1.4, modified — Notes 1 and 2 to entry deleted.]

3.9
energy consumption
quantity of *energy* (3.3) applied

Note 1 to entry: Energy consumption can be represented in volume (e.g. litres of fuel), mass, weight units or energy units (e.g. GJ, kWh).

[SOURCE: ISO 50006:2023, 3.1.5]

3.10
energy efficiency
ratio or other quantitative relationship between an output of process and an input of *energy* (3.3)

EXAMPLE Conversion efficiency, energy required/energy consumed, theoretical energy used to operate/energy used to operate.

Note 1 to entry: The output of a process can be products, services or energy.

Note 2 to entry: Both input and output should be clearly specified in terms of quantity and quality and should be measurable.

[SOURCE: ISO 50006:2023, 3.16, modified — Example revised.]

3.11
energy flow
description or mapping of processes for transfer of *energy* (3.3) or conversion of energy within the defined *energy audit scope* (3.5)

3.12
energy performance
measurable result(s) related to *energy efficiency* (3.10), *energy use* (3.16) and *energy consumption* (3.9)

[SOURCE: ISO 50001:2018, 3.4.3, modified — Notes 1 and 2 to entry deleted.]

3.13
energy performance improvement
improvement in measurable results of *energy efficiency* (3.10) or *energy consumption* (3.9) related to *energy use* (3.16), compared to a baseline

[SOURCE: ISO 50001:2018, 3.4.6, modified — “a baseline” replaced “the energy baseline”.]

3.14
energy performance improvement action
EPIA
action or measure or group of actions or measures implemented or planned within an *organization* (3.18) intended to achieve *energy performance improvement* (3.13) through technological, managerial or operational, behavioural, economical or other changes

[SOURCE: ISO 50015:2014, 3.5]

3.15
energy performance indicator
EnPI
measure used to quantify *energy performance* (3.12)

Note 1 to entry: If the EnPI is used for the demonstration of *energy performance improvement* (3.13), it refers to *energy efficiency* (3.10) or *energy consumption* (3.9).

Note 2 to entry: The EnPI is defined by the *organization* (3.18).

Note 3 to entry: EnPI(s) can be calculated by using an energy model.

[SOURCE: ISO 50006:2023, 3.1.10]

3.16
energy use
energy end-use
application of *energy* (3.3)

EXAMPLE Ventilation, lighting, heating, cooling, transportation, processes, data storage.

Note 1 to entry: Energy use is based on "what the energy is used for" as compared to *energy consumption* (3.9) which is based on "how much energy is used".

Note 2 to entry: The application can be from any energy type including renewables.

[SOURCE: ISO 50006:2023, 3.1.7]

3.17
normalization
process to enable analysis under equivalent or standard conditions

Note 1 to entry: Normalization can be used for the purpose of comparison of *energy performance* (3.12) or *energy performance improvement* (3.13), which accounts for the changes in *relevant variables* (3.19).

[SOURCE: ISO 50006:2023, 3.1.13]

3.18
organization
person or group of people that has its own functions with responsibilities, authorities and relationships to achieve its objectives, and that has the authority to control its *energy use* (3.16) and consumption

Note 1 to entry: The concept of an organization includes, but is not limited to, sole-trader, company, corporation, firm, enterprise, authority, partnership, charity or institution or part or combination thereof, whether incorporated or not, public or private.

Note 2 to entry: The person or an organization requesting an *energy audit* (3.4) can be called a "client". The subject of the energy audit can be called an "auditee". Their roles and responsibilities in the energy audit can be different.

[SOURCE: ISO 50001:2018, 3.1.1, modified — "and that has the authority to control its energy use and consumption" added to the definition. Note 2 to entry added.]

3.19
relevant variable
quantifiable factor that significantly impacts *energy performance* (3.12) and routinely changes

Note 1 to entry: Significance criteria are discussed and agreed between the *energy auditor* (3.6) and the *organization* (3.18).

EXAMPLE Weather conditions, operating conditions (indoor temperature, light level), working hours, production output.

[SOURCE: ISO 50006:2023, 3.1.15, modified — "determined by" replaced "discussed and agreed between the energy auditor and" in Note 1 to entry. Note 2 to entry deleted.]

3.20
risk
effect of uncertainty

Note 1 to entry: An effect is a deviation from the expected – positive or negative.

Note 2 to entry: Uncertainty is the state, even partial, of deficiency of information related to, understanding or knowledge of, an event, its consequence, or likelihood.

Note 3 to entry: Risk is often characterized by reference to potential "events" and "consequences", or a combination of these.

Note 4 to entry: Risk is often expressed in terms of a combination of the consequences of an event (including changes in circumstances) and the associated "likelihood" of occurrence.

[SOURCE: ISO 50001:2018, 3.4.11]

3.21
sampling
method of studying from representative selected audited objects, instead of the entire number of objects

Note 1 to entry: The selection is called a "sample".

Note 2 to entry: The principle of sampling is to analyse the samples selected in order to issue recommendations that will be valid for all audited objects.

3.22
significant energy use
SEU
energy use (3.16) accounting for substantial *energy consumption* (3.9) and/or offering considerable potential for *energy performance improvement* (3.13)

Note 1 to entry: Significance criteria are discussed and agreed between the *energy auditor* (3.6) and the *organization* (3.18).

Note 2 to entry: SEUs can be facilities, systems, processes or equipment.

[SOURCE: ISO 50001:2018, 3.5.6 — "discussed and agreed between the energy auditor and" replaced "determined by" in Note 1 to entry.]

3.23
static factor
identified factor that significantly impacts *energy performance* (3.12) and does not routinely change

Note 1 to entry: Significance criteria are discussed and agreed between the *energy auditor* (3.6) and the *organization* (3.18).

EXAMPLE Facility size, design of installed equipment, number of weekly shifts, range of products.

[SOURCE: ISO 50015:2014, 3.22, modified — "significantly" added to the definition. Note 1 to entry added. Example 1 modified. Example 2 deleted.]

4 Principles of energy auditing

4.1 General

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 enables energy auditors, working independently from one another, to reach similar conclusions in similar circumstances.

Clauses 5 and 6 are based on the principles outlined in 4.2 to 4.8.

4.2 Competency

The energy auditor should undertake the energy audit if suitably competent to do so within the agreed energy audit scope, boundaries and audit objectives. The energy auditor should also plan to conduct the energy audit ethically, truthfully and accurately. The minimum level of competence required for an energy auditor is described in Clause 6.

4.3 Confidentiality

The confidentiality of the audit deliverables should 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 and data.

4.4 Objectivity

The energy auditor should act independently, in an impartial manner and with due professional care. Conflicts of interest (personal, financial or other) should 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.

4.5 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, site(s), asset(s), equipment, system(s) and energy-using 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.

4.6 Evidence-based approach

The energy audit should be based on representative data drawn from typical operation, measurements and observations collected. On-site measurements should be obtained based on a traceable, accurate and repeatable manner. Identified energy performance opportunities should be analysed and quantified using appropriate data and technical and economic analysis.

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