



BSI Standards Publication

Energy audits -

Part 2: Buildings

National foreword

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A list of organizations represented on this committee can be obtained on request to its committee manager.

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European foreword

This document (EN 16247-2:2022) has been prepared by the Joint Technical Committee CEN-CENELEC/JTC 14 “Energy management and energy efficiency in the framework of energy transition”, the secretariat of which is held by UNI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2023, and conflicting national standards shall be withdrawn at the latest by February 2023.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN-CENELEC shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 16247-2:2014.

Significant changes compared to the previous edition are:

- a) terms and definition updated;
- b) structure aligned with EN 16247-1.

This document is part of series EN 16247 “*Energy audits*”, which comprises the following:

- *Part 1: General requirements;*
- *Part 2: Buildings;*
- *Part 3: Processes;*
- *Part 4: Transport;*
- *Part 5: Competence of energy auditors.*

This Part provides additional material to Part 1 for the Buildings sector and is intended to be used in conjunction with Part 1.

This document has been prepared under a mandate given to CEN and CENELEC by the European Commission and the European Free Trade Association.

Any feedback and questions on this document should be directed to the users’ national standards body/national committee. A complete listing of these bodies can be found on the CEN and CENELEC websites.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

Introduction

An energy audit can help an organization to identify opportunities to improve energy performance. It can be part of a site wide energy management system.

The use and operation of buildings requires the provision of services such as heating, cooling, humidification, dehumidification, ventilation, lighting, domestic hot water, transportation systems (e.g. elevators, escalators and moving walkways) in buildings, information systems, including building automation and control systems, and processes. In addition, energy is used by appliances within the building.

The energy consumption depends on:

- local climatic conditions;
- the characteristics of the building envelope;
- the designed indoor environment conditions;
- the characteristics and settings of the technical building systems;
- activities and processes in the building;
- occupant behaviour and operational regime.

Dealing with buildings, the audited objects are sometimes similar, technically simple and numerous (as in the residential sector) but can also be unique, complex and highly technical (such as hospitals, swimming pools and spas, etc.).

Energy audits in buildings may include the whole building or parts of the building or some technical system.

Energy performance indicators (benchmark values, if available) or average statistical specific energy consumption data are usually published nationally for different building types and ages. This information can be used in the analysis to provide comparative energy performance evaluation.

NOTE The energy audits covered under this standard might be independent from building energy performance certification and other legislative requirements.

1 Scope

This document is applicable to specific energy audit requirements in buildings. It specifies the requirements, methodology and deliverables of an energy audit in a building or group of buildings. It is applied in conjunction with, and is supplementary to, EN 16247-1, *Energy audits — Part 1: General requirements*. It provides additional requirements to EN 16247-1 and is applied simultaneously.

If processes are included in the scope of the energy audit, the energy auditor can choose to apply EN 16247-3, *Energy audits — Part 3: Processes*. If on-site transport on a site is included in the scope of the energy audit, the energy auditor can choose to apply EN 16247-4, *Energy audits — Part 4: Transport*.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 16247-1:2022, *Energy audits — Part 1: General requirements*

EN ISO 52000-1:2017, *Energy performance of buildings — Overarching EPB assessment — Part 1: General framework and procedures (ISO 52000-1:2017)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 16247-1 and the following apply.

ISO and IEC maintain terminological 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 building

construction as a whole, including the fabric and all technical building systems, where energy may be used to condition the indoor environment, to provide domestic hot water and illumination and other services related to the use of the building

Note 1 to entry: The term refers to the physical building as a whole, or to all parts thereof, that at least include the spaces and technical building systems that are relevant for the energy performance assessment.

Note 2 to entry: Parts of a building can be physically detached but are on the same building site. For example: a canteen or a guard house or one or more classrooms of a school in a detached part of a building, or an essential space in a dwelling (e.g. bedroom).

[SOURCE: EN ISO 52000-1:2017]

3.2**system boundary**

boundary that includes within it all areas associated with the audited object (both inside and outside the audited object) where energy is consumed or produced

Note 1 to entry: Inside the system boundary the system losses are taken into account explicitly, outside the system boundary they are taken into account in a conversion factor.

3.3**energy need**

energy to be delivered to or extracted from a building in a defined time period by a technical system to provide a building service

3.4**energy carrier**

substance or physical phenomenon that can be used directly or indirectly to be transformed into useful energy

Note 1 to entry: The default energy content of fuels is gross calorific value.

3.5**delivered energy**

energy, expressed per energy carrier, supplied to the technical building systems through the assessment boundary, to satisfy the uses taken into account or to produce the exported energy

Note 1 to entry: Delivered energy can be calculated for defined energy uses or it can be measured.

Note 2 to entry: Energy uses include heating, cooling, ventilation, domestic hot water, lighting, appliances, etc.

3.6**produced energy**

heat or electricity generated within the system boundary

Note 1 to entry: Produced energy can be used within the system boundary or exported.

3.7**exported energy**

energy, expressed for each energy carrier, delivered by the technical building systems through the system boundary and used outside the system boundary

Note 1 to entry: It can be specified by generation types (e.g. CHP, photovoltaic, etc.) in order to apply different weighting factors.

Note 2 to entry: Exported energy can be calculated or it can be measured.

3.8**building services**

the services provided by the technical building systems and by appliances to condition the indoor environment (thermal comfort, air quality, visual and acoustic quality) and other services related to the use of the building

3.9

technical building system

technical equipment for heating, cooling, ventilation, humidification, dehumidification, domestic hot water, lighting, information systems including building automation and control, and on-site energy production

Note 1 to entry: A technical building system can refer to one or a combination of building services (e.g. heating system include heating, domestic hot water system and controls).

Note 2 to entry: A technical building system is composed of different subsystems and includes controls.

Note 3 to entry: On-site energy production can include heat or electricity.

3.10

energy performance improvement action

EPIA

action or measure or group of action or measures implemented or planned within an organization intended to achieve energy performance improvement through technological, managerial or operational, behavioural, economical, or other changes

[SOURCE: ISO 50015:2014, 3.5]

4 Quality requirements

4.1 Energy auditor

4.1.1 Competency

The energy auditor shall demonstrate that they have qualifications or experience covering the scope, complexity and thoroughness of the audit.

NOTE See EN 16247-5.

4.1.2 Confidentiality

The energy auditor shall respect all the legal and commercial confidentiality requirements agreed with the organization, which cover all parties involved, such as tenants, maintenance organizations, building occupants.

4.1.3 Objectivity

Objectivity is defined in EN 16247-1:2022, 4.1.3.

4.1.4 Transparency

Transparency is defined in EN 16247-1:2022, 4.1.4.

4.2 Energy audit process

When a sampling method is used, any selected sample of spaces, systems or equipment shall be representative of the whole building or of a group of buildings.

NOTE 1 When sampling methods are used the audit level, as defined in EN 16247-1:2022, Annex B, should be documented.

NOTE 2 See informative Annex A of EN 16247-1:2022 for a flow diagram of the energy audit process.

5 Elements of the energy audit process

5.1 Preliminary contact

The energy auditor shall identify all parties/organizations and their roles in ownership, management, use, operation and maintenance of the building and their respective impacts and interests on energy use and consumption.

NOTE 1 See informative Annex A: Examples of parties of an energy audit in buildings.

The scope of the audit should be agreed to cover technical interaction of the systems within the building, and the interaction of the systems with the building. Optimization of some specific energy use to the exclusion of others may give misleading results.

The agreed aims of the energy audit may contain:

- a) reducing energy consumption and costs;
- b) reducing environmental impact;
- c) checking or ensuring indoor environment for quality of health and well-being (for example, comfort, indoor air quality, and illuminance levels);
- d) complying with legislation or with voluntary obligations.

The energy audit scope and boundaries shall define what is included, in terms of:

- e) which buildings from a list of buildings or parts of a building;
- f) which energy services;
- g) which technical building systems;
- h) which areas and systems outside the building;
- i) which energy performance indicators could be used as appropriate to the audit.

The energy audit level of thoroughness, as defined in EN 16247-1:2022, Annex B shall be agreed, taking into account that it will impact:

- j) time on site;
- k) choice of samples;
- l) requirements of modelling;
- m) requirements for measurements;
- n) requirements of metering, including sub-metering;
- o) requirements of defining the energy performance improvement actions (EPIA);
- p) required auditor's skills.

NOTE 2 See EN 16247-1:2022 informative Annex B: Examples of energy audit level.

5.2 Start-up meeting

During the start-up meeting the energy auditor shall agree with the organization on:

- a) timing of site visits, e.g. whether within or outside normal working hours;
- b) level of occupant engagement;
- c) areas of restricted access;
- d) potential health hazards and risks.

The energy auditor shall, where available, obtain from the organization:

- e) set-points and operational limits of indoor environmental conditions (such as temperatures, air flows, air quality, illuminance, noise) and any seasonal variations;
- f) occupancy patterns for the different range of activities within the building;
- g) comments from any occupant or other party on operational performance of the building and the level of the building service;
- h) energy certificates prepared for the building;
- i) whether any building occupant awareness or motivation programmes have been implemented.

5.3 Collecting data

5.3.1 General

The data collection shall be appropriate to the scope and level of thoroughness of the energy audit.

5.3.2 Information request

The energy auditor shall collect with the organization the following data as required by the scope and level of thoroughness of the energy audit:

- a) energy carriers, present and available;
- b) energy related data:
 - 1) delivered, produced and exported energy, for each energy carrier (for example, identify the energy streams for a CHP unit, or for photovoltaic systems where production is used locally or exported);
 - 2) energy consumption data (or readings with related time and date) of any available meters, counters or monitoring systems (e.g. heat meter, domestic hot water meter, fuel meter, burner hour counter);
 - 3) data from individual metering, if available;
 - 4) short-interval (e.g. hourly) energy demand / load curve, if available;
 - 5) relevant related measurements;

The frequency of the data should be appropriate to the scope and thoroughness of the energy audit. Building energy audits may deal with hourly, daily, weekly or monthly consumption data as available and appropriate.

NOTE Where only annual data are available, monthly profiles may be estimated, depending on the level of thoroughness of the audit.

The energy related data should be recorded by the building and control system if available.

- c) Information for quantifying the relevant variable and static factors affecting energy consumption should be recorded by the building control system if available:
 - 1) climatic data (e.g. temperature, degree-days, hygrometry, lighting) from the local building automation and control system (BACS), if available;
 - 2) type of building and requirements of building usage;
 - 3) occupancy patterns, including vacation and out of hours periods;
 - 4) internal set points and other environmental criteria.
- d) information on important changes in the past 3 years or the period covered by the available operational data, concerning:
 - 1) the physical form of the building;
 - 2) the spaces – either in dimension and/or in use;
 - 3) the building envelope (renovation of windows, added insulation, etc.);
 - 4) the technical building systems and the areas they serve;
 - 5) the tenant arrangements;
 - 6) occupancy of spaces (different occupancy times, extended hours behaviour and internal loads);
 - 7) set points and occupant behaviour;
- e) values to be used, adapted to the local/national performance indicators (if relevant):
 - 1) floor area;
 - 2) building volume;
 - 3) others;
- f) existing design, operation and maintenance documents and information, such as:
 - 1) as-built building plans, and any changes in them since the last audit, if applicable;
 - 2) any external factors that may influence the energy performance of the building (e.g. shading by adjacent trees or buildings);
 - 3) indications of supplied building services (i.e. which rooms or zones are heated, cooled, ventilated) on the building lay-out plan;

- 4) technical building system schematics, indicating the system zones, if any;
- 5) control diagrams and settings;
- 6) appliance and component data and ratings;
- g) the building information model (BIM) and/or design models of the building, if available;
- h) energy using equipment in the occupied spaces and other internal loads.

5.3.3 Review of the available data

The energy auditor shall review the information collected and provided by the organization.

The energy auditor shall review whether the scope and boundaries of the energy audit is still appropriate once initial information has been received.

The energy auditor shall judge whether or not the information provided by the organization allows the energy audit process to continue and the agreed objectives to be achieved.

Where there is missing data the organization will be given a choice to produce the missing data or accept that the auditor will have to make assumptions (that will be clearly detailed).

The energy auditor shall, based on experience and competence, choose the energy using systems and items to be checked on site, depending on the aim, scope and thoroughness of the energy audit.

5.3.4 Preliminary data analysis

The energy auditor shall carry out an analysis of the data collected to:

- a) undertake a preliminary analysis of the audited object's energy balance on the basis of energy data;
- b) establish the relevant variables and static factors;
- c) establish the relevant energy performance indicators;
- d) evaluate the distribution of energy consumption (consumption breakdown) if possible, depending on the measured data available;
- e) define the significant energy uses;
- f) if there is sufficient information, establish an initial energy reference (energy baseline) to be used for quantifying the impacts of energy saving interventions;
- g) plan further data collection and measurement to be carried out during field work.

The energy auditor should develop a preliminary list of EPIA.

5.4 Measurement plan

See EN 16247-1:2022, 5.4.

5.5 Sampling methods

See EN 16247-1:2022, 5.5.