



BSI Standards Publication

Energy audits

Part 1: General requirements

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 16247-1:2022) 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of an identical text or by endorsement, at the latest by February 2023, and conflicting national standards shall be withdrawn at the latest by February 2023.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 16247-1:2012.

Significant changes compared to the previous edition are:

- a) Terms and definition updated to be compliant with ISO 50001;
- b) New Annex A Energy Audit Process Flow Diagram added;
- c) New Annex B Examples of energy Audit level added;
- d) New Annex C Sampling (Based on ISO 19011:2018 Guidelines for auditing management systems) added.

This Part covers the general requirements common to all energy audits. There are four further parts of the EN 16247 series, which provide additional material to Part 1 for four specific sectors.

The other parts of EN 16247 “*Energy audits*” are:

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

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 is an important step for an organization, whatever its size or type, wanting to improve its energy performance, reduce energy consumption and bring related environmental and other benefits.

This document defines the attributes of a high-quality energy audit. It states the requirements for energy audits and corresponding obligations within the energy auditing process. It recognizes that there are differences in approach to energy auditing in terms of scope, aims and thoroughness, but seeks to harmonize common aspects of energy auditing in order to bring more clarity and transparency to the market for energy auditing services. The energy audit process is presented as a simple chronological sequence; this does not preclude however repeated iterations of certain steps.

This document applies to commercial, industrial, residential and public-sector organizations. This document does not deal with the energy audit programme/scheme properties (such as programme administration, training of energy auditors, quality control issues, energy auditors' tools, etc.).

1 Scope

This document specifies the requirements, common methodology and deliverables for energy audits. It is applicable to all forms of establishments and organizations, all forms of energy and energy uses.

This document covers the general requirements common to all energy audits. Specific energy audit requirements complete the general requirements in separate parts dedicated to energy audits for buildings, industrial processes and transport.

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 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

energy audit

systematic inspection and analysis of energy use and energy consumption of a site, building, system or organization with the objective of identifying energy flows and the potential for energy efficiency improvements and reporting them

3.2

energy auditor

individual, group of people or body carrying out an energy audit

Note 1 to entry: A group or body can include subcontractors.

3.3

audited object

site, building, equipment, system, process, vehicle, service or *organization* (3.4) which is the subject of the *energy audit* (3.1)

3.4

organization

person or group of people that has its own functions with responsibilities, authorities and relationships to achieve its objectives

Note 1 to entry: The concept of 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.

[SOURCE: ISO 50001:2018, 3.1.1]

3.5

energy consumption

quantity of *energy* (3.16) applied

[SOURCE: ISO 50001:2018, 3.5.2]

3.6

energy efficiency

ratio or other quantitative relationship between an output of performance, service, goods, commodities, or *energy* (3.16), and an input of energy

EXAMPLE Conversion efficiency; energy required/energy consumed.

Note 1 to entry: Both input and output should be clearly specified in terms of quantity and quality and be measurable.

[SOURCE: ISO 50001:2018, 3.5.3]

3.7

energy performance

measurable result(s) related to *energy efficiency* (3.6), *energy use* (3.10) and *energy consumption* (3.5)

Note 1 to entry: Energy performance can be measured against the *organization's* (3.4) objectives, *energy targets* (3.20) and other energy performance requirements.

Note 2 to entry: Energy performance is one component of the *performance* of the *energy management system* (3.18).

[SOURCE: ISO 50001:2018, 3.4.3, modified]

3.8

energy performance indicator

EnPI

measure or unit of *energy performance* (3.7), as defined by the *organization* (3.4)

Note 1 to entry: EnPI(s) can be expressed by using a simple metric, ratio, or a model, depending on the nature of the activities being measured.

Note 2 to entry: See ISO 50006 for additional information on EnPI(s).

[SOURCE: ISO 50001:2018, 3.4.4]

3.9

energy performance improvement action

EPIA

action or measure or group of action or measures implemented or planned within an *organization* (3.4) intended to achieve *energy performance improvement* (3.21) through technological, managerial or operational, behavioural, economical, or other changes

[SOURCE: ISO 50015:2014, 3.5]

3.10

energy use

application of *energy* (3.16)

EXAMPLE Ventilation; lighting; heating; cooling; transportation; data storage; production process

Note 1 to entry: Energy use is sometimes referred to as “energy end-use”.

[SOURCE: ISO 50001:2018, 3.5.4]

3.11

sampling method

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

Note 1 to entry: The selection is called 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 object.

3.12

significant energy use

SEU

energy use (3.10) accounting for substantial *energy consumption* (3.5) and/or offering considerable potential for *energy performance improvement* (3.21)

Note 1 to entry: Significance criteria are determined by the organization (3.4).

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

[SOURCE: ISO 50001:2018, 3.5.6]

3.13

energy balance

accounting of inputs and/or generation of energy supply versus energy outputs based on *energy consumption* (3.5) by *energy use* (3.10)

Note 1 to entry: Energy storage is considered within energy supply or energy use. If included in the energy audit scope (3.23), 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 against the energy, goods and products leaving the system boundary.

[SOURCE: ISO 50002:2014, 3.6]

3.14

static factor

identified factor that significantly impacts *energy performance* (3.7) and does not routinely change

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

Note 1 to entry: Significance criteria are determined by the *organization* (3.4).

[SOURCE: ISO 50015:2014, 3.22, modified — Note 1 to entry added, and EXAMPLE 1 have been modified and EXAMPLE 2 has been deleted.]

3.15

relevant variable

quantifiable factor that significantly impacts *energy performance* (3.7) and routinely changes

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

Note 1 to entry: Significance criteria are determined by the *organization* (3.4).

[SOURCE: ISO 50015:2014, 3.18, modified — Note 1 to entry has been added and wording of examples has been modified]

3.16

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]

3.17

process

set of interrelated or interacting activities which transform inputs into outputs

Note 1 to entry: A process related to an *organization's* (3.4) activities can be

- physical (e.g. energy-using processes, such as combustion), or
- business or service (e.g. order fulfilment).

[SOURCE: ISO 50001:2018, 3.3.6]

3.18

energy management system

EnMS

management system (3.19) to establish an energy policy, objectives, *energy targets* (3.20), action plans and *process(es)* (3.17) to achieve the objectives and energy targets

[SOURCE: ISO 50001:2018, 3.2.2]

3.19

management system

set of interrelated or interacting elements of an *organization* (3.4) to establish policies and objectives and *processes* (3.17) to achieve those objectives

Note 1 to entry: A management system can address a single discipline or several disciplines.

Note 2 to entry: The system elements include the organization's structure, roles and responsibilities, planning and operation.

Note 3 to entry: In some management systems, the scope of a management system can include the whole of the organization, specific and identified functions of the organization, specific and identified sections of the organization, or one or more functions across a group of organizations. The EnMS scope includes all energy types within its boundaries.

[SOURCE: ISO 50001:2018, 3.2.1]

3.20

energy target

quantifiable objective of *energy performance improvement* (3.21)

Note 1 to entry: An energy target can be included within an objective.

[SOURCE: ISO 50001:2018, 3.4.15]

3.21

energy performance improvement

improvement in measurable results of *energy efficiency* (3.6), or *energy consumption* (3.5) related to *energy use* (3.10), compared to the *energy baseline* (3.22)

[SOURCE: ISO 50001:2018, 3.4.6]

3.22

energy baseline

EnB

quantitative reference(s) providing a basis for comparison of *energy performance* (3.7)

Note 1 to entry: An energy baseline is based on data from a specified period of time and/or conditions, as defined by the *organization* (3.4).

Note 2 to entry: One or more energy baselines are used for determination of *energy performance improvement* (3.21), as a reference before and after, or with and without implementation of energy performance improvement actions.

Note 3 to entry: See ISO 50015 for additional information on measurement and verification of energy performance.

Note 4 to entry: See ISO 50006 for additional information on EnPIs and EnBs.

[SOURCE: ISO 50001:2018, 3.4.7]

3.23

energy audit scope

extent of *energy uses* (3.10) and related activities to be included in the *energy audit* (3.1), as defined by the *organization* (3.4) in consultation with the *energy auditor* (3.2), 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.

[SOURCE: ISO 50002:2014, 3.4]

3.24

site

activities of *organization* (3.4) within the boundaries of the audited object, service or system

3.25

interested party

person or *organization* (3.4) that can affect, be affected by, or perceive itself to be affected by a decision or activity

[SOURCE: ISO 50001:2018, 3.1.5]

3.26

net present value

NPV

sum of discounted cash flows over the whole lifetime of an investment

[SOURCE: EN 17463:2021, 3.13]

4 Quality requirements

4.1 Energy auditor

4.1.1 Competency

The energy auditor shall be suitably qualified (according to local guidelines and recommendations or as defined in EN 16247-5:2015) and experienced for the type of work being undertaken and for the agreed scope, aim and thoroughness.

4.1.2 Confidentiality

The energy auditor shall treat as confidential all information provided by the organization or disclosed during the energy audit.

4.1.3 Objectivity

The energy auditor shall treat the organization's interests as paramount and act in an objective manner.

The energy auditor shall ensure that the requirements apply to its subcontractors, if any.

4.1.4 Transparency

If the energy auditor has business goals, product and process or marketing involvement that might be in conflict with the energy audit, the energy auditor shall disclose any conflict of interests in a transparent way.

4.2 Energy audit process

The energy audit process shall be:

- a) appropriate: suitable to the agreed scope, aims and thoroughness;
- b) complete: in order to define the audited object and the organization;
- c) representative: in order to collect reliable and relevant data;
- d) traceable: in order to trace the origin and processing of data;
- e) useful: in order to include the energy savings and might be the associated greenhouse gas emissions, and a cost effectiveness analysis of the Energy Performance Improvement Action (EPIA) identified;
- f) verifiable: in order to allow the organization to monitor the achievement of the energy targets of implemented EPIA opportunities.

NOTE See Informative Annex A: A flow diagram of the energy audit process.

5 Elements of the energy audit process

5.1 Preliminary contact

- a) The energy auditor shall agree with the organization on:
 - 1) aims, needs and expectations concerning the energy audit;
 - 2) scope and boundary(ies);

EXAMPLE 1 The whole site and all energy using systems or the boiler plant or the vehicle fleet.

- 3) levels of thoroughness required, see Annex B;
 - 4) timescale to complete the energy audit;
 - 5) criteria for evaluating EPIA (e.g. NPV calculation);
 - 6) time commitments and other resources from the organization;
 - 7) requirement for data to be collected prior to the energy audit commencing and the availability, validity and format of the energy and activity data;
 - 8) collect information needed to use sampling methods, if applicable;
 - 9) foreseeable measurement and/or inspection to be made during the energy audit.
- b) The energy auditor shall request information about:
- 1) the energy audit context;
- EXAMPLE 2 Energy audit could be related to a government agreement/scheme or in an energy review of ISO 50001.
- 2) regulatory or other constraints affecting the scope or other aspects of the proposed energy audit;
 - 3) strategic wider programme (planned projects, outsourcing facilities management);
 - 4) management system (environmental, quality, energy management system or others);
 - 5) changes that may have a bearing on the energy audit and its conclusions;
 - 6) any existing opinions, ideas and restrictions relating to potential EPIA;
 - 7) expected deliverables and required format of the report;
 - 8) whether a draft of the final report to the organization should be presented for comment.
- c) The energy auditor shall inform the organization of any:
- 1) special facilities and equipment required to enable the energy audit to be carried out;
 - 2) commercial or other interest which could influence his or her conclusions or recommendations.

5.2 Start-up meeting

The aim of the start-up meeting is to brief all interested parties about the energy audit objectives, scope, boundaries and depth and agree the practical arrangements for the energy audit.

NOTE 1 The word meeting in this standard includes telephone calls, webinars and other remote interactive discussions.

- a) The energy auditor shall request the organization to:
- 1) nominate the person ultimately responsible for the energy audit within the organization;

- 2) nominate a person to liaise with the energy auditor, where necessary supported by other appropriate individuals constituted as a team for the purpose;
- 3) inform interested parties about the energy audit and any requirements placed on them in connection with it;
- 4) ensure the cooperation of the interested parties;
- 5) disclose any unusual conditions, maintenance work or other activities that will occur during the energy audit.

Where the energy auditor is not an individual, a member of the energy auditing team shall be nominated as lead energy auditor.

NOTE 2 Some of these requirements might already have been addressed at an earlier stage.

b) The energy auditor shall agree with the organization on:

- 1) arrangements for access for the energy auditor;
- 2) safety and security rules;
- 3) resources and data to be provided;
- 4) non-disclosure agreements (e.g. tenants in a building);
- 5) proposed schedule of visits with priorities for each;
- 6) requirements for specific measurements;
- 7) procedures to be followed for installation of measuring equipment, if needed;
- 8) the form and the type of the report and the expected delivery time.

The energy auditor shall describe the processes, means and schedule of the energy audit.

5.3 Collecting data

5.3.1 General

The data collection could be carried out over several stages during an energy audit.

5.3.2 Information request

The energy auditor shall, in cooperation with the organization, collect, where available, the following:

- a) list of energy using systems, processes and equipment;
- b) predefined criteria for selection of significant energy uses;
- c) detailed characteristics of the audited object(s) including known relevant variables and static factors and how the organization believes they influence energy consumption;
- d) historical data:
 - 1) energy consumption;

- 2) relevant variables and static factors;
- 3) relevant energy measurements;
- e) operational history and past events that could have affected energy consumption in the period covered by the data collected;
- f) design, operation and maintenance documents;
- g) previous energy audits and studies related to energy performance and energy efficiency;
- h) current and projected energy tariff, or a reference energy related tariff to be used for the protection of commercial confidence;
- i) other relevant economic data;
- j) the status of the energy management system.

5.3.3 Review of the available data

The energy auditor shall review the information collected for consistency and suitability. If data requested is not available or after the reviewing process these are considered as unreliable, the energy auditor shall define the method to obtain the necessary information (e.g. measurements, estimates, modelling, etc.).

5.3.4 Preliminary data analysis

The energy auditor shall carry out an analysis of the data collected. If there is sufficient information, the energy auditor shall establish an initial energy baseline to be used for quantifying the impacts of energy performance improvements. If more information is needed, the energy auditor shall plan further data collection and measurement to be carried out during field work.

5.4 Measurement plan

The energy auditor and the organization shall agree on a measurement plan for the data needed for the energy audit. The data measurement plan may be revised based upon the energy auditor's findings during the energy audit.

The main items that may be included in the measurement plan are the relevant measurement points, their associated processes and measuring equipment to be used.

NOTE EN 17267 specifies the requirements and principles for the design and implementation of an energy measurement and monitoring plan. This document can be considered as a tool to facilitate the data collection.

5.5 Sampling methods

Sampling methods can be used when it is not practical or cost effective to examine all available information during an energy audit.

When a sampling method is used, the selected samples shall be representative of the whole audited objects.

EXAMPLE Sites, same significant energy uses, energy sources and prices, same size, process, or vehicle.

The energy auditor shall agree with the organization on the samples selected.

More information about sampling methods and an example on sampling methodology can be found in Annex C.

5.6 Field work

5.6.1 Aim of field work

The energy auditor shall:

- a) inspect the object(s) or samples on-site to be audited;
- b) evaluate the energy use and energy performance of the audit object(s) according to the aim, scope and thoroughness of the energy audit;
- c) understand the operating routines, user behaviour and their impact on energy consumption and performance;
- d) generate preliminary ideas for EPIA;
- e) list areas and processes for which additional quantitative data are needed for later analysis;
- f) operate additional data collection and measurement scheme if needed.

5.6.2 Conduct

The energy auditor shall:

- a) ensure that measurements and observations are made in a reliable fashion and in situations which are representative of normal operation and, where relevant, under appropriate weather conditions; it is accepted that it may be beneficial to make observations and measurements outside normal operating and working hours, during maintenance and shut-down periods, or when no climatic load is expected;
- b) promptly inform the organization of any unexpected difficulties encountered during the work.

5.6.3 Site visits

Every site selected from the sampling method shall be physically visited. The energy auditor shall ask the organization to:

- a) nominate one or more individuals to act as guide and escort for the energy auditor's personnel during site visits as required; these individuals shall have necessary competences and authority to carry out direct operations on processes and equipment if required;
- b) give the energy auditor access to drawings, manuals, operational data and other technical documentation relevant to the installation together with the results of any commissioning tests that have been carried out.

5.7 Analysis

5.7.1 General

During this phase, the energy auditor shall establish the existing energy performance situation of the audited object. This situation becomes a reference against which improvements can be measured.

5.7.2 Energy balance and breakdown

The existing energy performance situation shall include:

- a) a breakdown of the energy consumption by use and source;
- b) list and identify significant energy uses;
- c) energy flows and an energy balance of the audited object;
- d) pattern of energy demand through time;
- e) relationships between energy consumption and relevant variables and static factors.

5.7.3 Energy performance indicators (EnPIs)

One or more EnPIs shall be included in the analysis to evaluate the audited object. The energy auditor and organization shall agree on the EnPIs to be used.

It is recommended to define an EPI for each energy use.

5.7.4 Identify and evaluate EPIA opportunities

Based on the existing energy performance of the audited object, the energy auditor shall identify and evaluate energy performance improvement action (EPIA) opportunities .

- a) The energy auditor shall evaluate the impact of each EPIA opportunity on the existing energy performance based on:
 - 1) the financial savings enabled by the EPIA;
 - 2) the necessary investments;
 - 3) an economic analysis;

NOTE As an example refer to EN 17463 Valuation of Energy Related Investments (VALERI).

- 4) the other possible non-energy gains (such as productivity or maintenance);
- 5) the comparison in terms of both cost and energy consumption between alternative EPIA;
- 6) technical interactions between multiple actions.

Energy saving actions shall be ranked upon the agreed criteria.

- b) In those cases where it is appropriate to the agreed scope aim and thoroughness of the energy audit, the energy auditor shall complement these results with:
 - 1) requirements for additional data;
 - 2) the definition of need for further analysis.

- c) The energy auditor shall:
- 1) evaluate the reliability of data provided and highlight defaults or abnormalities;
 - 2) use transparent and technically appropriate calculation methods;
 - 3) document the methods used and any assumption made ensuring transparency, such as changing energy prices or operational costs.
 - 4) subject the results of the analysis to appropriate quality and validity checks
 - 5) consider any regulatory or other constraints of the potential EPIA.

5.8 Report

5.8.1 General

When reporting the results of the energy audit, the energy auditor shall:

- a) ensure that the energy audit requirements agreed with the organization have been met;
- b) check the quality of the report before submission to the organization;
- c) summarize relevant measurements made during the energy audit, commenting on:
 - 1) consistency and quality of data;
 - 2) rationale for the measurements and how they contribute to analysis;
 - 3) difficulties encountered in data collection and field work.
- d) state whether the results of the analysis are on the basis of calculations, simulations or estimates;
- e) summarize the analyses detailing any assumptions;
- f) state the limits of accuracy of estimates of savings and costs;
- g) report the ranking of EPIA according to their evaluated financial and additional qualitative benefits.

NOTE Whenever possible, use the NPV method instead of Payback Period Method in order to take account of long-term savings, residual values of long-term investments and discount rates. EN 17463 Valuation of Energy Related Investments (VALERI) offers a procedure for such an evaluation.

5.8.2 Content of report

The exact content of the report shall be appropriate for the scope, aim and thoroughness of the energy audit.

The report of the energy audit shall contain:

a) Executive summary:

- 1) ranking of EPIA;
- 2) suggested implementation programme.

EPIA can be presented in a table which may include the following parameters:

- Order of priority;
- Building/company/site;
- Name of measure;
- Investment costs in € (or other currency);
- Energy cost savings in €/y (or other currency);
- Final energy savings in MWh/a;
- Emissions savings in tCO₂eq/a;
- Net present value (whenever possible);
- Life cycle costs (where applicable).

b) These EPIA opportunities shall be documented as appropriate:

- 1) general information of audited organization, energy auditor and energy audit methodology, especially where sampling is used;
- 2) context of the energy audit;
- 3) description of audited object(s);
- 4) relevant standards and regulations.

c) Energy audit:

- 1) energy audit description, scope, aim and thoroughness, timeframe and boundaries;
- 2) information on data collection:
 - i) metering setup (current situation);
 - ii) statement about which data was used (which is measured and which is estimated);
 - iii) copy of key data used and calibration certificates where appropriate;

- 3) analysis of energy consumption;
 - 4) presentation of the SEU and their relevant variable and statics factors;
 - 5) EnPI;
 - 6) criteria for ranking EPIA.
- d) EPIA:
- 1) proposed actions, recommendations, plan and implementation schedule;
 - 2) assumptions used in calculating savings and the resulting accuracy of the recommendations;
 - 3) information about applicable grants and subsidies;
 - 4) appropriate economic analysis suitably described;
 - 5) potential interactions with other proposed recommendations;
 - 6) measurement and verification methods to be used for post-implementation assessment of the recommended EPIA.
- e) Conclusions.

5.9 Final meeting

At the final meeting, the energy auditor shall:

- a) hand over the report on the energy audit;
- b) present the results of the energy audit in a way that facilitates decision making by the organization;
- c) be able to explain the results.

The need for follow-up shall be discussed and a conclusion shall be reached.

Annex A
(informative)

Energy Audit Process Flow Diagram

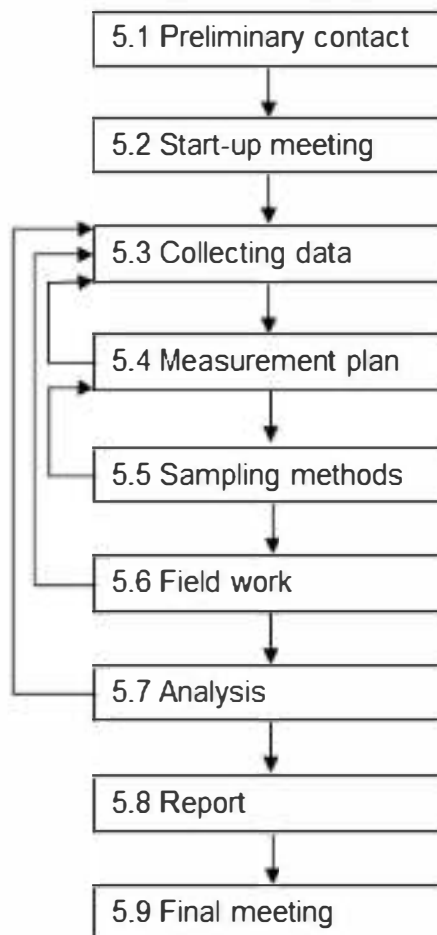


Figure A.1

Annex B (informative)

Examples of energy audit level

The standard proposes three levels of audit to meet the appropriate needs of organizations, from Level 1 to Level 3, detailed in Table B.1 below.

The first level is the level of compliance with EN 16247-1. Levels 2 and 3 are optional additional requirements to those specified in the standard.

The second level is intended for organizations that require consumption of more significant energy uses to be measured and a more detailed analysis.

The third level is intended for organizations that require consumption of significant energy uses to be measured and who want the financial analysis supported by accurate quotations.

Table B.1

	Level 1	Level 2	Level 3
Overall intent	Standard audit conforms to EN 16247 standard requirements	Detailed audit	Detailed audit with costs supported by quotations
Suitable sites type/situation	All sites; sites that require a comprehensive analysis of energy saving opportunities		All sites; sites that require a comprehensive analysis of energy saving opportunities and detailed information with cost calculation for investment
Site visit	Required; interview of key staff members, determine monitoring and measurement plan		
Data collection	Use of relevant significant data (billing-invoice-site data), with measuring	Significant energy uses shall be measured (no estimation)	
Annual energy endues breakdown	Significant energy uses as reflected by the requirements of local legislation or best practice of the audited object or organization in accordance with energy audit scope should be taken into account	All energy uses that represent more than 10 % of the energy consumption of the audited object or organization in accordance with energy audit scope should be taken into account	

	Level 1	Level 2	Level 3
Reliability of the recommendations	Based on valuations of expected energy savings and estimated Operational and Capital costs (OPEX and CAPEX)	Reliability of expected energy savings based on detailed calculation including Operational and Capital costs (OPEX and CAPEX)	Reliability of expected energy savings with investment costs supported by quotations

Annex C (informative)

Sampling (Based on ISO 19011:2018 Guidelines for auditing management systems)

Audit sampling takes place when it is not practical or cost effective to examine all available information during an audit, e.g. audited objects are too numerous or too dispersed geographically to justify the examination of objects (building, process, vehicle).

The principle of sampling for a lot (lot of vehicles or sites) is to analyse the individuals in the sample in order to issue recommendations that will be valid for each individual in the lot.

The objective of audit sampling is to provide information for the auditor to have confidence that the audit objectives can or will be achieved.

The risk associated with sampling is that the samples may not be representative of the audited object from which they are selected. Thus, the auditor's conclusion may be biased and be different from that which would be reached if the whole audited objects was examined.

Therefore, the selected sample shall be representative of the whole audited objects.

EXAMPLE Same significant energy uses, same size, process or vehicle.

The energy auditor shall agree with the organization on the samples selected.

Audit sampling typically involves the following steps:

- a) establishing the objectives of sampling;
- b) selecting the extent and composition of the scope to be sampled;
- c) selecting a sampling method;
- d) determining the sample size to be taken;
- e) conducting the sampling activity;
- f) compiling, evaluating, reporting and documenting results.

When sampling, consideration should be given to the quality of the available data, as sampling insufficient and inaccurate data will not provide a useful result. The selection of an appropriate sample should be based on both the sampling method and the type of data required.

Reporting on the sample selected could take into account the sample size, selection method and estimates made based on the sample and the confidence level.

NOTE Various sampling methods for multisite companies exists in the different countries. The Italian model can as an example be found via this link: www.efficientzaenergetica.enea.it

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- [28] Directive 2004/8/EC of the European Parliament and of the Council of 11 February 2004 on the promotion of cogeneration based on a useful heat demand in the internal energy market
- [29] Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control

European Commission reference documents on Best Available Technologies (BREF BAT)¹ with codes

- [30] *ENE – Energy Efficiency* (Note: includes EA and Energy management)
- [31] *ECM – Economics and Cross Media Effects*
- [32] *ROM – Monitoring of Emissions to Air and Water from IED Installations*

¹ These documents are available from: <https://eippdb.jrc.ec.europa.eu/reference/>

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