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Energy audits —

Part 3: Guidance for conducting an energy audit using ISO 50002-1 in processes

Audits énergétiques —

Partie 3: Recommandations pour la conduite d'un audit énergétique selon l'ISO 50002-1 dans des processus

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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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*.

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

An energy audit can help an organization identify opportunities to improve energy performance. It can be part of a site-wide energy management system (EnMS). This document provides guidance for conducting an ISO 50002-1-based energy audit of processes.

There are many types of processes in industry and commerce. In general, energy is used:

— directly by a process (e.g. furnaces, direct fired dryers);

— indirectly by a process (e.g. heat exchange, distillation, extrusion), including the specific conditions of production (e.g. start-up, shut-down, product change over, cleaning, maintenance, laboratory and product transfer);

— directly by a commercial organization, (e.g. meal preparation process, TV broadcasting process, data centre process, coffee roasting);

— utility processes (e.g. motor driven systems (fans, pumps, motors, compressors, etc.), steam, hot water), including on-site power plants;

— product or service changeover, (e.g. change of production feed or production quality, start-up, shut down, cleaning-in-place, sterilization);

— other processes (e.g. sterilization in hospitals, fume cupboards, laboratories).

The energy audits covered by this document may be independent from energy performance certification.

Energy audits —

Part 3:
Guidance for conducting an energy audit using ISO 50002-1 in processes

1 Scope

This document gives guidance on how to apply ISO 50002-1 to carry out energy audits of a process. It is intended to be used in conjunction with, and is supplementary to, ISO 50002-1.

If buildings are included in the scope of the energy audit, the energy auditor can choose to apply ISO 50002-2.

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.

ISO 50002-1, *Energy audits — Part 1: General requirements with guidance for use*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 50002-1 and the following 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 client
person or organization that commissions an energy audit

Note 1 to entry: to entry. The audit client can be the owner, operator, process licensor and/or the service provider.

3.2
process
set of interrelated or interacting activities that use inputs to deliver an intended result

Note 1 to entry: to entry. This can include one or more production lines, laboratories, research centres, packaging and warehouse sections with specific operational conditions and site transportation. An energy audit can be conducted on selected processes or systems in an organization or *site* (3.4) or on all processes in an organization or site.

3.3
production process
all the steps, or some of the steps, necessary to manufacture a product, intermediate product, by-product or co-product, or to deliver a service

Note 1 to entry: Production process can include specific facilities for health, safety and environmental pollution control.

3.4
site
processes (3.2) within the boundary of the organization

Note 1 to entry: This may include processes for pollution treatment, energy recovery and waste management.

3.5
utility
generation and distribution of energy necessary for the *process* (3.2) and auxiliary

4 Principles of energy auditing

The principles of ISO 50002-1 apply.

5 Performing an energy audit

5.1 General

The general requirements of ISO 50002-1 apply.

5.2 Planning

In processes, the audit client and the auditee can be different. Their roles and responsibilities in the process can also be different. For example, a process can be owner operated and maintained by a single organization. The process can also be owned, operated and maintained by different organizations.

The energy auditor should obtain a preliminary description of the site and the process from the organization or from a site visit.

NOTE 1 The preliminary contact can be by telephone, webinar, meeting or other remote interactive discussions.

The energy audit scope and boundaries should be defined and agreed between the energy auditor and the audit client. At a minimum:

a) the audit client should have operational control of the process, or should have the ability to influence and seek the cooperation of the operator;

b) the energy audit scope should cover energy use within the process and/or the interaction of energy use with other energy use within the process. Optimization of some energy use while excluding others can give misleading results.

Considerations for the audit scope and boundary include:

— processes included in the energy audit;

NOTE 2 A process can be defined as the whole process, part of a process, part of a system or a component.

— whether or not outsourced utilities are included in the energy audit;

— depending on the thoroughness of the energy audit, the need for a detailed energy audit to be carried out for specific processes should be checked; in this case, reference should be made to the relevant standard.

For energy use not directly related to the process (e.g. storing, packaging, logistics, offices, research centres, laboratories, transport), the energy auditor should agree with the organization on the applicability of ISO 50002-2 (buildings) or ISO 50002-3 (processes); depending on the nature of the activities, the auditor may also rely on the general framework of ISO 50002-1. This decision and the agreed scope should be clearly stated in the final energy audit report (see 5.8).

ISO 50002-1:2025, Annex A, describes three different types of energy audit, each having a different level of detail and thoroughness. The level of detail agreed by the parties will have an impact on:

— application;

— business needs;

— data collection;

— analysis;

— opportunities identification;

— opportunities evaluation;

— outputs;

— the time on-site.

For each audited process, the energy auditor and organization should agree on the relevant personnel, and their roles which have an impact on energy consumption, and should propose a preliminary list of data to be collected.

5.3 Opening meeting

No additional guidance to ISO 50002-1.

5.4 Data collection

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

During data collection, the energy auditor should:

a) collect and collate appropriate energy data that support the audit objectives, the required audit scope and the level of thoroughness of the energy audit, including:

   1) site information including building, boundary and other relevant information;

   2) utility information;

   3) production process information;

      i) product specification;

      ii) main processes equipment involved in the process (drawings, other relevant technical data and datasheets);

      iii) current operating conditions (set points) of utilities and production process;

      iv) other considerations that can impact energy performance on a non-routine basis (static factors);

      v) specific conditions and constraints for process and environment (security, pollution, health, etc.);

   4) information on energy source types;

b) verify the data and information provided by the organization (e.g. the power or the number of pieces of equipment);

c) obtain any missing data;

d) check the quality and plausibility of the data, and ask for correction if significant mistakes or inaccuracies are identified.

NOTE 1 The collected data can be based on invoices, contracts, measurements, calculations from given operating hours and installed capacity (technical characteristics), operation and maintenance documents, meeting with operations and maintenance personnel, etc.

NOTE 2 See Annex A for examples of data that can be collected.

5.5 Measurement plan

5.5.1 General

The energy auditor should review the information collected and provided by the organization. This is carried out to ensure that the information is complete and representative and to identify further information and measurement needs. If the data requested are not available, the energy auditor should define the method to obtain the necessary information (e.g. measurements, estimates, modelling).

It is also possible to identify preliminary opportunities for energy performance improvement or areas for investigation during the site visit.

5.5.2 Preliminary data analysis

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

a) undertake a preliminary analysis of the process energy balance on the basis of energy data;

b) establish the relevant variables and static factors;

c) identify significant energy uses (SEUs);

d) establish the relevant energy performance indicators (EnPIs);

e) evaluate the distribution of energy consumption (consumption breakdown) if possible, depending on the measured data available;

f) if there is sufficient information, establish an initial energy reference (energy baseline) to be used for quantifying the impacts of energy performance improvement actions (EPIAs);

g) plan further data collection and measurement to be carried out during field work.

The energy auditor should develop a preliminary list of EPIAs.

5.5.3 Data measurement plan

If there are missing data and information, depending on the scope of the energy audit and level of thoroughness, the energy auditor should:

a) request the missing information from the organization;

b) carry out additional measurements during the site visit;

c) make an assumption about the data based on experience and competence (and provide details in the energy audit report).

Where additional on-site measurement is determined to be feasible, ISO 50002-1 outlines a short list of data that can be measured while on-site.

The energy auditor should also review the collected data (and eventual data measurement) to see whether the energy audit objective(s) and audit scope are still appropriate and can be achieved. If the audit objective and audit scope cannot be achieved, the energy auditor should discuss and agree on an alternative with the organization.

NOTE See Annex B for quality data measurement plans.

5.6 Site visit

5.6.1 Site visits

No additional guidance to ISO 50002-1.

5.6.2 Management of field work

The energy auditor should inspect the processes within the audit scope in order to achieve the audit objective. This includes:

a) collecting any missing data needed for analysis;

b) confirming the suitability of energy baseline if available;

c) confirming the energy consumption, energy balance, relevant variables and static factors if an EnMS has already been introduced;

d) confirming the current operating conditions (set points) of utilities and production processes and the impact on energy use and consumption;

e) collecting relevant information from identification plates, runtime information, interviews with operators, etc;

f) identifying EPIAs and related constraints and restrictions.

5.7 Analysis

5.7.1 General

No additional guidance to ISO 50002-1.

5.7.2 Analysis of current energy performance

Analysis of current energy performance is described in ISO 50002-1.

The energy auditor provides:

a) a breakdown of the energy consumption by energy type;

b) a breakdown of the energy consumption into a company energy structure (e.g. main activities, auxiliary services, general services) to a cost-effectiveness level;

c) a breakdown of the energy consumption by processes in absolute number and in consistent energy unit (if the activity is time varying, it is recommended to establish the energy consumption at different time periods in relation to the processes);

d) a demonstration of an energy balance between energy consumption and energy losses based on an appropriate method.

EXAMPLE Material and energy balance, Sankey diagram, steady-state computer simulation.

If feasible, the energy auditor should determine the energy consumption without production or activity (baseload).

The energy balance and breakdown should be representative of the energy input and energy use. It should be clear which is based on measurement, estimation or accurate calculation in accordance with the level of thoroughness of the energy audit.

The energy auditor and the organization should discuss and agree on the relevant EnPIs if required. The analysis should use the agreed EnPIs.

NOTE If an EnMS exists, the energy auditor can use the relevant EnPIs detailed in the EnMS.

The energy auditor should:

— calculate the current energy performance of the process;

— compare current energy performance against the best available technology benchmarks and/or against equipment design specifications;

— compare the current sizing of the process and/or its components, and the corresponding energy needs;

— evaluate the optimal quantity of energy and utilities for the process.

5.7.3 Identification of energy performance improvement opportunities

Evaluation of EPIAs is described in ISO 50002-1.

The energy auditor should identify and propose EPIAs, including one or more of the following:

a) measures in order to reduce or recover the energy losses;

EXAMPLE 1 Improve insulation, reduction of leakage of compressed air, waste heat recovery.

b) replacement, modification or addition of equipment or new technology;

EXAMPLE 2 High efficiency boiler, variable speed motor, energy efficient lighting.

c) more efficient operation and continual optimization;

EXAMPLE 3 Operating procedure, process and utility automation, logistic and layout optimization, set point adjustment, maintaining the installed equipment to its best performance.

d) improved maintenance;

EXAMPLE 4 Maintenance planning, instruction of the operation and maintenance staff.

e) deployment of behavioural change programme;

EXAMPLE 5 Training, energy awareness campaigns.

f) improvement of energy management.

EXAMPLE 6 Improvement in metering and monitoring plan, implement EnMS.

The energy auditor should identify EPIAs on the basis of:

— the equipment's age, condition and how it is operated and managed;

— the technological suitability of the actual equipment in comparison with alternatively available more efficient equipment;

— the planned lifetime of the processes.

The energy auditor should consider the use of renewable energy sources and combined heat and power plant.

The energy auditor should propose to categorize the EPIAs as:

— people-based opportunities (e.g. training, awareness);

— technical-based opportunities (e.g. operations, maintenance and replacement of machines);

— organizational-based opportunities (e.g. structure of organization, responsibilities).

For each of the proposed EPIAs, the energy auditor should calculate the expected energy saving (before and after implementing the energy performance improvement), taking into consideration the appropriate relevant variables and static factors.

Whenever possible, the energy auditor should consider the applicability of life cycle cost analysis.

The energy auditor should consider the possible tariff change for lower energy cost.

5.7.4 Evaluation of energy performance improvement opportunities

No additional guidance to ISO 50002-1.

5.8 Reporting

5.8.1 General

The contents of energy audit reports are given in ISO 50002-1.

5.8.2 Report content

The auditor should give the following information for each of the recommended EPIAs:

a) a description of the existing system or equipment that is affected, its current energy consumption, energy performance and the reason for the proposal for improvement;

b) a description of the proposed EPIAs, the predicted energy consumption, energy performance and cost savings;

c) non-energy-performance-related benefits;

EXAMPLE Quality improvement, manufacturing flexibility, reduced maintenance, reduced water consumption, reduced waste, lower carbon dioxide emissions, improved working conditions.

d) where available, benchmarking of energy consumption of process against best available technologies/ industry standards.

5.9 Closing meeting

No additional guidance to ISO 50002-1.

6 Competence of the energy auditor

The energy auditor's competencies should include knowledge of the following items as required by the specific processes included in the scope of the audit:

a) general equipment start-up and shut down, process change overs and maintenance;

b) ovens, furnaces, dryers, kilns, heat exchangers and other heat transfer equipment;

c) pumps, fans, conveyers, chillers, compressors, refrigeration units, material handling equipment, cooling towers and other motor-driven systems;

d) heating, ventilation and air conditioning (HVAC) and hot water systems including boilers, steam systems, roof-top units, air-handling units, hot-water heaters, cooling and heating coils, control systems and other related items;

e) commercial and institutional processes including laundries, central or district heating or cooling systems, data centres, laboratories, sterilization systems, site/process management systems, back up emergency electric power generation and other related items.

Annex A
(informative)

Data which can be collected

This annex provides a list of data which can be collected. This is not an exhaustive list; some of the information on this list is not necessarily applicable to a specific organization or site.

The following data can be collected:

a) general information on the running of the organization:

   1) products processed/manufactured;

   2) daily/annual production;

   3) name of the energy official;

   4) name of the transport official;

   5) operating times;

   6) start up and shut downs;

   7) shift patterns;

b) energy types:

   1) inventory of energy types used on-site;

   2) daily/monthly/annual consumption;

   3) size and annual energy production of renewable energy on-site (plus size and type of energy storage);

   4) size and annual energy production of solar thermal installations on-site (temperature of the heat produced, which process uses the heat, size and type of the energy storage);

   5) production of biogas on-site (how much is produced in terms of standard cubic metre and/or joule);

c) energy management:

   1) structure of energy consumption;

   2) metering and maintenance of meters;

   3) energy tariff;

   4) invoice amounts (fuels, electricity, water);

   5) peak demand management;

   6) energy management and monitoring level (which indicators, who monitors them);

   7) operating mode;

   8) training of staff in the rational use of energy;

d) transportation, handling of materials and products in the plant:

   1) description of fleet;

2) upkeep planning and record book;

3) energy consumption;

4) handling lines, overhead cranes, helpers, etc.;

5) personnel transportation on the industrial site (excluding the company's circulation plan);

e) production process:

1) description, brand, age and capitalized life (expected life/capital depreciation) of major equipment;

2) nature of operation:

i) drying;

ii) heating, cooking, sterilization, polymerization, melting, etc.;

iii) concentration;

iv) thermal separation (distillation column, evaporator, etc.);

v) incineration;

vi) assembly of parts (brazing, welding, etc.);

3) types of machines:

i) crucible furnace, vacuum furnace, removable-cover furnace, open-hearth furnace, etc.;

ii) tunnel, stack, drying tower, cylinder dryer, etc.;

iii) incinerator, etc.;

4) installed thermal power;

5) nature of the fluid (hot air, steam, hot water, etc.);

6) recoverable condensate;

7) waste heat recovery (flow rates, temperatures, suspended particles, corrosiveness, critical dew point, etc.) of the exhaust gases/discharged fluids, to evaluate the heat recovery opportunities;

8) production capacities and output rates (number of parts, m^2, kilograms produced, kilograms of evaporated water, etc., according to unit of time);

9) processing method (static, dynamic, batch);

10) products processed (input water content and composition);

11) processing parameters (input fluid temperatures, thermal cycle, application speeds and temperatures of the fluid, power densities applied, etc., and regulations);

12) control;

13) metering;

14) number of operating hours;

15) annual consumption;

16) consumption specific to processing;

f) boiler house:

1) description of the facility, installed capacity and its matching data to operational needs;

2) number of boilers;

3) description of operating regime (cascade, backup, shutdown, supplementary, etc.);

4) operating mode;

5) generator (commissioning date, power, brand, type, fluid (hot water, steam, super-heated water, thermal oil, air, etc.), pressure, outgoing temperatures, nominal flow rate, thermal insulation);

6) control and measurement equipment (fuel, heat carrier, fumes), number of operating hours, recovery of condensates and steam traps;

7) burner (nature of fuels, age, type, power);

8) presence and performance of recuperators, superheaters, economizers and air heaters;

9) boiler feed water tank volume and temperature;

10) discharge of combustion products (temperature, contaminants in flue gases: NO_x, SO_x, CO_2) and combustion efficiency;

11) power supply circuits and complementary accessories (circulation pumps, fans, etc.);

12) general condition of the equipment (last settings, maintenance, recent repairs and modifications);

13) water treatment (nature and characteristics of water types, model and flow rates, treatment, blow down, makeup);

14) atmospheric discharge measurement and performance readings on the basis of the boiler house record book or the regular inspection report;

15) readings (including accuracy class);

16) annual consumption and production levels;

g) heat exchange:

1) description of the system, installed capacity and its matching data to operational needs;

2) buildings and premises serviced, and volume heated;

3) exchangers and blenders;

4) function (heating, domestic hot water (DHW), heating plus DHW);

5) primary fluid/secondary fluid;

6) number of operating hours;

7) annual consumption;

h) fluid distribution networks:

1) nature of fluid;

2) type of network (above-ground, channels, tunnel, etc.);

3) distribution method and layout diagram;

4) characteristics (lengths, diameters, flow rates, pressure (low pressure, medium pressure or high pressure), temperatures, return systems, etc.);

5) recovery of condensates and steam traps;

6) thermal insulation and thermal bridges;

7) number of operating hours;

8) losses;

9) networks condition and upkeep;

i) generators of mechanical, thermal or electrical energy:

1) description of the system, installed capacity and its matching data to operational needs;

2) types and number of machines (turbines, diesel engines, combined heat and power systems, compressors);

3) brand, type and commissioning year;

4) energy source (steam, oil, distillates, gas, renewable energy, etc.);

5) generator's characteristics (nominal power, rotating speed, cycle, exhaust temperatures or steam pressure and temperature, etc.);

6) nature of the machine powered (characteristics (pressure, flow or power, voltage) and operating mode (compressor, alternator, etc.));

7) control systems;

8) metering;

9) number of operating hours;

10) general condition of equipment;

11) annual thermal consumption, and mechanical and electric production levels;

j) electric distribution and equipment:

1) list of the main pieces of equipment and characteristics (transformers, low voltage panel, capacitor bank, power plant (turbines, electricity generating sets), inverters, networks, engines, pumps, fans, compressors);

2) variable speed drives (VSDs), etc.;

3) operation (for each of the main pieces of equipment);

4) annual consumption by station and sector;

5) regulations (for each of the main pieces of equipment);

k) cooling towers:

1) description of the system, installed capacity and its matching data to operational needs;

2) types and number of machines (air cooled, water cooled, evaporative, etc.);

3) thermal capacity;

4) temperatures (approach, cooling range, wet-bulb, dry-bulb);

5) control;

6) metering;

7) general condition of the material and the distribution network (system, pump, etc.);

8) number of operating hours;

9) annual energy and water consumption (make up, blow down);

l) chillers:

1) description of the system, installed capacity and its matching data to operational needs;

2) types and number of machines (compression- or absorption-based refrigerating unit, compressor, condenser, air cooler, heat pump, etc.);

3) capacity (refrigerating, electric, etc.);

4) nature of the refrigerant;

5) temperatures of the input/output secondary refrigerant;

6) control;

7) metering;

8) general condition of the material and the distribution network (system, pump, etc.);

9) number of operating hours;

10) annual consumption;

m) pumps:

1) description of the system, installed capacity and its matching data to operational needs;

2) pump description(s);

3) pump type(s) and number;

4) pump application;

5) physical location of pump(s) and installed motor data (rated nameplate power, voltage, full load amperage, frequency);

6) annual operational hours (or percentage of operation);

7) control method (e.g. control valve, VSD, bypass);

8) flow rate;

9) pressure;

10) pumped media (liquid);

11) input/output temperature;

12) general condition of pumps;

n) fans:

1) description of the system, installed capacity and its matching data to operational needs;

2) fan(s) description;

3) fan type(s) and number;

4) fan application;

5) physical location of fan(s) and installed motor data (rated nameplate power, voltage, full load amperage, frequency);

6) annual operational hours (or percentage of operation);

7) control method;

8) input/output temperature;

9) general condition of fans;

o) compressed air:

1) description of the system, installed capacity and its matching data to operational needs;

2) type and number of compressors;

3) pressure;

4) power;

5) input/output temperature;

6) flow rate;

7) air production and quality;

8) operation;

9) annual consumption;

10) control;

11) general condition of the equipment and network (insulation, leaks, traps, etc.);

p) vacuum system:

1) description of the system, installed capacity and its matching data to operational needs;

2) type and number of vacuum systems;

3) suction;

4) power;

5) flow rate;

6) operation;

7) annual consumption;

8) control;

9) general condition of the material and the system (insulation, leaks, traps, etc.);

q) HVAC:

1) description of the system, installed capacity and its matching data to operational needs;

2) analysis of the HVAC systems;

3) nature of the heat source (fluid distribution, fuel, electric, etc.);

4) types of devices and distribution of energy carrier;

5) installed capacity (global and by system);

6) heat recovery;

7) control and setting method (zone, sectioning, modulation, etc.), controlled variables and correcting variables;

8) monitoring equipment (thermometers, hygrometers, etc.);

9) rate of use;

10) general condition of the devices and the distribution pipes systems;

11) annual consumption levels by system;

r) DHW:

1) description of the system, installed capacity and its matching data to operational needs;

2) production principle (centralized, independent, mixed, etc.);

3) characteristics of the material (power, temperature, fluid pressure, etc.);

4) storage (temperature, insulating material, etc.);

5) description and characteristics of distribution: storage tanks (capacity, coupling), circulation pumps (flow rate, pressure), regulations, network (diameter, number of outgoing lines) and insulating material;

6) DHW needs, number of points serviced;

7) condition of the equipment and distribution network;

8) metering;

9) annual consumption;

s) lighting:

1) description of the system, installed capacity and its matching data to operational needs;

2) measurement of lighting levels;

3) installed devices (lamps, instruments, lighting quality, etc.);

4) age of the lighting system (renewal period of light sources);

5) lighting duration (estimation of usual/emergency consumption levels);

6) control systems;

7) access to daylight;

8) occupancy rate by staff;

9) dimensions of the premises;

10) dust accumulation;

11) type of activity pursued.

Annex B
(informative)

Quality of measurement plan

B.1 General

For any on-site measurement and data collection, the energy auditor and organization should come to an agreement on:

a) a list of the measurement points and their location;

b) preparation of measurement points/location and access to them;

c) measurement duration (one-off or logged);

d) acquisition frequency for each measurement;

e) period during which the organization's activity is representative;

f) people responsible for carrying out the measurements (e.g. organization, energy auditor, any subcontractors);

g) operating constraints linked to the processes;

h) implementation constraints of the measurement equipment.

The use of sampling can impact on measurement frequency and duration. Additional guidance on sampling is described in Annex C.

B.2 Measurement plan

B.2.1 General

The measurement plan is developed over three stages, as described in B.2.2 to B.2.4.

B.2.2 Stage 1: Use of a measurement instrument

The energy auditor should:

a) define the measurements to be taken and the level of accuracy required;

b) be responsible for the measurements taken on-site;

c) check the proper operations and functioning of the measurement equipment;

d) check that measurement taken by the measurement equipment is accurate and repeatable (e.g. a calibration certificate is valid).

The type of sensor to be used should be in line with its measuring range, the accuracy required, the nature of the magnitude measured and the conditions of use.

B.2.3 Stage 2: Measurement

During the measurement, the organization can be asked to provide the corresponding adjustment factors (e.g. operating parameters, production data).

B.2.4 Stage 3: Preliminary data analysis

This stage is to shape the large amount of collected data into comprehensive and usable data for analysis. This includes an assessment of:

a) the principle of each measurement, the level of uncertainty and the elements which allow its level of accuracy to be assessed;

b) the calculations made and range of applicability;

c) the derived charts and graphs;

d) the summary of measurement results shown in a table.

Annex C
(informative)

Representative energy sampling approach for multi-site organizations

The sampling of sites to be audited can be applied to multi-site organizations where sites are too numerous, dispersed geographically and/or their energy consumption is too low to justify the audit.

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 every object (building, process, vehicle).

The multi-site organizations, their headquarters with its subsidiaries, or linked and partner enterprises, can carry out an energy audit on at least a representative sample of their whole number of sites.

This annex gives an example of methodology for multi-site audit sampling in industrial companies.

The sampling selection is based on the annual energy consumption of each source per site, e.g. in toe (tonne of oil equivalent). A percentage rate of the sites to be audited is defined according to the annual energy consumption (see Figure C.1).

NOTE Toe is equivalent to 41,85 gigajoules or 11,630 kWh.

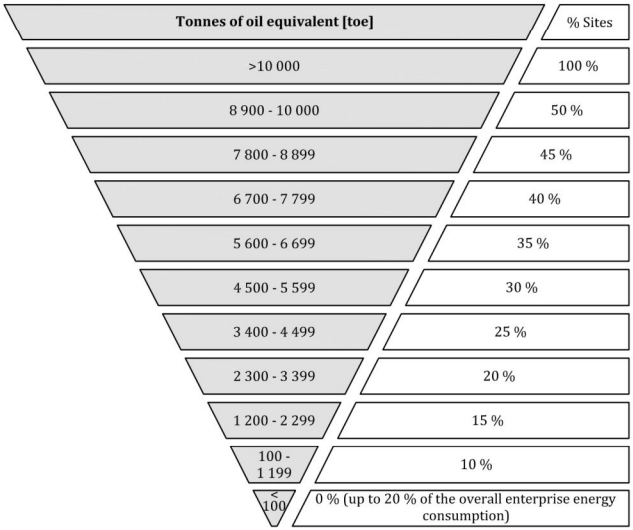

Figure C.1 — Sampling methodology

An energy audit is mandatory for all sites with energy consumption higher than 10 000 toe per year. A total number of 100 sites can be considered as a satisfactory representation.

Sites with energy consumption less than 100 toe are excluded from the audit until they reach a maximum number of sites covering 20 % of the total consumption of the enterprise.

If it is not possible to exempt sites with energy consumption rates lower than 100 toe and the total amount of sites clustered in a high energy consumption rate is less than 100, then the following two further slots can be sorted out:

— 1 toe to 50 toe with a sampling rate of 1 %;

— 51 toe to 99 toe, with a sampling rate of 3 %.

Referring to the approximation of the number of sites to be audited, the criterion adopted shall be as follows:

— if the result is less than one, the approximation shall be 1;

— if the result is greater than one, the approximation shall refer to the closest integer number.

When establishing the number of sites to be audited in every consumption slot as listed, a multi-site organization can choose to sort them as it follows:

— auditing the number of sites in every consumption slot;

— replacing the number of sites of in an energy consumption slot with different sites from a higher energy consumption slot.

Organizations with network/distributed sites (i.e. aqueduct, pipelines, etc.) can consider the network/distributed sites as a whole virtual site, and therefore can conduct an energy audit on the network connecting different sites.

EXAMPLE 150 homogeneous sites with the same production lines, with energy consumption rates ranging between 38 toe per year and 112 toe per year. The 150 sites are clustered as shown in Table C.1.

The company has the option to carry out six energy audits on sites from slots 1, 2 or 3. It can choose to carry out six energy audits on sites from slot 1 and none on sites from slot 2 or 3.

The company has also the option to carry out two audits on slot 1 and four audits on slot 2 and none from slot 3.

Table C.1 — Homogeneous sites with the same production lines

Slot no.	Annual energy consumption toe	No. of sites	% of times to be energy audited	No. of sites to be energy audited
Slot 1	100 to 199	21	10 %	2
Slot 2	51 to 99	84	3 %	3
Slot 3	0 to 51	45	1 %	1

Bibliography

[1] ISO 50002-2, *Energy audits — Part 2: Guidance for conducting an energy audit using ISO 50002-1 in buildings*

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