INTERNATIONAL STANDARD

ISO 50021

First edition
2019-02

Energy management and energy savings — General guidelines for selecting energy savings evaluators

Lignes directrices générales pour la sélection des personnes chargées d'évaluer les économies d'énergie

Reference number
ISO 50021:2019(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword

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

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

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

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

For an explanation 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*.

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

This document provides guidelines for the selection of energy savings evaluators, i.e. people conducting energy savings evaluations who have the required knowledge and skills to determine energy savings leading to credible and reliable results. Energy savings evaluations are widely used for assessing programme effects and policy impacts, and for validation and/or verification of results at project, organization and region levels.

At the project level, energy savings evaluation results can help entities reduce operating costs and determine financial returns, help government regulators understand policy impacts, and help financing institutions make loan or grant decisions.

At the organization level, energy savings evaluation results can help leaders of organizations reduce operating costs and control risks.

At the region level, energy savings evaluation results can help governments understand and improve the impacts of policies.

Evaluation methods to determine energy savings vary depending on the level (project, organization or region). Different knowledge and skills are required for each level.

By selecting an appropriate energy savings evaluator with the required knowledge and skills, it is possible to properly calculate the energy savings and to implement climate and energy policy agreements appropriately.

Energy management and energy savings — General guidelines for selecting energy savings evaluators

1 Scope

This document gives guidelines for selecting energy savings evaluators to determine ex-post (realized) energy savings for projects, organizations and regions. It gives general principles and identifies the key factors to consider. It also defines roles and responsibilities, recommends the required competence and provides key elements for assessing the knowledge and skills of energy savings evaluators.

At the project and organization level, this document is applicable to both internal and external energy savings evaluators.

Selecting evaluators who calculate predicted energy savings is out of the scope of this document.

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 http://www.electropedia.org/

3.1
energy savings
reduction of energy consumption compared to an energy baseline

Note 1 to entry: Energy savings may be the result of implementation of an action(s) or of autonomous progress.

Note 2 to entry: An evaluation of savings from implementation of actions may need to identify the separate impacts of the actions compared to other factors.

[SOURCE: ISO 17743:2016, 3.8, modified — The notes to entry have been replaced.]

3.2
energy savings evaluation
systematic process to measure, quantify, verify, analyse and report *energy savings* (3.1) within a defined boundary

3.3
energy savings evaluator
individual, or a team of people, conducting an *energy savings evaluation* (3.2)

Note 1 to entry: The internal energy savings evaluator is affiliated with the implementer of the evaluated project or evaluated organizations.

Note 2 to entry: The external energy savings evaluator who is being entrusted or commissioned is not affiliated with the interested parties or entities to be evaluated.

3.4
lead energy savings evaluator
person who is competent to lead and/or review and provides assurance of consistency to relevant requirements of an *energy savings evaluation* (3.2)

Note 1 to entry: A lead energy savings evaluator might also take part in an energy savings evaluation.

3.5
selector of energy savings evaluator
entity or personnel appointed by the client to choose an energy savings evaluator

Note 1 to entry: the client is an organization or a person requesting *energy savings evaluation* (3.2). The client could be the responsible party, the programme administrator or the interested party.

3.6
objective
results to be achieved

Note 1 to entry: An objective can be strategic, tactical or operational.

Note 2 to entry: Objectives can relate to different disciplines (such as financial, health and safety, and environmental goals) and can apply at different levels (such as strategic, organization-wide, project, product and process).

Note 3 to entry: An objective can be expressed in other ways, e.g. as an intended outcome, a purpose, an operational criterion, as an energy objective, or by the use of other words with similar meaning (e.g. aim, goal).

[SOURCE: ISO 50001:2018, 3.4.13, modified — Note 4 to entry has been deleted.]

3.7
competence
ability to apply *knowledge* (3.9) and *skills* (3.10) to achieve intended results of *energy savings evaluation* (3.2)

[SOURCE: ISO 9000:2015, 3.10.4, modified — "of energy savings evaluation" has been added to the definition and the notes to entry have been deleted.]

3.8
experience
<evaluation> combination of *knowledge* (3.9) and *skills* (3.10) obtained through a period of practical application of carrying out *energy savings evaluation* (3.2)

3.9
knowledge
<evaluation> assimilation of facts, theories and practices with regard to carrying out an *energy savings evaluation* (3.2)

3.10
skill
<evaluation> ability to apply *knowledge* (3.9) in order to carry out an *energy savings evaluation* (3.2)

3.11
energy performance improvement action
EPIA
action, measure, or group of actions 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 Considerations for selecting energy savings evaluators

4.1 General

When selecting the energy savings evaluator, the following key factors, explained in more detail below, should be considered:

— the final objectives of the energy savings evaluation;

— the subjects of the energy savings evaluation;

— the approaches to the energy savings evaluation;

— the reporting requirements;

— the budgets for the energy savings evaluation.

Some of the key factors affecting the energy savings evaluation may be confirmed in the planning stage by the evaluation client (e.g. final objectives). Other factors will be confirmed in the planning process by either the energy savings evaluators or the evaluators' organization. The energy savings evaluators may be selected from competitive bids or appointed from internal employees based on how well the potential energy savings evaluator understands the key factors and needs of the evaluation.

4.2 Final objectives of the energy savings evaluation

Energy savings evaluators should be assessed on an understanding of the basic knowledge of final objectives. This includes, but is not limited to:

— the financial return of EPIAs;

— the policy effect(s);

— financial assistance (e.g. subsidy, loan, grant);

— compliance with various initiatives and commitments to various interested parties (e.g. to government and industry);

— verification of an energy savings claim;

— technical issues involved in the EPIA or other improvement actions being evaluated;

— energy efficiency benchmarking.

4.3 Subjects of the energy savings evaluation

The subject(s) of an energy savings evaluation can include:

— a project;

— an organization (or part of an organization);

— a city, region or country;

— a group of organizations;

— any other entity that has the capacity to make energy savings.

4.4 Approaches to the energy savings evaluation

Energy savings evaluators should have the technical competence to apply suitable calculation method(s) for a certain approach(es) to fulfil an evaluation task. The methods should be agreed prior to the evaluation.

Examples of approaches and corresponding methods include, but are not limited to:

— a top-down approach, which is an entity-based approach (e.g. evaluating the change in the total energy consumption of the whole entity, such as a building, organization or city) involving indicator-based calculation methods;

— a bottom-up approach, which involves measure-based calculation methods, aggregating energy savings from identified EPIAs, energy consumption-relevant variables modelling, calibrated simulation and direct comparison;

— identifying the separate impacts of the energy saving actions compared to other factors.

NOTE ISO 17741, ISO 17742 and ISO 50047 give approaches and methods for determining energy savings. These International Standards can be applied independently or in combination.

4.5 Reporting requirements

Energy savings evaluators should have the competencies to satisfy specific reporting requirements agreed to prior to the evaluation. Some issues for consideration include:

— the level of accuracy of energy savings evaluation results;

— whether or not a formal report is needed;

— requirements on reporting format and data documentation;

— confidentiality;

— energy units to be used (e.g. kWh, GJ, toe);

— whether the report is solely about energy or if CO_2 equivalents are also expected.

4.6 Budgets for the energy savings evaluation

The financial and time budgets are likely to affect the quality of the energy savings evaluation and the qualification of energy savings evaluators. Budget and time should be set in order to allow hiring of energy savings evaluators with the appropriate competency to achieve the desired outcomes. In determining the financial and time budgets, the following factors should be considered:

— the final objective of the energy savings evaluation;

— the subject of the energy savings evaluation;

— the scale and complexity of the subject;

— the level of required accuracy for the results of the energy savings evaluations;

— the availability of data and evaluation models, including completeness, timeliness, granularity, etc.;

— the availability of the technical means to carry out the necessary data collection (e.g. measurement, recording, storing);

— the methods for evaluation [e.g. measurement and verification (M&V), simple statistical calculation or extensive calibrated modelling, calculation especially desired accuracy].

5 Roles and responsibilities

The main roles and responsibilities for selector of energy savings evaluator, lead energy savings evaluator and additional team member(s) of the energy savings evaluator are defined in Table 1.

NOTE Examples of selection methods for energy savings evaluators are shown in Annex A.

Table 1 — Roles and responsibilities for selector of energy savings evaluator, lead energy savings evaluator and additional team member(s) of the energy savings evaluator

Roles and responsibilities	Selector of energy savings evaluator	Lead energy savings evaluator	Additional team member(s) of the energy savings evaluator
Set the specifications for the energy savings evaluation (including time frame, budget and required competences) and possibly organize a tendering process	X		
Submit a bid describing how the energy savings evaluation would be performed (data collection, data processing, etc.)		X	
Agree on the energy savings evaluation contract (possibly including negotiations of budget and/or other contractual aspects)	X	X	
Agree on the energy savings evaluation methodology (boundary, evaluation method, baseline, etc.)	X	X	X
Ensure that the energy savings evaluator will have access to the information needed for the energy savings evaluation	X		
Perform the energy savings evaluation (data collection, data processing, etc.)		X	X
Report the energy savings evaluation		X	X
Communicate the energy savings evaluation	X	X	X
Manage the energy savings evaluation work within the agreed time frame and budget		X	
Mitigate the risks of the energy savings evaluation process regarding budget, data, etc.	X	X	

6 Principles for selecting energy savings evaluators

6.1 General

The selection of an energy savings evaluator is governed by several principles. The selection should be made in a way that allows clients to assess whether the proposed energy savings evaluator has the competence to perform the required energy savings evaluation consistently.

6.2 Confidentiality

Prior to the start of the energy savings evaluation, the energy savings evaluator agrees to the confidentiality agreement established by the selector of the energy savings evaluator, which is related to the disclosure or distribution of the results of the energy savings evaluation (e.g. the funder of the energy savings evaluation, government agency using the results), as applicable.

Energy savings evaluators should not use energy savings evaluation information for personal interest or in a manner detrimental to the legitimate interest of the entity being evaluated.

NOTE 1 This concept includes the proper handling of sensitive or confidential information.

NOTE 2 Subject to agreement by the client commissioning the energy savings evaluation, energy savings evaluators can be permitted to use anonymous data, for example, to improve advice about future EPIAs or to improve upon publicly available benchmarks.

6.3 Impartiality

Both internal and external energy savings evaluators should act in an independent and impartial manner to address the potential sources of bias, to ensure objectivity and to avoid conflicts of interest. Energy savings evaluators do not evaluate their own work.

6.4 Transparency

An energy savings evaluator should be prepared to perform evaluations such that all aspects of the energy savings evaluation are transparent, at least to the evaluation client.

6.5 Competence

The energy savings evaluator is an individual or a team with core competencies to conduct an energy savings evaluation. The core competencies include, but are not limited to:

a) knowledge of relevant legal and other requirements;

b) appropriate education, background experience and/or training experience in accordance with Clause 7;

c) demonstrating alignment with applicable standards and recommended energy savings evaluation protocols;

d) understanding of the context of a project, an organization or a region, as applicable;

e) the ability to identify the evaluation boundary and determine the energy baseline applicable to the subjects being evaluated;

f) a detailed understanding of energy use, energy consumption, energy efficiency, relevant variables and static factors;

g) a detailed understanding of energy systems, the division of sectors (especially for analysis of regions) and indicators, as applicable;

h) the ability to carry out appropriate measurement and/or other data collection, calculation and verification applicable to subjects of evaluation, and to ensure the data are accurate, traceable and kept consistently;

i) familiarity with, and ability to apply, the energy savings calculation methods and, where appropriate, proficiency in statistical and quantitative analysis;

j) the ability to ensure recording, retention and documentation of all data, as well as of the evaluation process, and of decisions made in conducting the energy savings evaluation;

k) having the appropriate communication skills to report energy savings;

l) completing the energy savings evaluation within the agreed time frame and budget.

NOTE Where there is a single energy savings evaluator, the evaluator is considered to be a lead energy savings evaluator. If a team is necessary to meet the competencies, a lead can be appointed.

6.6 Professional conduct

An energy savings evaluator should conduct the energy savings evaluation in a professional manner. Evaluators should be required to comply with a written code of conduct or code of ethics.

Previous clients or employers may be asked to provide a reference for potential evaluators.

7 Competencies of energy savings evaluators

7.1 General

The energy savings evaluator may be selected from competitive bids. An energy savings evaluator can be selected based on requirements, including knowledge and skills that may be demonstrated through education, experience and credentials.

7.2 Knowledge and skills

Energy savings evaluators should provide evidence that their knowledge and skills are current at the time of undertaking an energy savings evaluation. The evaluator candidates should give a statement of competencies according to the actual subjects of energy savings evaluation. Knowledge and skills directly relevant to the task to be performed should be demonstrated.

Annex B provides examples of frequently needed knowledge and skills of energy savings evaluators at the project, organization and region level.

7.3 Demonstration of knowledge and skills

7.3.1 General

The selector of energy savings evaluators should define the requirements on education and experience of the lead and other energy savings evaluators. Where a national or local energy savings evaluators' certification scheme, or equivalent, is available, certified energy savings evaluators may be considered.

Knowledge and skills are mainly demonstrated by education, experience, records and credentials. Additional private study, work experience, training, coaching, and attendance at conferences, meetings and seminars that help professional development can also be used as evidence of knowledge and skills.

Annex C gives examples of the demonstration of knowledge and skills of energy savings evaluators.

7.3.2 Education

Energy savings evaluators should have appropriate education covering the technical and/or financial and/or statistical aspects of energy savings evaluation, including the evaluation of associated risks, depending on the evaluation objective(s) and evaluation approach(es).

Annex C gives examples of educational requirements for energy savings evaluators.

NOTE Where there is a lack of relevant formal education, work experience can be a substitute.

7.3.3 Experience

Energy savings evaluators should have appropriate technical, project management and professional experience, and should work within their field of expertise. Experience directly relevant to the task to be performed should be demonstrated.

Annex C gives examples of relevant formal working experience of energy savings evaluators.

7.3.4 Records and credentials

Energy savings evaluators may be required to provide specific credentials and should be encouraged to provide other credentials, such as affiliations or professional status, to demonstrate relevant knowledge and skills. These could include:

— records of the relevant knowledge, skills, training or work experience;

— customer references;

— a licence or another certificate;

— qualifications.

Annex D gives examples of credentials that can be considered as evidence for competency.

NOTE Where qualifications are absent, reputation and customer evaluation can be considered.

Annex A
(informative)

Examples of selection methods for energy savings evaluators

Table A.1 — Examples of selection methods for energy savings evaluators

Rating methods	Purposes	Examples for rating methods
Review of professional records of potential evaluators regarding energy savings evaluation	Verify personal background of candidate evaluators	Analysis of education records, training, and working experience regarding relevant fields and energy savings evaluation tasks, etc.
Feedback from various interested parties	Provide information about personal performance	Survey form, questionnaire, personal materials, certificates, peer review, etc.
Face-to-face interview	Evaluate personal attributes and capacity of applying knowledge and skills	Face-to-face talk or telephonic conversation, etc.
Visual observation	Evaluate personal attributes and capacity of applying knowledge and skills	Role play, witness evaluation, job performance, etc.
Test	Evaluate personal attributes and capacity of applying knowledge and skills	Oral test, written test, psychological test, etc.
Review of previous performance regarding energy savings evaluation	Provide information regarding personal performance when visual observation is not available or appropriate	Review of previous evaluation reports, talk with previous clients and team members, etc.

Annex B
(informative)

Examples of the knowledge and skills of energy savings evaluators

Table B.1 — Frequently needed knowledge and skills of energy savings evaluators at the project, organization and region level

Descriptor	Project	Organization	Region
Legal issues	X	X	X
Material and energy balance and energy transfer	X	X	X
Technical area-related energy use and consumption	X	X	X
Division of sub-units of organizations and their corresponding energy consumption	X	X	
Division of sectors and typical energy indicators			X
Methodologies	X	X	X
M&V planning	X	X	X
Measurement and data gathering	X	X	X
Calculation and data interpretation	X	X	X
Reporting and communication	X	X	X
Management (evaluation plan, budget, time, resources)	X	X	X
Interested parties' engagement	X	X	X

Table B.2 — Examples of knowledge and skills of energy savings evaluators

Descriptor	Knowledge	Skills
Legal issues.	Legal codes, policies, laws and regulations, etc.	Identifying applicable laws, regulations, etc.
Material and energy balance and energy transfer.	Thermodynamic principles and analysis. Basic material and energy principles. Energy conversion and the interrelationship between various mechanisms of energy transfer.	Familiarity with energy specific terminology. Drawing flow charts of materials and energy flow. Assessing building relationships and equations regarding energy consumption using materials and energy inputs and outputs. Using materials and energy balance to determine the evaluation scope. Familiarity with carrying out energy transfer and thermodynamic calculations.
Technical area (e.g. industry, building, agriculture, etc.) -related energy use and consumption.	Basic engineering and management principles. Fluid (air, gaseous and liquid) flow principles and calculations (flow-pressure-power). Basic understanding of best available technologies and theoretical limits for typical sector. Basic understanding of typical production process (refer to ISO 50003:2014, Table 2) and energy performance improvement technologies. Good understanding of common energy systems (refer to ISO 50003:2014, Table 2), e.g. steam system, HVAC system, motor system, process heat.	Analysing EPIAs. Analysing energy efficiency and energy consumption for a typical energy system.
Division of sub-units of organizations and their corresponding energy consumption.	Energy accounting principles and practices. The structures of companies, institutions, etc. The boundaries and interrelation between sub-units.	Differentiating the boundaries of sub-units. Selecting and verifying appropriate energy accounting methods.
Division of sectors and typical energy indicators.	Basic understanding of industry classifications. The energy indicators framework at national, regional and sector levels. The models for energy savings estimation for a region.	Verifying applicable indicators. Applying a suitable quantitative aggregation of indicators, such as households, total employment, total production. Carrying out statistical analysis.

Table B.2 *(continued)*

Descriptor	Knowledge	Skills
Methodologies.	Good understanding of the concept and content of energy savings. At the project level, commonly used methodologies for energy savings calculation, including, but not limited to: — direct comparison; — adjusted baseline calculation; — calibrated simulation. At the organization level, commonly used methodologies for energy savings calculation, including, but not limited to: — the organization-based approach (change in the total energy consumption of the organization or its constituent parts); — aggregating energy savings from identified EPIAs. At the regional level, commonly used methodologies for energy savings calculation, including, but not limited to: — indicator-based calculation; — measure-based calculation. Currently available tools and software for energy savings calculation. General techniques of modelling, simulation and direct metering.	Proficiency in applying methodologies, related tools and software.
M&V planning.	Good understanding of the contents of the M&V plan. Good understanding of the logical relationship between M&V and project implementation (refer to ISO 17741). Good understanding of project stages.	Verifying the appropriate scope and boundary to include all related energy systems and EPIAs. Choosing highly viable methods according to data access. Budgeting, scheduling and defining roles.

Table B.2 *(continued)*

Descriptor	Knowledge	Skills
Measurement and data gathering.	Representative sampling. Available measuring techniques and equipment for flow, pressure, temperature, electricity, etc. The installation requirements of different measuring devices. The range of errors and uncertainty in measurement.	Installing, calibrating, sampling, metering and monitoring for flow, pressure, temperature, electricity, etc.
Calculation and data interpretation.	Principles of statistics. General knowledge of concepts and procedures for normalization and data calibration. The concepts of uncertainty, confidence and precision.	Identifying static factors and relevant variables. Carrying out statistical and quantitative analysis, such as average values, median, interquartile range, correlation and regression, factor analysis and trends analysis. Interpreting data, such as financial data, and material and energy inputs. Applying normalization and adjustment to energy savings results. Determining key elements and sources of uncertainty, and carrying out uncertainly analysis, including sensitivity analysis, where appropriate.
Reporting and communication.	Graphics and data representation techniques. General knowledge of EPIAs for typical energy systems.	Developing reports using common terminologies. Responding to a range of interested parties, including both technical and non-technical people. Delivering a viable presentation of the energy savings achieved through EPIAs.
Management (evaluation plan, budget, time, resources).	Strategic and analytical thinking regarding activities planning. Principles of project management, including team management and management of time, budget and workflow. Conflict resolution and risk control.	Planning design and organizing skills. Proficiency in team management, and management of time, budget and workflow. Negotiating and persuading skills. Proficiency in conflict resolution and risk control.
Interested parties' engagement.	Managing people.	Persuading skills, negotiation skills and management skills.

Annex C
(informative)

Examples of demonstrating the knowledge and skills of energy savings evaluators (education and experience)

Table C.1 — Examples of demonstrating the knowledge and skills of energy savings evaluators (education and experience)

Descriptor	Ways to demonstrate knowledge and skills	
	Education	**Experience**
Project	— Education on power system/ machinery, engineering and automation, thermodynamics, thermophysics, energy utilization, energy efficiency, electricity system, statistics and quantitative methods, etc. — Training on relevant standards, energy balance, energy-using equipment, measuring, sampling, sub-metering, etc.	The experience may include the following: — work experience in relevant fields; — work experience in energy savings evaluation of similar projects; — work experience with verifying the implementation of EPIAs; work experience that uses sampling methods representative of the target population. For the leader of an energy savings evaluation team, the following experience is also needed: — experience of managing energy savings evaluation teams; — experience regarding budget and finance for energy savings evaluation.
Organization	— Education on power systems, engineering, thermodynamics, energy utilization, energy (electricity) system, business management, financial management, etc. — Training on standards, energy balance, management of energy system, energy (electricity) system, energy-using process, energy accounting, measuring, sampling, metering, energy and financial data interpretation, etc.	The experience may include the following: — work experience in relevant sectors; — having participated in conducting energy savings evaluations for similar organizations; — work experience in sector management or business management; — familiarity with energy management and energy accounting; — understanding of building processes and transport, where applicable. For the leader of an energy savings evaluation team, the following experience is also needed: — experience of managing energy savings evaluation teams; — experience regarding budget and finance for energy savings evaluation.