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Energy performance of buildings — Assessment of overall energy performance

Performance énergétique des bâtiments — Evaluation de la performance énergétique globale

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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 on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 163, *Thermal performance and energy use in the built environment*, in collaboration with Technical Committee ISO/TC 205, *Building environment design*.

Introduction

This International Standard is prepared by ISO/TC 163, *Thermal performance and energy use in the built environment*, in collaboration with Technical Committee ISO/TC 205, *Building environment design* and is one of three closely linked documents dealing with definitions and general procedures for the overall building energy performance rating and certification (see also Figure 1):

— ISO/TR 16344, *Energy performance of buildings — Common terms, definitions and symbols for the overall energy performance rating and certification*;

— ISO 16343: *Energy performance of buildings — Methods for expressing energy performance and for energy certification of buildings*;

— ISO 16346: *Energy performance of buildings — Assessment of the overall energy performance*.

ISO/TR 16344 provides a coherent set of terms, definitions, and symbols for concepts and physical quantities related to the overall energy performance of buildings and its components, including definitions of system boundaries, to be used in all International Standards elaborated within ISO on energy performance of buildings.

ISO 16343 sets out ways of expressing the energy performance in an energy performance certificate of a building (including the technical building systems) and ways of expressing requirements as to the energy performance. This includes an overall numerical energy performance indicator and classes against benchmarks.

Their development greatly benefited from similar CEN documents (viz. CEN/TR 15615, EN 15217, and EN 15603) developed to support the European Energy Performance of Buildings Directive (EPBD).

A revision of the set of CEN standards to support the EPBD is anticipated in the near future. Issuing the ISO documents aims to bring the key subjects of building energy performance assessment to the global international level.

Given the strong demand for these International Standards at ISO level, it was decided not to delay the advancement of these International Standards and Technical Report by waiting on these CEN developments. However, it is expected that a future revision of these International Standards and Technical Report will be carried out in collaboration with CEN under the Vienna Agreement.

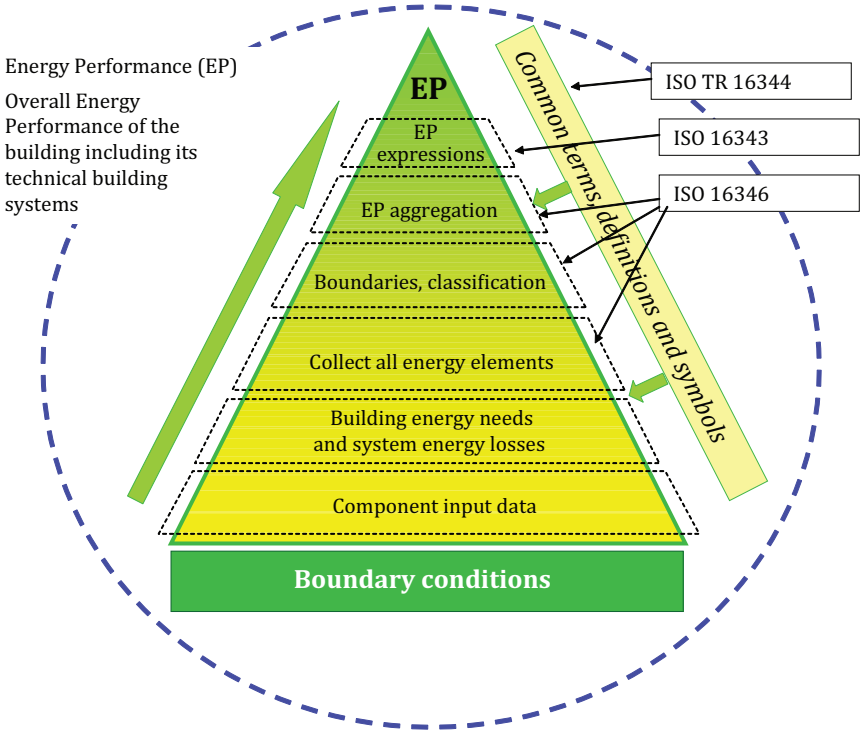


Figure 1 — Flow diagram illustrating the successive elements of the general procedures

Introduction to the assessment of overall energy performance

Energy assessments of buildings are carried out for various purposes, such as:

a) judging compliance with building regulations expressed in terms of a limitation on energy use or a related quantity;

b) checking for transparency in commercial operations through the energy certification and/or display of a level of energy performance (energy performance certification);

c) monitoring of the energy efficiency of the building and its technical building systems;

d) helping in planning retrofit measures through prediction of energy savings which would result from various actions.

This International Standard specifies a general framework for the assessment of overall energy use of a building and the calculation of energy ratings in terms of primary energy, CO_2 emissions, or parameters defined by a national energy policy. Separate standards calculate the energy use of services within a building (heating, cooling, hot water, ventilation, lighting, and transport for people) and produce results that are used here in combination to show overall energy use. This assessment is not limited to the building alone, but takes into account the wider environmental impact of the energy supply chain.

An allowance is made for energy that may be generated within or on the surface of the building and which is used to offset fuel and power drawn from other sources. Energy generated at the building site and exported is credited, provided it is exported for use elsewhere.

Energy certification of buildings requires a method that is applicable to both new and existing buildings and which treats them in an equivalent way. Therefore, a method to obtain equivalent results from different sets of data is presented in this International Standard. A method to assess missing data and to calculate a standard energy use for space heating and cooling, ventilation, domestic hot water, and lighting is provided. This International Standard also provides a method to assess the energy effectiveness of possible improvements.

Two principal types of energy ratings for buildings are proposed in this International Standard:

a) calculated energy rating;

b) measured energy rating.

Because of the differences in the way these two ratings are obtained, they cannot be directly compared. However, the difference between the two ratings for the same building can be used to assess the cumulative effects of actual construction, systems, and operating conditions versus standard ones and the contribution of energy uses not included in the calculated energy rating.

Values for factors and coefficients needed to calculate primary energy and CO_2 emissions related to energy policy should be defined in a national annex.

NOTE Energy is not produced, but only transformed. However, in this International Standard, energy is used in one form by systems that generate other forms of energy. At its final stage in the building, energy is used to provide services such as heating, cooling, ventilation, hot water, lighting.

Energy performance of buildings — Assessment of overall energy performance

1 Scope

This International Standard defines the general procedures to assess the energy performance of buildings, including technical building systems, and defines the different types of ratings, and the building boundaries.

The purpose of this International Standard is to

a) collate results from other International Standards that calculate energy use for specific services within a building,

b) account for energy generated in the building, some of which may be exported for use elsewhere,

c) present a summary of the overall energy use of the building in tabular form,

d) provide energy ratings based on primary energy, carbon dioxide emission, or other parameters defined by a national energy policy, and

e) establish general principles for the calculation of primary energy factors and carbon dioxide emission coefficients.

This International Standard defines the energy services to be taken into account for setting energy performance ratings for planned and existing buildings and provides for

1) a method to compute the standard calculated energy rating, a standard energy use that does not depend on occupant behaviour, actual weather, and other actual (environment or indoor) conditions,

2) a method to assess the measured energy rating, based on the delivered and exported energy,

3) a method to improve confidence in the building calculation model by comparison with actual energy use, and

4) a method to assess the energy effectiveness of possible improvements.

This International Standard is applicable to a part of a building (e.g. flat), a whole building, or several buildings.

It is up to national bodies to define under which conditions, for which purposes, and for which types of buildings the various ratings apply.

This International Standard handles the energy performance of a building as a whole. The assessment of the energy performance of specific technical building systems is handled in the appropriate part of the EN 15241, EN 15243, and EN 15316 series or the appropriate International Standards or national standards as listed in Annex A.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7345:1995, *Thermal insulation — Physical quantities and definitions*

ISO 12569, *Thermal performance of buildings and materials — Determination of specific airflow rate in buildings — Tracer gas dilution method*

ISO 13789, *Thermal performance of buildings — Transmission and ventilation heat transfer coefficients — Calculation method*

ISO 13790, *Energy performance of buildings — Calculation of energy use for space heating and cooling*

ISO 14025, *Environmental labels and declarations — Type III environmental declarations — Principles and procedures*

ISO 16343, *Energy performance of buildings — Methods for expressing energy performance and for energy certification of buildings*

ISO 16818, *Building environment design — Energy efficiency — Terminology*

ISO/TR 16344, *Energy performance of buildings — Common terms, definitions and symbols for the overall energy performance rating and certification*

EN 15193:2007, *Energy performance of buildings — Energy requirements for lighting*

EN 15232:2007, *Energy performance of buildings — Impact of Building Automation, Controls and Building Management*

EN 15241, *Ventilation for buildings — Calculation methods for energy losses due to ventilation and infiltration in commercial buildings*

EN 15243, *Ventilation for buildings — Calculation of room temperatures and of load and energy for buildings with room conditioning systems*

EN 15316 (all parts), *Heating systems in buildings — Method for calculation of system energy requirements and system efficiencies*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7345 and ISO/TR 16344 apply.

NOTE These terms and definitions are applicable to energy calculations according to this International Standard and to International Standards that are based on this one, to provide input to or use output from this International Standard.

4 Symbols and abbreviated terms

The International Standards dealing with the energy performance of buildings introduce a large number of quantities and their associated symbols.

To facilitate the use of the International Standards, a common set of symbols and subscripts has been defined, as given in ISO/TR 16344 (Terms, definitions, and symbols). The symbols follow established standards of nomenclature, such as ISO 7345, and introduce others that are common to the set of International Standards needed to assess the energy performance of buildings, in particular a set of subscripts to distinguish between different energy uses, different energy carriers, etc.

The symbols given in ISO/TR 16344 concern only data passed from one International Standard (or part of an International Standard) to another.

5 Assessment of energy performance of buildings

5.1 Energy uses

The assessment of the annual energy used by a building shall comprise the following services:

— heating;

— cooling and dehumidification;

— ventilation and humidification;

— hot water;

— lighting (optional for residential buildings);

— transport for people (optional);

— other services (optional).

The annual energy use includes auxiliary energy and losses of all systems.

National bodies decide if energy for lighting in residential buildings, as well as energy for transport for people and other services (e.g. electrical appliances, cooking, industrial processes) in all types of buildings shall be included or not in the calculated rating.

NOTE Energy uses for lighting and other services are included in the measured energy rating.

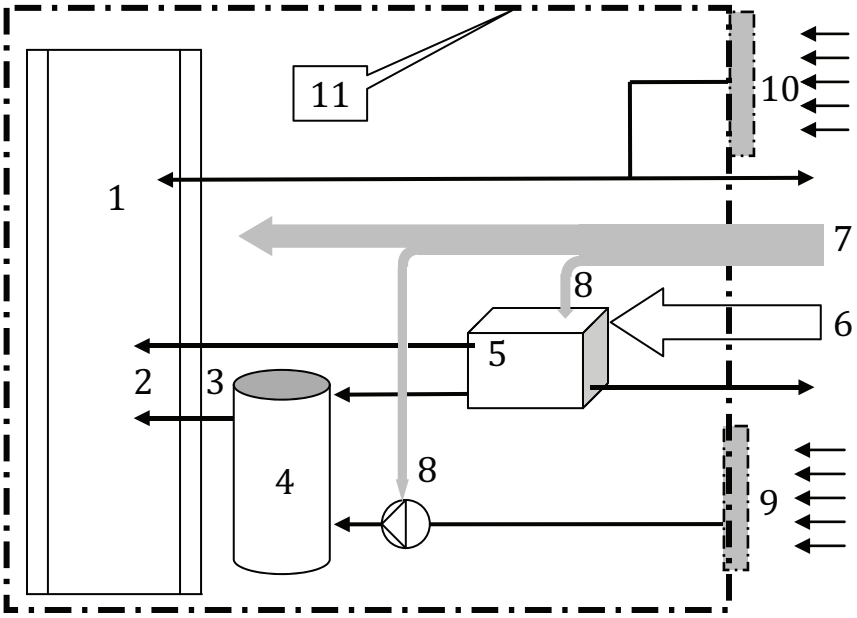
5.2 Assessment boundaries

The boundary for the energy performance assessment shall be clearly defined before the assessment. It is called system boundary. The system boundary is related to the rated object (e.g. flat, building).

Inside the system boundary, the system losses are taken into account explicitly; outside the system boundary, they are taken into account in the conversion factor.

Energy can be imported or exported through the system boundary. Some of these energy flows can be quantified by meters (e.g. gas, electricity, district heating, and water). The system boundary for energy carriers is the meters for gas, electricity, district heating, and water, the loading port of the storage facility for liquid, and solid energy carriers.

Consequently, if a part of a technical building system (e.g. boiler, chiller, cooling tower, etc.) is located outside the building envelope but forms part of the building services assessed, it is considered to be inside the system boundary and its system losses are therefore taken into account explicitly.



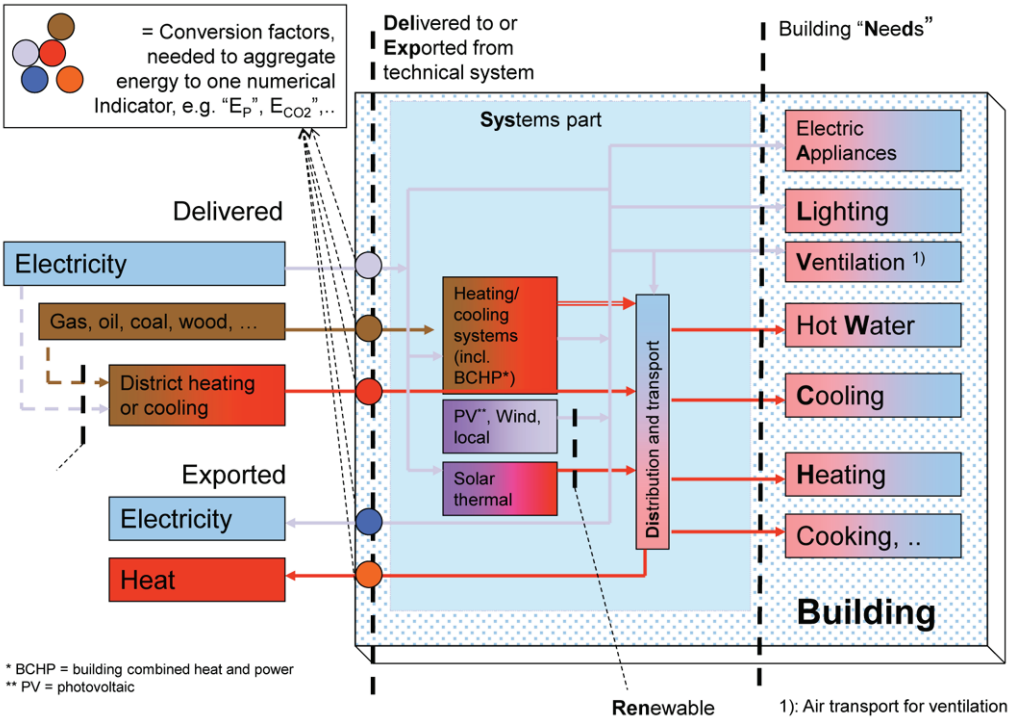
Key

1 user
2 emission
3 distribution
4 storage
5 boiler
6 fuel
7 electricity
8 auxiliary energy
9 thermal solar collector
10 photovoltaic panels
11 boundary

Figure 2 — Boundary — Examples of energy flows across the system boundary

The following two figures illustrate the energy flows inside and across the system boundary.

NOTE 1 These illustrations are more complete than Figure 2.



NOTE 2 Part of the recoverable heat or cold from the systems may be recovered in the building, thus reducing or augmenting the building energy needs for heating and/or cooling.

Figure 3 — Boundary and energy flows — Main energy flows within and crossing the boundaries

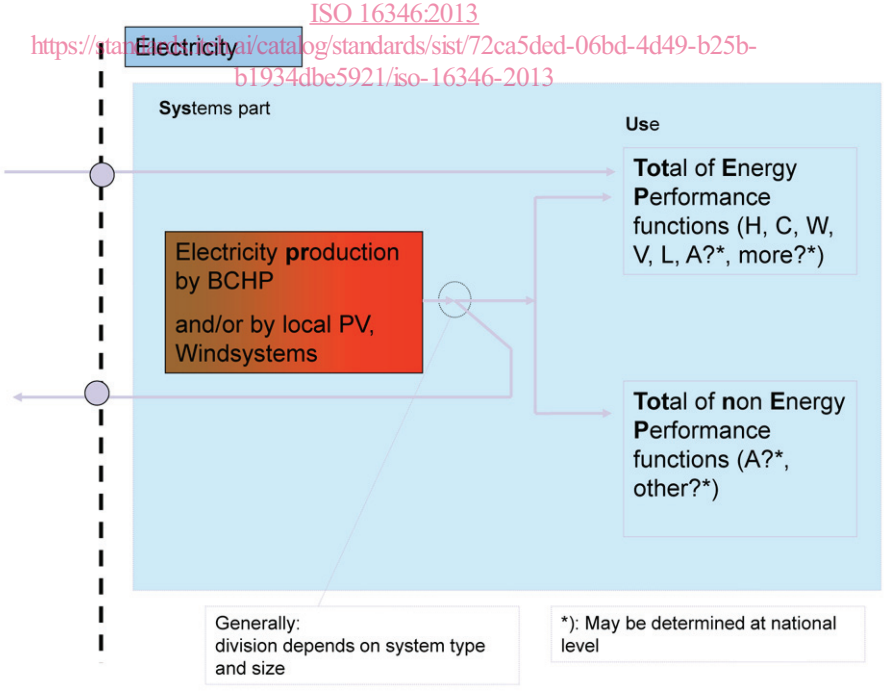


Figure 4 — Boundary and energy flows — More detailed view on the energy flows for produced, used, and exported electricity at and from the building site

For active solar, wind, or water energy systems, the incident solar radiation on solar panels or the kinetic energy of wind or water is not part of the energy balance of the building. Only the energy delivered by the generation devices and the auxiliary energy needed to supply the energy from the source (e.g. solar

collector) to the building are taken into account in the energy balance. It is decided on the national level whether this energy is part or not of the delivered energy.

The assessment can be made for a group of buildings if they are on the same lot or are serviced by the same technical systems.

Specific rules for the boundaries, depending on the purpose of the energy performance assessment and the type of the buildings, may be provided at national level.

5.3 Types and uses of ratings

This Internatonal Standard gives two principal options for energy rating of buildings:

— calculated energy rating;

— measured energy rating.

The calculated energy rating includes energy use for heating, cooling, ventilation, hot water, and when appropriate, fixed built-in lighting. It does not include energy for other services unless so decided at national level. Therefore, both ratings cannot be compared without special caution, as mentioned in Clause 8.

The calculated energy rating can be either:

— standard, based on conventional climate, use, surroundings, and occupant-related input data defined at national level and given in a national annex. This rating is called “design rating” when applied to a planned building;

— tailored, calculated with climate, occupancy, and surroundings data adapted to the actual building and the purpose of the calculation.

The assessment method of the measured energy rating is given in Clause 8.

National bodies determine

— which type of rating applies for each building type and purpose of the energy performance assessment,

— under what conditions the design rating can be considered as or converted to a calculated energy rating for the actually realized building, and

— if renewable energy produced on site is part or not of delivered energy.

The types of rating are summarized in Table 1.

Table 1 — Types of ratings

	Name	Input data			Utility or purpose
		Use	Climate	Building	
Calculated	Design	Standard	Standard	Design	Building permit, certificate under conditions
	Standard	Standard	Standard	Actual	Energy performance certificate, regulation
	Tailored	Depending on purpose		Actual	Optimization, validation, retrofit planning
Measured	Operational	Actual	Actual	Actual	Energy performance certificate, regulation

6 Weighted energy ratings

6.1 Types of ratings and indicators used

NOTE 1 Annex G contains a worked example of the procedures in this clause.

NOTE 2 ISO 16343 describes different levels of ratings, from integrated building energy performance to energy performance at component level. So it is to be discussed if the performance ratings of the envelope and of systems would not be better placed in ISO 16343.

ISO/FDIS 23045 presents a list of indicators for the different aspects of the energy efficiency of buildings, as in the following:

— performance of the building envelope;

— performance of the building envelope including the building technical systems;

— performance of technical building systems;

— performance of the building expressed in terms of primary energy use;

— performance of the building expressed in terms of related CO_2.

The indicators may be expressed as an absolute value that gives information about the global performance of the building or a relative value that allows comparison between the buildings and/or the technical building systems of the same category. As energy required and, consequently, energy delivered are closely related to designed comfort, indoor design conditions shall also be given at project definition stage.

Area (or volume) considered for the expression of efficiency and performance factors is the heated and/or cooled area as defined in ISO 16818. If not applicable, the definition of the floor area shall be defined as most factors can be related to this area.

A building usually uses more than one energy carrier. Therefore, a common expression of all energy carriers shall be used to aggregate the used amounts, sometimes expressed in various units and always having various impacts.

According to this International Standard, the aggregation methods are based on the following impacts the use of energy have:

— primary energy;

— carbon dioxide emission;

— parameters defined by national energy policy.

NOTE 3 Cost is a parameter that may be used in the energy policy aggregation method.

6.2 Types of factors or coefficients

6.2.1 General

The aggregation needs factors and coefficients determined at a national level according to the rules given below. Values for factors needed to calculate the primary energy and/or CO_2 emissions should be defined in a national annex.

NOTE 6.4.2 provides factors which can be used if no national values are given.

In a multi-plant generation system (e.g. electricity, district heating), the weighting factor at any time depends on which generation plants operate continuously and which plants are affected by a change in energy demand. A distinction between average, marginal, and end-use factors or coefficients may therefore be appropriate for the aggregation.

6.2.2 Average factor or coefficient

The average factor or coefficient reflects the annual average impact of all plants delivering energy (directly or indirectly) to the building. It is calculated by estimating the total impact (primary energy use, CO_2 production) during a year and divided by the total energy delivered.