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Energy performance of buildings — Methods for expressing energy performance and for energy certification of buildings

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National foreword

This British Standard is the UK implementation of ISO 16343:2013.

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

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INTERNATIONAL STANDARD

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Energy performance of buildings — Methods for expressing energy performance and for energy certification of buildings

Performance énergétique des bâtiments — Méthodes d'expression de la performance énergétique et de certification énergétique des bâtiments

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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. www.iso.org/directives

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

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 16346 defines the general procedures to assess the energy performance of buildings, including technical building systems, different types of ratings, and building boundaries.

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

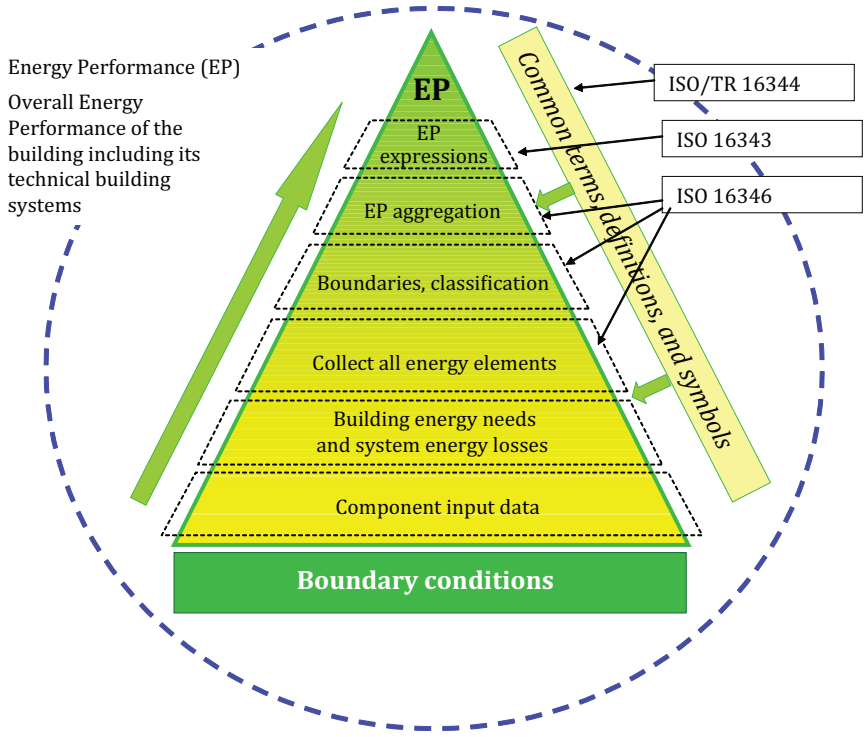


Figure 1 — Flow diagram illustrating the successive elements of the general procedures

Introduction to methods for expressing energy performance and for energy certification of buildings

Expression of the energy performance of buildings is needed to

— enable the establishment of regulations regarding energy performance of buildings, and

— encourage building designers, owners, operators, and users to improve the energy performance of buildings.

This International Standard provides methods to express the energy performance of buildings in a way that serves these purposes. It is based on International Standards that provide methods to calculate or measure energy performance.

This International Standard is intended to be used by

— developers of a procedure for building energy certification,

— building authorities setting minimum requirements on the energy performance, and

— building designers, building owners, building operators, and building users to assess the performance of a planned or existing building and ways to improve it and to express this performance.

INTERNATIONAL STANDARD ISO 16343:2013(E)

Energy performance of buildings — Methods for expressing energy performance and for energy certification of buildings

1 Scope

This International Standard 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 energy performance requirements. This includes an overall numerical energy performance indicator and classes against benchmarks.

This International Standard additionally includes numerical indicators at system or component level.

This International Standard defines the different types of rating (such as calculated, measured, design, and tailored rating) and the energy uses to take into account (such as heating, cooling, domestic hot water, ventilation, and lighting).

This International Standard defines

a) overall indicators to express the energy performance of whole buildings, including heating, ventilation, air conditioning, domestic hot water, and lighting systems (this includes different possible indicators),

b) ways to express energy requirements for the design of new buildings or renovation of existing buildings,

c) procedures to define reference values, and

d) ways to design a procedure for building energy certification.

Furthermore, it provides a (calculation) link between delivered energy and the energy performance indicators for buildings. Since a building generally uses more than one fuel (e.g. gas and electricity), the different energy sources are collected per energyware. The overall rating is based on a weighted sum of delivered energywares. The weightings can be related to, for instance, primary energy or CO_2 emissions to provide the end result of the calculation of energy performance.

It also provides calculation procedures to assess the energy performance on the basis of measured energy use, including ways to convert the measured values to values under standardized conditions (environment, user).

Finally, it defines the system boundaries needed to make a distinction between building energy needs, technical building systems, energy supply systems on site, and distant energy supply systems.

This International Standard can be applied to a group of buildings if they are on the same lot, if they are serviced by the same technical systems, and if no more than one of them has a conditioned area of more than 1 000 m^2.

This International Standard provides different options at different levels. When this International Standard is used to set up national or regional methods for expressing energy performance and/or for energy certification of buildings, the choices between the options shall not be made by the individual user but by authorized national or regional bodies.

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, *Thermal insulation — Physical quantities and definitions*

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

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

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 abbreviations

4.1 Introduction

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

To facilitate the use of the standards, a common set of symbols and subscripts have been defined, as given in ISO/TR 16344. The symbols follow established standards on 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 standard (or standard part) to another.

4.2 Principal symbols

Table 1 provides the specific symbols for this International Standard that are not covered in ISO/TR 16344.

Table 1 — Specific symbols and units for this International Standard

Symbol	Quantity	Unit
A_C	conditioned area	m^2
A_E	thermal envelope area	m^2
R	Reference	*)

4.3 Subscripts

Table 2 provides the specific subscripts for this International Standard that are not covered in ISO/TR 16344.

Table 2 — Specific subscripts for this International Standard

R	requirement of regulation
C	conditioned
S	building stock
E	envelope

5 Procedure for building energy certification

5.1 General

Clause 5 includes the following:

a) content of the procedure for building energy certification;

b) content of an energy certificate;

c) options in selecting the overall energy performance indicator EP which is used for the procedure for building energy certification;

d) description of a performance scale;

e) description of types of recommendations to be included in the energy certificate.

In addition to Clause 5, Annexes C and D provide a way to describe a procedure for building energy certification, an informative procedure for buildings classification, and three examples of an energy certificate format.

5.2 Content of procedure for building energy certification

When the procedure for building energy certification is set up according to this International Standard, information on the choices done shall be documented according to the format provided in Annex B.

The national party or other responsible body setting up a procedure for building energy certification may state that its procedures are in accordance to this International Standard if the documentation according to Annex B has been completed and the completed Annex B is published as national or equivalent annex to this International Standard.

NOTE The purpose of the national annex is to achieve transparency on the differences in (national or regional) procedures for building energy certification.

The following shall be included in a procedure for building energy certification.

a) BUILDING FUNCTIONS: Description of the function or functions of the building or part of the building to which the procedure applies. The main functions of buildings considered are: single family houses, apartment blocks, offices, education buildings, hospitals, hotels and restaurants, sport facilities, wholesale and retail trade service buildings, and other types.

b) APPLICATION: Specification of the cases where the procedure for building energy certification applies:

— for sale, rent, new building design or after construction, display in a public building, etc;

— for checking compliance with minimum energy performance requirements or not.

c) TYPE OF RATING: Specification of the type of rating or ratings used, as specified in 5.4, for each application [calculated (design, standard, or tailored) and/or measured; compliance check or not] and for which building function(s) it applies. In case of design rating, this includes under what conditions the design rating can be considered as or converted to a calculated energy rating for the actually realized building. In case of measured energy rating, this includes specification of which

information on the actual conditions in the building is to be recorded (if any) and whether or not corrections shall be made to correct for deviating periods, weather, and/or indoor conditions.

d) OVERALL NUMERICAL INDICATOR: Specification of what the overall numerical indicator represents, as specified in 6.1, and specifically, which energy services are included and if renewable energy produced on site is part of delivered energy or not.

e) NORMALIZATION: Specification of how the overall numerical indicator is normalized, as specified in 6.4.

f) ENERGY PERFORMANCE REQUIREMENTS: Specification of how the energy performance requirements are expressed, as specified in 7.1, including the way requirements for buildings with different functions are defined, as specified in 7.2, the way the impact of certain parameters is modified, as specified in 7.3, the way the requirements are expressed in case of renovations of and extensions to existing buildings, as specified in 7.4, and the specifications in case of the application of the notional (reference) building approach as described in Annex F.

g) REFERENCE VALUES: Specification of the definition of the reference values and the procedure to define the values, as specified in Clause 8, including the way the impact of certain parameters is modified, as specified in 8.1.

h) OTHER (COMPONENT) INFORMATION: Specification of other information on the energy performance of main building and system components required on the certificate (if any).

i) ADDITIONAL INDICATORS: Specifications and assessment procedures on additional indicators required on the certificate (if any, see 6.1).

j) RECOMMENDATIONS: Procedures to assess the recommendations for cost-effective improvements, as defined in 5.6, and for which applications these are required on the certificate.

k) ENERGY PERFORMANCE CLASSES OR SCALING: Setup and procedures to assess the energy performance class presented on a scale or other scaling (to be specified), as defined in 5.5.

EXAMPLES Examples of energy certificate classes or other scaling options are given in Annex D.

l) ADDITIONAL CONTENT: Specific additional content on the certificate to identify the characteristics of the building.

EXAMPLES Conditioned area, number of conditioned floors, year or period of construction, and year or period of the last major refurbishment.

m) ADDITIONAL INFORMATION: Specification of any other additional information required on the certificate (if any).

n) COMPLETION OF THE CERTIFICATE: General procedures for the completion of the administrative and technical data required on the certificate, as specified in 5.3.

o) FORMAT OF THE CERTIFICATE: Format of the certificate and which content is to be given in the certificate itself and which is to be given in an accompanying report.

EXAMPLES Examples of energy certificate formats are given in Annex D.

p) CENTRAL DATABASE: If this is part of the certification procedures, the purpose of this procedure is to ensure that the data obtained from the energy certificates describing the building stock are stored in an organized way and in a central place (one database).

5.3 Content of the energy performance certificate

The following administrative and technical data shall be provided according to the setup of the procedure for building energy certification as specified in 5.2.

a) **Administrative data**:

1) reference to a specific procedure for building energy certification, including its date;

2) name of person responsible for issuing the energy certificate;

3) address of the building where the energy certificate was issued to;

4) date when the energy certificate was issued and its limit of validity;

b) **Technical data**:

1) one overall indicator representing the energy performance, as specified in 5.2 under d);

2) type of rating(s) used, as specified in 5.2 under c), adding the following note depending on the type of rating:

In case of type:	**Note:**
Calculated energy rating	
Design rating	based on design data
Standard rating	based on standard conditions
Tailored rating	based on actual data
Measured energy rating	based on actual conditions

3) reference values as specified in 5.2 under g);

4) if the certificate is based on design energy rating, the requested additional content as specified in 5.2 under c);

5) if the certificate is based on measured energy rating, the requested additional content as specified in 5.2 under c);

6) specific other information on the energy performance of main building and system components, as specified in 5.2 under h);

7) specific additional indicators, as specified in 5.2 under i);

8) recommendations for cost-effective improvements, as specified in 5.2 under j);

9) energy performance class or other scaling presented on a scale, as specified in 5.2 under k);

10) specific additional content on the certificate to identify the characteristics of the building, as specified in 5.2 under l).

5.4 Overall energy performance rating types

The procedure for building energy certification shall specify the chosen type or types of rating, as listed in 5.2 under c), and for which application and building functions.

The types of rating are defined in 5.3 of ISO 16346.

— A) Calculated energy rating, with the following subdivisions:

  — A1) Design rating: rating applied to a planned building;

  — A2) Standard rating: rating based on standard input data for climate, use, surroundings, and occupant-related input data;

  — A3) Tailored rating: rating calculated with climate, occupancy, and surroundings data adapted to the actual building and to the purpose of the calculation.

— B) Measured energy rating: rating based on measurement of all energy carriers delivered to the building and exported by the building and corrected for non-standard conditions, as specified in Clause 8 of ISO 16346.

If the choice depends on the application and function of the building, this shall be described in the procedure as part of 5.2 point c).

NOTE Which energy services are included or not is dealt with under 6.1.

Rationale for making the choice:

The selection of the relevant rating type shall take into account the following points.

The procedure for building energy certification shall describe how these points have been taken into account as part of 5.2 point c).

— For new buildings, the measured energy indicator is not available.

— The utilities which collect data on energy consumption may not be authorized to disclose them for privacy reasons.

— A measured energy indicator will no longer be valid following a change of building occupier or of the pattern of use of the building. For existing buildings which are rented or sold, the way the building is managed could change and the measured energy indicator could change as a result.

— Defining a standard calculated energy indicator includes the collection of data on the building (insulation, heating system, etc.) which will be useful in giving advice on the improvement of its energy performance.

— In existing public buildings where there is no change in ownership, the measured energy indicator can be a measure of the quality of the management and can be used to motivate building operators and users.

— When the energy certificate is displayed in an existing public building, the operational indicator can be a measure of the quality of the management and can be used to motivate building operators and users.

— For managers of buildings, a measured energy indicator can be easily obtained from data often stored in their information systems (energy bills, areas, etc.).

— Measured energy indicator and standard calculated energy indicator do not necessarily include the same energy uses.

— For new buildings, a design indicator may be the only practical means of assigning an indicator.

The typical application of the different rating types is summarized in Table 3.

Table 3 — Types of ratings

	Name	Input data			Type of application
		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

NOTE When applicable, the presentation of both indicators enables differentiation between the calculated intrinsic potential of the building represented by the standard calculated energy indicator and the impact of building management and actual properties of the building and its installations (including control), the effects of which are included in the measured energy indicator.

5.5 Performance scale

The procedures for building energy certification shall specify the setup and the procedures to assess the performance scale as part of 5.2 point k).

In addition to the numerical indicator EP, the energy certificate contains energy efficiency classes or another scaling.

If sufficient information is not available to define the boundaries of classes for a given type of building, the use of classes or another scaling may be postponed until sufficient data becomes available.

The energy class for a given building shall be based on the value of the energy performance indicator.

A procedure to neutralize or reduce the impact of certain parameters on the energy class can be used by modifying some parameters used in the calculation of EP as described in 7.3.

Unless differently defined by the developer of the procedure for building energy certification, the following applies as specified in 5.2 under k).

— The performance scale shall range from A (buildings of highest energy performance) to G (buildings of lowest energy performance).

— The energy performance regulation reference, R_r, shall be placed at the boundary between classes B and C.

— The building stock reference, R_s, shall be placed at the boundary between classes D and E.

— A building with a net delivered energy equal to 0 shall be placed at the top of class A.

— Subclasses can be defined in order to subdivide the classes, e.g. class A can be split between A*, A**, A***.

The procedure for building energy certification shall describe the limits of each class, to be specified in 5.2 under k).

NOTE 1 Annex C (informative) provides a procedure for building classification.

NOTE 2 This means that for a given country or region and a given building type, most buildings completed from 2006 onwards should be in classes A and B, approximately 50 % of the building stock will be in classes between A and D, and approximately 50 % of the building stock will be in classes E, F, and G.

NOTE 3 Annex D (informative) provides example descriptions of an energy certificate.

5.6 Recommendations

The procedures for building energy certification shall specify the procedures to assess the recommendations for cost-effective improvements and for which applications these are required on the certificate, as part of 5.2 point j).

The energy certificate shall contain, if applicable, recommendations dealing with:

a) modernisation measures (building envelope, technical systems);

b) measures of property management (improvement of the operation and control of building and technical systems).

The assessment of the impact of possible measures can be done according to ISO 16346.

6 Energy performance indicators

6.1 Overall indicator

The procedures for building energy certification shall specify the energy performance indicator or indicators and for which applications these are required on the certificate, as part of 5.2 points d), e), and i).

The energy performance of a building is represented by an overall indicator, *EP*, that is the weighted sum of the delivered and exported energy per energyware determined according to Clause 5 of ISO 16346, normalized according to 6.4.

The procedure for building energy certification shall describe whether EP represents the following:

a) primary energy (E_p);

b) CO_2 emissions (m_{CO2});

c) net delivered energy weighted by any other parameter defined by national energy policy (e.g. delivered energy, E_p, or cost).

The calculated energy rating shall include energy use for heating, cooling, ventilation, and hot water.

The procedure for building energy certification shall describe [as part of 5.2 point i)] if lighting is included or not. The procedure for building energy certification shall also describe [as part of 5.2 point i)] if energy for other services is included, for instance, transport of people (elevators, escalators) and/or appliances.

6.2 Other indicators

The procedure for building energy certification shall describe if this overall indicator *EP* is complemented by other indicators, in which case, these are to be specified as part of 5.2 point i). In case specific requirements are defined (see 7.1), appropriate indicators to check compliance with the requirements shall be specified.

EXAMPLE Thermal performance of the building envelope. See also 7.1 and Annex E.

6.3 Indicator basis

The indicators shall be based on one of the types of ratings chosen under 5.4, to be specified as part of 5.2 point i).

6.4 Normalization of energy rating

The overall indicator, *EP*, is the rating defined in ISO 16346, divided by the conditioned area, A_C.

The procedures for building energy certification shall specify [as part of 5.2 point e)] the type of dimensions used to calculate A_C: internal dimension, external dimension, or overall internal dimension.

Rationale for making the choice:

NOTE 1 The type of dimension used has a high impact on the indicator obtained after normalization. For a house of 10 m × 10 m, the indicator obtained using internal dimensions could be 20 % larger than the one obtained with external dimensions.

NOTE 2 Usually, the choice is the same as for the calculation of the transmission heat transfer (see ISO 13789:2007); in addition, there is a direct correlation with input parameters that are related to the conditioned area (e.g. conventional hot water demand, minimum ventilation, lighting).

NOTE 3 An estimate of A_C can be obtained from the conditioned volume and mean floor height.

7 Expression of energy requirements

7.1 Ways of expressing the requirements

The procedures for building energy certification shall specify [as part of 5.2 point f)] the way or ways the energy performance requirements are defined and for which applications.

Two main types of requirements can be defined:

a) overall energy performance requirement in accordance with 7.2;

b) specific requirements based on the following:

   1) energy use for one specific purpose (e.g. heating, domestic hot water, cooling, lighting, ventilation);

   2) energy need for heating domestic hot water and cooling;

   3) characteristics of the building itself or of its technical building systems considered as a whole (e.g. heat transfer coefficient of the building envelope, heating, hot water or cooling system, efficiency of lighting systems);

   4) characteristics of the building envelope or technical building systems components (e.g. thermal transmittance of walls, efficiency of boilers, insulation of heating and hot water pipes, specific fan power).

NOTE 1 Information on possible specific requirements is given in Annex E.

An overall indicator may be combined with specific requirements.

Rationale for making the choice:

NOTE 2 Reasons for doing that include:

a) to avoid too large trade-offs between the performance of the building envelope and the performance of the technical systems;

b) to avoid technical health or discomfort risks;

c) to prevent components with low performance to be put on the market.

See Reference [2] for more background information on the advantages and disadvantages of additional requirements.

The indicators used can be different for:

— a new building;

— renovation of an existing building;

— an extension to an existing building;

— different types of buildings.

For new buildings and major renovations, the requirement shall include one overall energy performance requirement expressed according to 7.2.

For partial renovation of existing buildings and for extension to an existing building where overall requirements can be difficult to apply, simplified approaches based on specific requirements can be used. When specifying these requirements, consideration shall be given to the following important energy uses:

— thermal characteristics of the building envelope;

— heating installation and hot water supply;

— air conditioning installation (including dehumidification);

— ventilation (including humidification);

— built-in lighting installation;

— passive solar heat sources and solar protection;

— energy production, particularly by renewable sources and co-generation.

7.2 Overall energy performance requirements

The procedures for building energy certification shall specify [as part of 5.2 point f)] the way the overall energy performance requirements are defined, particularly in case of buildings with more than one function with different requirements.

The overall energy requirement, EP_r, shall be a limit value of the overall energy performance indicator, EP, defined in 6.4.

The requirement is written as

$$EP \leq EP_r \tag{1}$$

where

EP is the overall performance indicator;

EP_r is the limit value which defines the requirement.

When a given building has different functions, k, (e.g. education + sport) with different requirements, $EP_{r,k}$, procedures shall be defined to weight the different requirements.

Unless differently defined by the developer of the procedure for building energy certification, as specified in 5.2 under f), Formula (2) applies:

$$EP_r = \frac{\sum_{k=1}^{n} A_{c,k} \cdot EP_{r,k}}{A_c} \tag{2}$$

where

k represents the functions: $k = 1, 2, \ldots, n$.

The conditioned area of a space that is commonly used for more than one building function shall be proportionally divided over the conditioned areas of these building functions.

7.3 Modification of the impact of certain parameters

7.3.1 General

The procedures for building energy certification shall specify [as part of 5.2 point f)] the way the impact of certain parameters is modified.

The requirements can be written so as to modify (e.g. reduce, neutralize, correct, or normalize) the impact of some parameters. These parameters can include those listed in Table 4.

Table 4 — Parameters with reduced or neutralized impacts

Parameter	Possible reason
Climate	To adapt the level of technologies requested to the climate
Building function	To adapt the requirements to the different design, occupation, and feasible technologies
Energyware	For national energy policy regarding the possible use of different energy sources (e.g. gas/ electricity) or to take into account the availability of specific energy sources in specific locations
Building size and/or shape	To avoid unduly onerous requirements on detached houses and too low requirements on large compact buildings To adapt the requirements to buildings with different sizes and shapes
Ventilation rate	To prevent too costly requirements for building/occupation which requires a high ventilation rate
Illumination level	To prevent too costly requirements for building/occupation which requires a high illumination level

The impact of a parameter can be modified either by specifying particular values or procedures for the data used in the calculation of *EP* [see 7.3.1, item a)] or by adjustment of the energy performance requirement, EP_r, [see 7.3.1, item b)].

a) Standard values for climate and occupant-related input are defined as described in 8.3.2 of ISO 16346.

b) EP_r can be made dependent upon the parameters whose impact is to be reduced. In this case, EP_r may be defined by either

   1) the **formula approach** wherein EP_r is defined by a simple formula, e.g. $EP_r = f$ (climate, building form and function, etc.), or

   2) the **notional building approach** wherein EP_r is the value of *EP* calculated for a building having the same location, building function, size, etc. but with parameters such as insulation level, heating system efficiency, activity schedules, internal heat gains etc. replaced by reference values.

NOTE See Reference [2] for more background information on different reasons and ways to neutralize the impact of certain parameters and the consequences.

7.3.2 Impact of building shape

The building shape is characterized by the building shape factor:

$$f = A_E / A_C \quad (3)$$

or the compactness ratio

$$c = A_E / V_C \quad (4)$$

where

A_E is the thermal envelope area, in m^2;

A_C is the conditioned area, in m^2;

V_c is the conditioned volume, in m^3.

The impact of the building shape is taken into account by introducing the building shape factor or the compactness ratio in the formula expressing EP_r.

EXAMPLE $EP_r = EP_o$ (a + b·f), where a and b are non-dimensional coefficients.

7.3.3 Evolution of the requirements

The requirements can be modified throughout time by writing EP_r in the following way:

$$EP_r = \alpha \cdot EP_{r,date} \quad (5)$$

where

α is a strengthening factor between 0 and 1, which evolves with time;

$EP_{r,date}$ corresponds to the value of EP_r at a given date.

7.4 Renovation of and extensions to existing buildings

The procedures for building energy certification shall specify [as part of 5.2 point f)] the way the requirements are expressed in case of renovations of and extensions to existing buildings.

In case of a minor renovation or extension, dealing with few single components or subsystems, e.g. windows, boilers, artificial lighting installation, the requirements are set at the component or subsystem level.

In case of large renovation, the overall energy performance indicator shall be used but the procedures for building energy certification may specify higher values of EP_r than for new buildings.

In case of large extension, the overall energy performance indicator shall be used but the procedures for building energy certification may specify distinct values of EP_r for the existing part and the new part.

When the notional or reference building approach is used, the performance of the unchanged elements is set at their actual value in the calculation of EP_r.

8 Reference values

8.1 Types of reference values

The procedures for building energy certification shall specify [as part of 5.2 point g)] the definition of the reference values and the procedure to define the values.

Reference values are used to compare the energy performance of a given building to the energy performance of similar buildings.

Different reference values shall be defined for classes of buildings having different functions (e.g. single family houses, apartment blocks, offices, education buildings, hospitals, hotels and restaurants, sport facilities, wholesale and retail trade service buildings, and other types).

The procedures for building energy certification can choose [to be specified as part of 5.2 point g)] between the following references:

— R_r: Energy performance regulation reference. This corresponds to the value typical of the requirements of energy performance regulations for new buildings;

— R_s: Building stock reference. This corresponds to the energy performance reached by approximately 50 % of the national or regional building stock (median value).

The procedures for building energy certification may contain a procedure [to be specified as part of 5.2 point g)] to neutralize or reduce the impact of certain parameters on the reference values by modifying some parameters used in the calculation of R_r and R_s as described in 7.3 for EP_r.

EXAMPLE $R_r = R_{r,o}$ (a + b·f), where a and b are non-dimensional coefficients.

If the indicator used is a measured energy indicator, the procedures for building energy certification may adopt alternative definitions for R_r until sufficient data on the operational performance of buildings completed according to the regulations becomes available [to be specified as part of 5.2 point g)].

NOTE 1 Definition of R_s: The building stock value can be difficult to assess precisely due to an insufficient knowledge of the performance of the building stock. A rough estimate of it could be obtained by collecting energy consumption of a small subset of the building stock.

NOTE 2 A minimum of 5 years between changes in the values of the references is recommended.

NOTE 3 National policy can decide whether to keep the same value for R_r even if the regulations are changed.

When a given building has different functions (e.g. education + sport), one shall either

— define a reference for each building function, or

— define the reference value as an area weighted average of the reference values for each building function.

8.2 Content of reference values

The energy services considered when defining the reference values shall be the same as the energy services considered when establishing the energy performance indicator.

If the indicator used is a standard calculated energy indicator, the reference shall be obtained with the same assumptions as the standard calculated energy indicator regarding use patterns and internal and external climate.

The procedures for building energy certification may contain a procedure [to be specified as part of 5.2 point g)] to adapt the reference value to a specific function of the building. This can take into account a particular specification of internal climate.

NOTE This can be used, for example, to differentiate between buildings which are used for 5, 6, or 7 days a week or buildings having different occupation densities.

8.3 Documentation of reference values

The procedures for building energy certification shall document [to be specified as part of 5.2 point g)] the following for each reference value:

— type of reference value: R_r, R_s;

— building function;

— energy flows considered;

— assumptions regarding internal and external climate;

— assumptions regarding use patterns;

— procedure to adapt the reference value.

Annex A
(normative)

Parallel routes in normative references

This International Standard contains specific parallel routes in referencing to other International Standards, in order to take into account existing national and/or regional regulations and/or legal environments while maintaining global relevance.

The standards that shall be used as called for in the successive clauses are given in Table A.1.

NOTE 1 Annex A intends to take into account that the "CEN area" requires links to specific CEN standards where ISO standards may be different or (at the moment) absent.

NOTE 2 An example of a similar annex can be found in ISO 13790:2008 (Annex A).

NOTE 3 Normative Annex A has been prepared in anticipation that a future revision of this International Standard will be carried out in collaboration with CEN under the Vienna Agreement (see Introduction).

Table A.1 — Normative references

Clause (in this International Standard)	Subject	CEN area[a]	Elsewhere
Clause 3	Terms and definitions	EN/TR 15615, Annex C	ISO/TR 16344
Clause 4	Symbols and subscripts	EN/TR 15615, Annex D	ISO/TR 16344
Clauses 5, 6, 7, and 8	Overall energy performance assessment	EN 15603	ISO 16346

[a] CEN area = Countries whose national standards body is a member of CEN. Attention is drawn to the need for observance of EU Directives transposed into national legal requirements. Existing national regulations with or without reference to national standards may restrict for the time being the implementation of European Standards.

Annex B
(informative)

Procedure for building energy certification documentation

B.1 Purpose of the procedure for building energy certification documentation

Annex B is intended to be used by national bodies setting up a procedure for building energy certification to document this procedure. It will be used to compare the different procedures for building energy certification.

National bodies setting up a procedure for building energy certification and stating that their procedures are in accordance to this International Standard shall complete the documentation according to Annex B and the completed Annex B shall be published as national annex to this International Standard.

The documentation of an energy certification procedure shall describe, in the manner set out in Annex B, the options chosen when defining the procedure for building energy certification.

It can be used by the following:

— authorities setting up a procedure for building energy certification to document their energy certification procedure;

— authorities setting up a procedure for building energy certification to compare their energy certification procedure to the energy certification procedures set up by other authorities;

— people comparing energy certificates issued in different countries or regions to understand the meaning of the different energy certificates.

B.2 Content

B.2.1 General

The document defining the content of the procedure for building energy certification shall be written by the body setting up the procedure.

The following shall be included in a procedure for building energy certification.

B.2.2 Building functions

The function or functions of the building or part of the building to which the procedure applies are:

Building function	**Applies? (Yes/No)**	**Specific conditions**
Single family houses		
Apartment blocks		
Offices		
Education buildings		
Hospitals		
Hotels and restaurants		
Sport facilities		
Wholesale and retail trade service buildings		
Other types, namely: ……		
……		
……		

For apartments or units within buildings designed for separate use, the energy certification is based on the assessment of:

Apartment building	**Applies? (Yes/No)**	**Specific conditions**
The apartment or unit		
A common energy certification of the whole building		
Another representative apartment or unit in the same building		

B.2.3 Application domain of the procedure

Specification of the cases where the procedure for building energy certification applies.

Cases	**For checking compliance with minimum EP requirements? (Yes/No)**	**Specific conditions**
For sale		
For rent		
New buildings design		
New buildings after construction		
Display in a public building		
Major renovation		
Replacement of building or technical building system elements		
Other, namely: …		

B.2.4 Type of rating

Type of rating	For checking compliance with minimum EP requirements? (Yes/No)	For which building function(s)	Specific conditions
Calculated energy rating			
Design rating			
Standard rating			
Tailored rating			
Measured energy rating			

In case of design rating: under what conditions can the design rating be considered as or converted to a calculated energy rating for the actually realised building?
(free text)

In case of measured energy rating: specification of which information on the actual conditions in the building is to be recorded (if any) and whether or not corrections shall be made to correct for deviating periods, weather, and/or indoor conditions.
(free text)

B.2.5 Basis of the performance indicator

Specification of what the overall numerical indicator represents.

Energy services	**Included in the overall numerical indicator, as specified in 6.1? (Yes/No)**		**Specific conditions**
	Residential buildings	**Non-residential buildings**	
Space heating, including humidification			
Domestic hot water			
Space cooling, including dehumidification			
Mechanical ventilation			
Lighting			
Transport of people in the building (elevators, escalators)			
Appliances			
Other, namely: …			

Type of aggregation of energy carriers (see ISO 16346, Clause 6):	**(Yes/No)**	**Specific conditions**
ISO weighted energy use (Table 2 of ISO 16346)		
Primary energy		
CO_2 emissions		
Policy energy rating		
Other, namely: …		

Weighting factors composition and values (see ISO 16346, Clause 6)					
A) Which type					
	ISO energy weighting?	**Primary energy?**	**CO_2 emission?**	**Policy rating?**	**Other?**
For which of these aggregation types are the values given in this table? (Yes/No)					
Symbol	$f_{ISO;...}$	$f_{P;...}$	$K_{;...}$	$F_{pol;...}$	…
Unit[a]	MJ/MJ or kWh/kWh	MJ/MJ or kWh/kWh	kg/MJ[a]	MJ/MJ or kWh/kWh	…

B) Composition of the coefficients or factors:	**Yes/No**	**Specific conditions**
Are energy losses for mining included in case of gas, oil, and/or coal?		
Are energy losses for transport and storage included in case of gas, oil, and/or coal?		
Are energy losses for electricity transport (grid losses) included in case of electricity?		

If part of the energy *delivered* to the building site consists of renewable energy (e.g. green electricity from the grid): is this included in the conversion factor?		(b)

C) Values

	Subscript	**Value[a]**	**Specific conditions**
Delivered energy:			
gas	del;gas		
oil	del;oil		
coal	del;coal		
wood	del;wd		
Other biomass or bio-oil	del;bm		
Delivered heat for space heating, humidification, and/or domestic hot water	del;DH		
Delivered cold for space cooling and/or dehumidification	del;DC		
Delivered electricity	del;el		
Other, namely: …	del;..		
Energy used and produced at site			
Produced own used electricity	pr;us;el		
Other[c]	pr;us;..		
Energy produced and exported from site			
Own produced electricity exported	exp;el		

Own produced thermal energy exported	$_{exp;T}$		
(a) Note that for the CO_2 factors, the unit is relevant (kg/MJ or kg/kWh); use kg/MJ; for the other types of aggregation, the values are the same whether MJ/MJ or kWh/kWh is chosen. (b) Example: Yes, it is included in the conversion factor because the energy performance of the building may benefit from a better performing delivered mix; or No, it is excluded from the conversion factor because the benefit of renewable energy, which is not produced on the site itself, is outside the scope of the building site and consequently rewarded elsewhere (e.g. via green certificates). (c) Note that heat or cold produced on site and used at own site does not need a conversion factor because it is part of the calculation of the heating and cooling system performance.			

Normalisation of the numerical indicator	**Specific conditions**
Which dimensions are used for the conditioned area when normalising the energy performance?	
Internal dimensions?	
External dimensions?	
Overall internal dimensions?	
Others, namely: …	

B.2.6 Additional (component) information and indicators

Specification of other information on the energy performance of main building and system components required on the certificate (if any). **Specifications and assessment procedures on additional indicators required on the certificate (if any).**
(free text)

B.2.7 Way to express the energy performance requirements

Specification of how the energy performance requirements are expressed, as specified in 7.1, including the way the requirements for buildings with different functions are defined, as specified in 7.2, the way the impact of certain parameters is modified, as specified in 7.3, and the way the requirements are expressed in case of renovations of and extensions to existing buildings, as specified in 7.4.
(free text)

Are the requirements expressed following a notional or reference building approach as described in Annex F?	**Residential buildings**	**Non-residential buildings**	**Specific conditions**
For checking compliance with minimum *EP* requirements, new buildings? (Yes/No)			
For checking compliance with minimum *EP* requirements, existing buildings (renovation)? (Yes/No)			
For information at the energy certificate? (Yes/No)			
Other, namely: …			
If yes: which of the following parameters are kept the same in the calculation of the energy performance of the reference building (EP_r) and in the calculation of the energy performance of the actual building (*EP*)?	**For *EP* calculation, reference value is used?[a,c] (Yes/No)**	**For EP_r calculation, actual value is used?[b,c] (Yes/No)**	
Climate			
Building environment [e.g. location, obstacles for solar radiation, roughness (wind), …, ground reflection]			
Ventilation rate			
Illumination level			
Internal heat gains			
(Other) occupancy and/or operational assumptions (e.g. number of occupants, thermostat settings, operation of solar blinds, …)			
Building function			
Energyware			
Building size			
Building shape			
Other, namely: …			

(a) If "Yes": This is typical for both the "formula approach" and the "notional building approach"; the impact of the parameter on the energy performance is neutralized. Typical examples: climate, occupancy, thermostat settings, etc.

(b) If "Yes": This is typical for the "notional building approach"; again [as under (a)], the impact of the parameter on the energy performance is neutralized. Example: building size, building shape, etc.

(c) If both are "No": The parameter has full impact. Example: thermal insulation level, passive solar gains, system efficiencies (heating, domestic hot water, cooling, ventilation, lighting), etc.

See also 7.3.1.

B.2.8 Reference values

Specification of the definition of the reference values and the procedure to define the values, as specified in Clause 8, including the way the impact of certain parameters is modified, as specified in 8.1.

Reference type	Value of the reference (with unit)	Specific conditions
Energy performance regulation		
Building stock		
Other, namely: …		

B.2.9 Classification or scaling

The setup and procedures to assess the energy performance class presented on a scale or other scaling, (to be specified) as defined in 5.5.

Classification or scaling type	Applied? (Yes/No) if "Yes", provide the lower and upper limit	Specific conditions
Classification in distinct classes?		
If no distinct classes: Continuous scale?		
Other, namely: …		

B.2.10 Recommendations

Procedures to assess the recommendations for cost-effective improvements and for which applications these are required on the certificate
(free text, include all points described in 5.6)

B.2.11 Additional content on the certificate

Specific additional content on the certificate to identify the characteristics of the building
[free text, include 5.2 points g) and i)]

B.2.12 Completion of the certificate

General procedures for the completion of the administrative and technical data required on the certificate
[free text, include 5.2 point n)]

B.2.13 Energy certificate format

The format of the certificate and which part of the content should appear in the certificate and which part should appear in the accompanying report (if any). In addition, if part of the content should appear in the accompanying report, the format of the accompanying report.

Format of the energy certificate	**Yes/No**	**Comments**
Resembles the example 1 in Annex D		
Resembles the example 2 in Annex D		
Resembles the example 3 in Annex D		

Details of the energy certificate format
[*free text, include all points described in 5.3 which are not in an accompanying report (see next)]*

Accompanying report?	**Yes/No**
Is some of the content to be given in an accompanying report instead of in the certificate itself?	
If yes, provide details on the format of the report accompanying the certificate	
(free text, include all points described in 5.3 which are not in the certificate)	

B.2.14 Central database

If this is part of the certification procedures, the purpose of this procedure is to ensure that the data obtained from the energy certificates describing the building stock are stored in an organized way and in a central place (one database).

Are the data obtained from the energy certificates describing the building stock stored in an organized way and in a central place?	**Yes/No**
If yes, provide a list of data stored and/or reference to documents	
(free text)	

Annex C
(informative)

Procedure for building energy performance classification

C.1 Introduction

Annex C provides a simple procedure to define the limits of the classes of building energy performance.

The procedure enables the definition of classes that are consistent for all building types.

It can be applied to standard calculated energy indicators, to measured energy indicators, and to any of the indicators defined in 6.1.

To apply the procedure to a given type of building, it is necessary to define the values of the references R_r and R_s for the building type concerned.

C.2 Classification procedure

The steps of the procedure to determine the performance class of a given building are the following.

a) Define the type of the building (e.g. office building).

b) Select the energy performance regulation reference, R_r, and the building stock reference, R_s, corresponding to this building type.

c) Determine the values of the energy performance of the building, *EP*.

d) Determine the performance class using the following rules:

1) Class A if $EP < 0{,}5 \cdot R_r$;

2) Class B if $0{,}5 \cdot R_r \leq EP < R_r$;

3) Class C if $R_r \leq EP < 0{,}5 \cdot (R_r + R_s)$;

4) Class D if $0{,}5 \cdot (R_r + R_s) \leq EP < R_s$;

5) Class E if $R_s \leq EP < 1{,}25 \cdot R_s$;

6) Class F if $1{,}25 \cdot R_s \leq EP < 1{,}5 \cdot R_s$;

7) Class G if $1{,}5 \cdot R_s \leq EP$.

C.3 Additional steps

For a measured energy indicator, it can be appropriate to apply two additional procedures.

a) The value of *EP* can be modified, in accordance with ISO 16346, to take into account a possible difference between the actual climatic data and the reference climatic data used to define the values of R_r and R_s.

b) The values of R_r and R_s can be adjusted or the indicator has to be modified if the actual use of the building is different from that assumed to define the values of R_r and R_s for that building type (e.g. building open for 7 days a week and R_r and R_s corresponding to building open for 5 days a week).

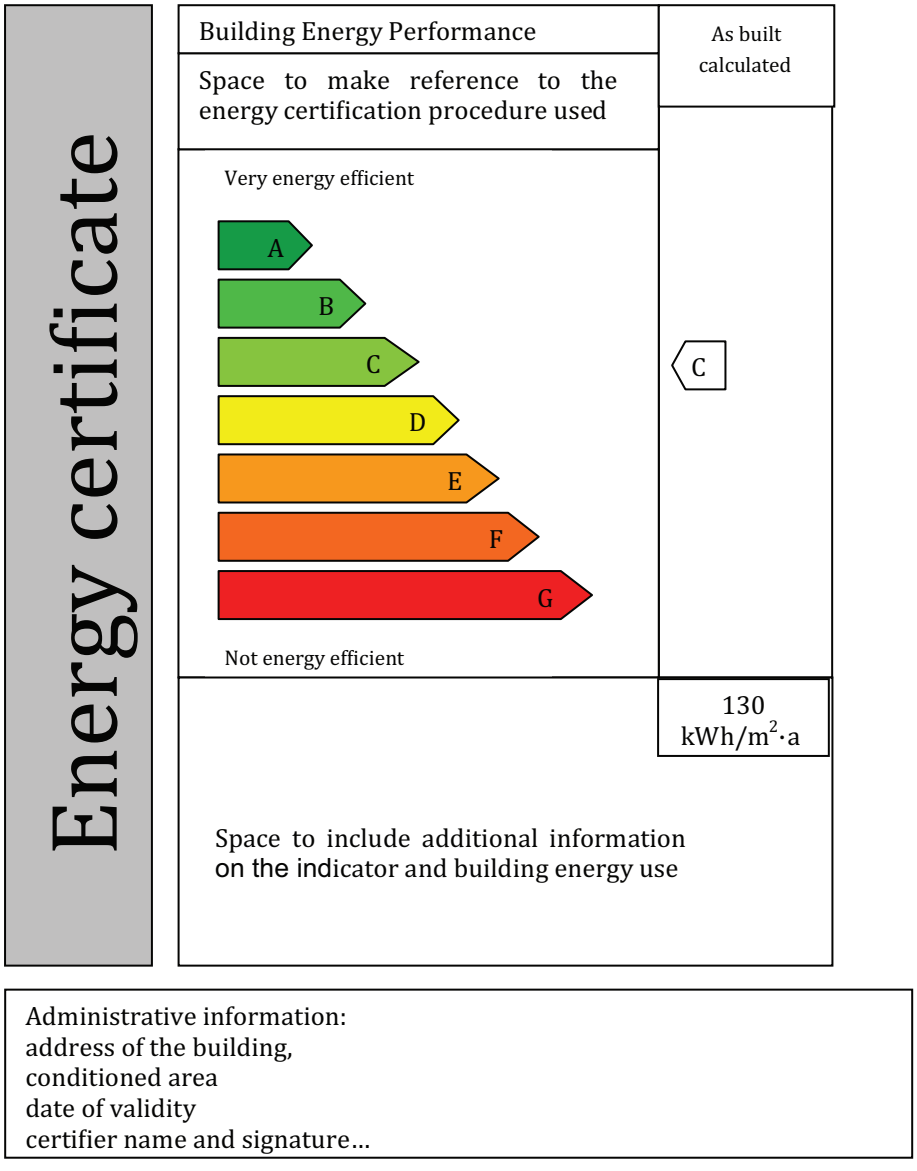
Annex D
(informative)

Energy certificate format

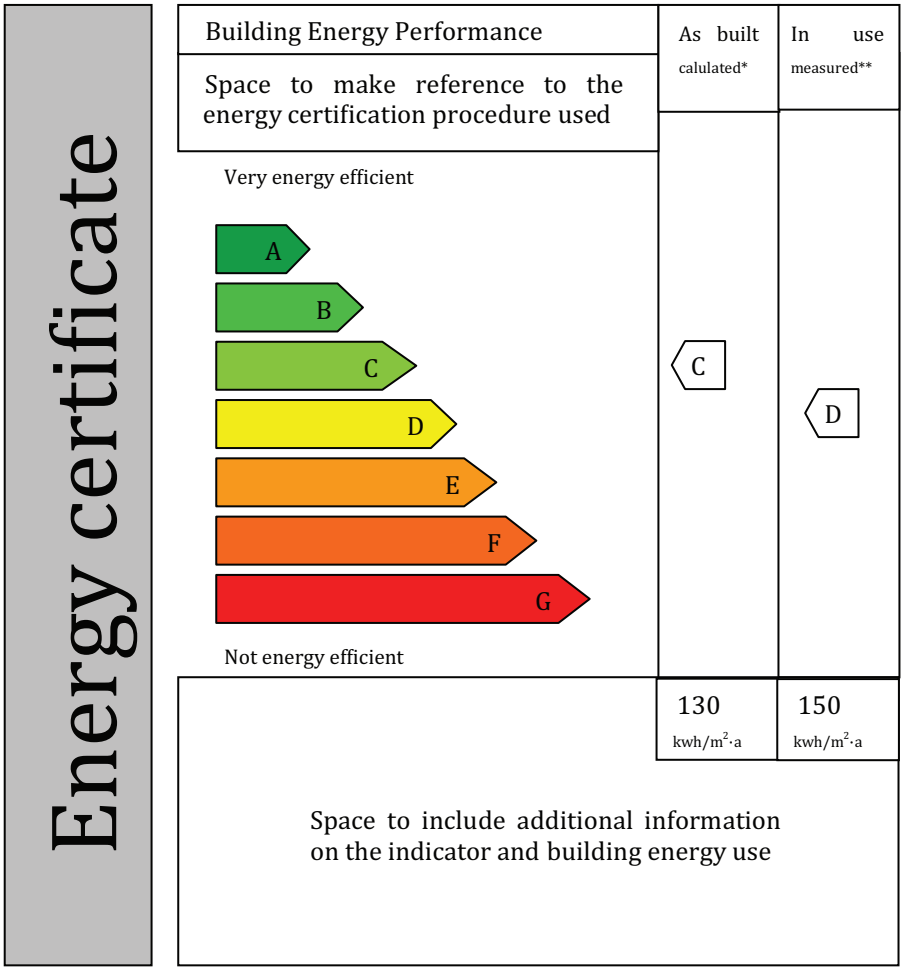
Annex D provides three examples of an energy certificate format. These examples are provided for illustration only and do not show all the details needed for an energy certificate. In particular, ways to present recommendations for improvements as well as ways to present the supporting evidence of the energy certificate are not presented.

Many other solutions are possible.

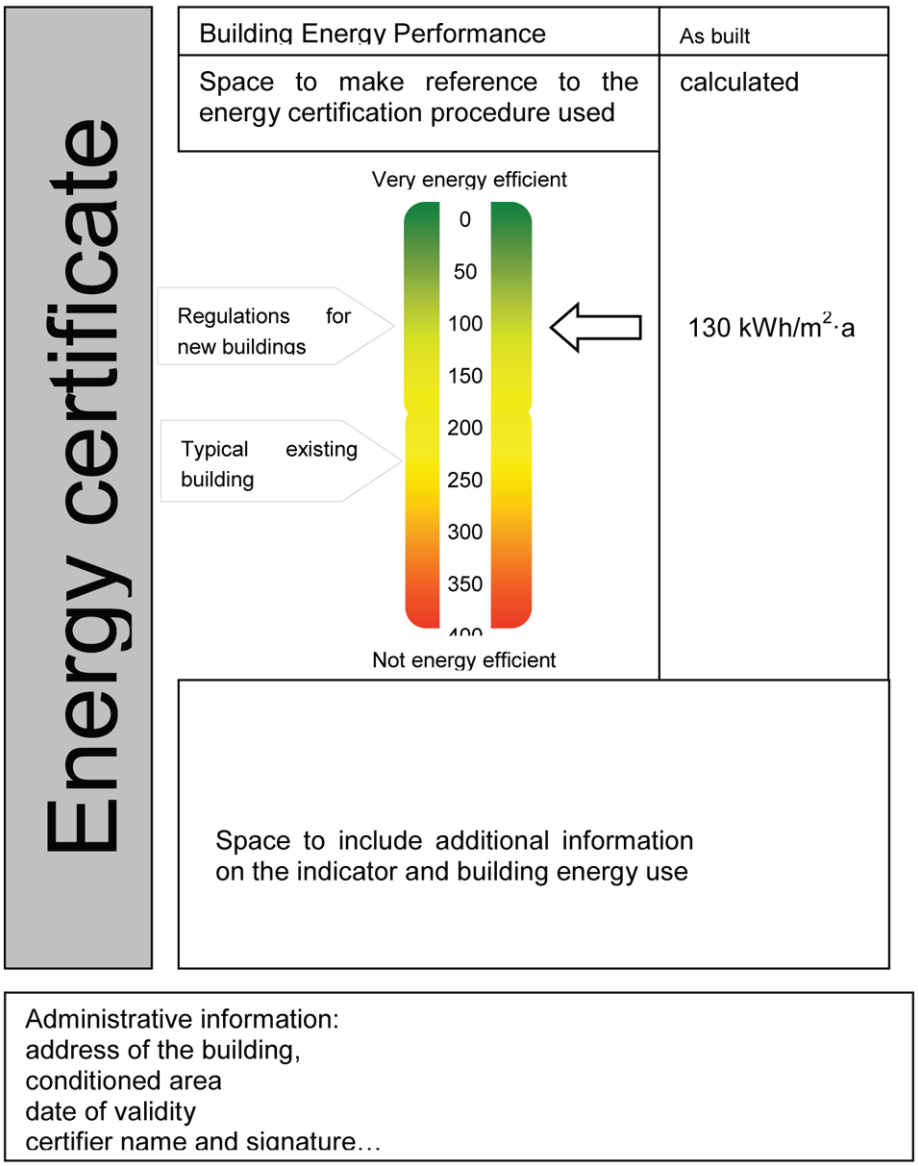
EXAMPLE 1 With one indicator and with classes.



EXAMPLE 2 With two indicators and with classification.



EXAMPLE 3 With one indicator and without classification.



Annex E
(informative)

Requirements on the characteristics of the building envelope and system components

E.1 General

Annex E provides examples on how to define requirements on the characteristics of the building envelope and systems components.

In all cases, different requirement levels could be set for different building types.

E.2 References

In analogy to the normative Annex A, parallel routes are provided in referencing to other International Standards in order to take into account existing national and/or regional regulations and/or legal environments while maintaining global relevance.

CEN area[a]	Elsewhere
EN 308, *Heat exchangers — Test procedures for establishing performance of air to air and flue gases heat recovery devices*	
EN 410, *Glass in building — Determination of luminous and solar characteristics of glazing*	ISO 9050, *Glass in building — Determination of light transmittance, solar direct transmittance, total solar energy transmittance, ultraviolet transmittance and related glazing factors*
EN 14501, *Blinds and shutters — Thermal and visual comfort —Performance characteristics and classification*	
EN 13363-2, *Solar protection devices combined with glazing — Calculation of total solar energy transmittance and light transmittance — Part 2: Detailed calculation method*	ISO 15099, *Thermal performance of windows, doors and shading devices — Detailed calculations*
EN 13779, *Ventilation for non-residential buildings — Performance requirements for ventilation and room-conditioning systems*	
EN 13829, *Thermal performance of buildings — Determination of air permeability of buildings — Fan pressurization method (*ISO 9972:1996*, modified)*	ISO 9972:2006, *Thermal insulation — Determination of building airtightness — Fan pressurization method*
EN 15193:2007, *Energy performance of buildings — Energy requirements for lighting*	
EN 12464-1, *Light and lighting — Lighting of work places — Part 1: Indoor work places*	
EN 12193, *Light and lighting — Sports lighting*	
EN 15232, *Energy performance of buildings — Impact of Building Automation, Controls and Building Management*	
(EN) ISO 6946:2007, *Building components and building elements — Thermal resistance and thermal transmittance — Calculation method*	
(EN) ISO 10077-1, *Thermal performance of windows, doors and shutters — Calculation of thermal transmittance — Part 1: General*	
(EN) ISO 13789:2007, *Thermal performance of buildings — Transmission and ventilation heat transfer coefficients — Calculation method*	
(EN) ISO 13790:2008, *Energy performance of buildings — Calculation of energy use for space heating and cooling*	
(EN) ISO 14683:2007, *Thermal bridges in building construction — Linear thermal transmittance — Simplified methods and default values*	

[a] CEN area = Countries whose national standards body is a member of CEN. Attention is drawn to the need for observance of EU Directives transposed into national legal requirements. Existing national regulations with or without reference to national standards may restrict for the time being the implementation of European Standards.

E.3 Thermal transmittance

E.3.1 Thermal transmittance of the building envelope

Requirements can be expressed in terms of the maximum mean thermal transmittance of the building envelope calculated in accordance with (EN) ISO 13789:2007.

The requirement can be set as a function of the building shape with a procedure similar to the one described in 7.3.2.

NOTE To avoid that the mean thermal transmittance is too much favourable in case the building's envelope has a significant portion with reduced thermal transmission due to adjacent unheated spaces, ground floor, and such, the corresponding areas of the building envelope may be weighted with a (nationally fixed) reduction factor.

E.3.2 Thermal transmittance of building components

Requirements can be expressed in terms of the maximum thermal transmittance of the component calculated in accordance with (EN) ISO 6946:2007.

The requirement can be set at different levels for different building components (wall, roof, floor, window, door).

For windows (see E.2):

(EN) ISO 10077-1, *Thermal performance of windows, doors and shutters — Calculation of thermal transmittance — Part 1: General*

EN 13363-2, *Solar protection devices combined with glazing — Calculation of total solar energy transmittance and light transmittance — Part 2: Detailed calculation method*

ISO 15099, *Thermal performance of windows, doors and shading devices — Detailed calculations*

E.3.3 Thermal bridges

Requirements can be expressed in terms of the maximum linear thermal transmittance for junctions between building components. Values of linear thermal transmittance can be obtained by any of the methods set out in (EN) ISO 14683:2007.

The requirement can be set at different levels for different types of junctions (wall/floor, window jamb, etc.).

E.3.4 Air tightness

Requirement can be expressed in terms of maximum value of air permeability measured according to EN 13829 (or equivalent, see E.2).

E.4 Heating and domestic hot water

Requirements can be expressed in terms of the following:

— maximum value of energy use for heating as obtained according to ISO 13790:2008 (or equivalent, see E.2);

— maximum value of energy need for heating as obtained according to (EN) ISO 13790:2008;

— minimum efficiency of the heat generation system;

— minimum insulation of pipes, ducts, and tanks.

E.5 Cooling

Requirements can be expressed in terms of the following:

— energy use for cooling as obtained according to (EN) ISO 13790:2008;

— energy need for cooling as obtained according to (EN) ISO 13790:2008.

E.6 Solar protection

Requirements can be expressed in terms of the solar factor of the combined glazing and solar protection device, g_{tot}, in accordance with EN 410 or ISO 9050 and EN 14501 (see E.2).

E.7 Ventilation

The requirement can be expressed as the efficiency of heat recovery units according to EN 308 (or equivalent, see E.2).

The requirement on the specific fan power of the ventilation system can be defined according the categories defined in EN 13779 (or equivalent, see E.2).

The requirement can be expressed as the energy need for ventilation.

E.8 Lighting

The requirement on artificial lighting can be defined according to EN 15193:2007 (or equivalent, see E.2).

Requirement can also be set in terms of minimum level of daylight.

E.9 Automatic control

Requirements can be expressed in terms of the minimum level of control. This level can be defined according to the list of control functions given in EN 15232 (or equivalent, see E.2).

E.10 Metering and monitoring

Requirements can be expressed in terms of minimum level of metering and monitoring.

Annex F
(informative)

Reference buildings or notional building approach

F.1 Introduction

F.1.1 General

The main aims of the informative Annex F is to

— explain the merits and limitations of a reference (or notional) building approach,

— provide harmonized procedures for reference buildings, and

— include one or a few reference buildings which might be acceptable for international comparison.

NOTE 1 The major challenges in this respect are what to do with the differences in, e.g. socio-economic and climate factors, but also, e.g. building age.

In 7.3, the notional building approach has already been introduced, including some of the possible options and reasons.

In the reference or notional building approach, the calculated energy use of a building is compared with the energy use of a reference building with a reference set of measures.

By using this relative energy use of the actual building compared to the reference building (instead of the calculated absolute energy use), the impact of certain parameters is neutralized.

One of the possible advantages compared to other methods (e.g. the formula approach, see 7.3, in case methods that use an energy use per square metre as a reference, possibly corrected for loss area):

— user patterns specifically assumed for the actual building can be used in the energy performance calculation (EP) without (large) impact if the same user pattern is used in the calculation of the reference building (EP_r): the impact is (more or less) neutralized.

  Similar parameters that can be neutralized (in addition to the parameters already mentioned in 7.3):

  — partitioning of the building into different building functions;

  — assumptions with respect to the properties (e.g. areas, thermal insulation level) for non-renovated elements in a renovated building using the overall energy indicator.

Other possible advantage of the reference method:

— giving consumers a better idea of the level of energy saving measures that have already taken place and that are still possible (e.g. when the energy use of a building is compared to the energy use of that same building without any measures and with all possible measures, you know how far off the building is from what is realistically possible).

Possible disadvantages are:

— (particularly for new buildings) using the reference building method design aspects such as compactness and good use of orientation are not rewarded;

— an actual/concrete set of measures to set the threshold favours the measures that are used (e.g. the set might contain a highly efficient boiler and not a heat pump).

NOTE 2 See Reference [5] for more background information on different reasons and ways to neutralize the impact of certain parameters and the consequences.

Bibliography

[1] EN/TR 15615, *Explanation of the general relationship between various CEN standards and the Energy Performance of Buildings Directive (EPBD) ("Umbrella Document"), CEN, April 2008*

[2] EN 15603, *Energy performance of buildings — Overall energy use and definition of energy ratings, CEN, January 2008*

[3] EN 15217, *Energy performance of buildings — Methods for expressing energy performance and for energy certification of buildings, CEN, June 2007*

[4] ISO 13600, *Technical energy systems — Basic concepts*

[5] VAN DIJK H.A.L., SPIEKMAN M.E., Energy Performance of Buildings; Outline for Harmonised EP Procedures. Final report of EU ENPER project, Task B6. Contract SAVE 4.1031/C/00-018. TNO Building and Construction Research, Delft, The Netherlands, June 29, 2004

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