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Energijske karakteristike stavb – Ugotavljanje porabe energije in definicije ocenitev

Energy performance of buildings - Assessment of energy use and definition of ratings

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Energy performance of buildings - Assessment of energy use and definition of ratings

Performance énergétique des bâtiments - Evaluation de l'énergie utilisée et définition des indices de performance

Energetische Verhalten von Gebäuden - Evaluierung des Energieverbrauchs von Gebäuden und Definition der Leistungsindikatoren

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This document (prEN 15203:2005) has been prepared by Technical Committee CEN/TC 89 “Thermal performance of buildings and building components”, the secretariat of which is held by SIS.

This document is currently submitted to the CEN Enquiry.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

Introduction

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) Transparency in commercial operations through the certification and/or display of a level of energy performance (energy certification);

c) Monitoring of the energy efficiency of the building including heating, ventilation and air conditioning systems

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

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 methodology to obtain equivalent results from different sets of data is presented in this standard. A methodology 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 standard also includes a methodology that allows assessment of the energy effectiveness of possible improvements.

Two principal types of ratings for buildings are proposed in this standard:

1) The **asset rating** is obtained by calculation for standardised conditions, but there can be different ways of assembling the input data – from drawings and design values for new buildings, from drawings, site surveys and rules derived from building typology for existing buildings, and by improving on the latter by making use of metered energy.

2) The **operational rating** is obtained by metering and summing up all delivered energywares.

Because of the differences in the way these two ratings are obtained, they cannot be compared directly. 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 asset rating.

1 Scope

This standard defines the uses of energy to be taken into account for setting energy performance ratings for new and existing buildings, and provides:

a) A method to compute the asset rating, a standard energy use that does not depend on occupant behaviour, actual weather and other actual (environment or input) conditions. For this, occupancy, climate and some other data that do not depend on the building itself are conventional ones, depending on the intended use of the building and on the climatic zone considered.

b) A method to assess the operational rating, based on the delivered energy.

c) A methodology to improve confidence in the building calculation model by comparison with actual energy consumption.

d) A method to assess the energy effectiveness of possible improvements.

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

2 Normative references

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

EN 410, *Glass in building – Determination of luminous and solar characteristics of glazing*

EN 673, *Glass in building – Determination of thermal transmittance (U value) – Calculation method*

EN 12412-2, *Thermal performance of windows, doors and shutters – Determination of thermal transmittance by hot box method – Part 2: Frames*

EN 13187, *Thermal performance of buildings – Qualitative detection of thermal irregularities in building envelopes – Infrared method*

prEN wi 1+3, *Energy performance of buildings — Methods for expressing energy performance and for energy certification of buildings*

prEN wi 2, *Energy performance of buildings — Overall energy use, primary energy and CO_2 emissions*

prEN wi 7, *Heating systems in buildings – Method for calculation of system energy requirements and system efficiencies – Part 1: General*

prEN wi 8, *Heating systems in buildings – Method for calculation of system energy requirements and system efficiencies – Part 2.1: Space heating emission systems*

prEN wi 9, *Heating systems in buildings – Method for calculation of system energy requirements and system efficiencies –*

Part 2.2.1: Boilers
Part 2.2.2: Heat pumps
Part 2.2.3: Heating generation – Thermal solar systems
Part 2.2.4: Performance and quality of CHP
Part 2.2.5: Performance and quality of district heating and large volume systems
Part 2.2.6: Performance of other renewables (heat and electricity)
Part 2.2.7: Space heating generation – Biomass combustion systems

prEN wi 10, *Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies – Part 2.3: Space heating distribution systems*

prEN wi 11, *Heating systems in buildings – Method for calculation of system energy requirements and system efficiencies – Part 3.1: Domestic hot water systems, including generation efficiency and the tap water requirements*

prEN wi 12, *Calculation of room temperatures and of load and energy for buildings with room conditioning systems*

prEN wi 13, *Energy performance of buildings – Energy requirements for lighting — Part 1: Lighting energy estimation*

prEN wi 14, *Energy performance of buildings – Calculation of energy use for space heating and cooling*

prEN wi 17, *Thermal performance of buildings – Calculation of energy use for space heating and cooling – General criteria and validation procedures for detailed calculations*

prEN wi 20+21, *Ventilation for buildings – Calculation methods for energy requirements due to ventilation systems in buildings*

prEN wi 22, *Calculation methods for energy efficiency improvements by the application of integrated building automation systems*

prEN ISO 6946:2005, *Building components and building elements – Thermal resistance and thermal transmittance – Calculation method*

EN ISO 7345, *Thermal insulation – Physical quantities and definitions*

prEN ISO 10077-1:2004, *Thermal performance of windows, doors and shutters – Calculation of thermal transmittance – Part 1: General*

EN ISO 10077-2, *Thermal performance of windows, doors and shutters – Calculation of thermal transmittance – Part 2: Numerical method for frames*

prEN ISO 10211:2005, *Thermal bridges in building construction – Heat flows and surface temperatures – Detailed calculations*

EN ISO 12567 (all parts), *Thermal performance of windows and doors – Determination of thermal transmittance by hot box method*

EN ISO 12569, *Thermal insulation in buildings – Determination of air change in buildings - Tracer gas dilution method*

EN ISO 13790, *Thermal performance of buildings – Calculation of energy use for space heating*

prEN ISO 14683:2005, *Thermal bridges in building construction – Linear thermal transmittance – Simplified methods and default values*

EN ISO 15927-4[1)], *Hygrothermal performance of buildings – Calculation and presentation of climatic data – Part 4: Hourly data for assessing the annual energy use for heating and cooling*

prEN ISO 15927-6:2004, *Hygrothermal performance of buildings – Calculation and presentation of climatic data – Part 6: Accumulated temperature differences (degree-days)*

ISO 9869, *Thermal insulation – Building elements – In-situ measurement of thermal resistance and thermal transmittance*

ISO 13600, *Technical energy systems – Basic concepts*

ISO 13601, *Technical energy systems – Structure for analysis – Energyware supply and demand sectors*

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1) To be published.

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN ISO 7345 and the following apply.

3.1
rating
evaluation of the energy performance of a building based on the weighted sum of the calculated or metered use of energy carriers.

3.2
asset rating
rating based on calculations of the energy used by a building for heating, cooling, ventilation, hot water and lighting, with standard input data related to internal and external climates and occupancy

NOTE It represents the intrinsic energy potential of a building under standardised conditions of weather and occupancy This is particularly relevant to certification of standard performance. The asset rating represents a weighted sum per energyware of the total energy for heating, hot water heating, cooling, ventilation and lighting. This rating quantifies the calculated energy intensity of the building under standardised conditions for a given set of energy end uses.

3.3
design rating
rating based on calculations using building drawings and design values, calculated for a building at the design phase

NOTE The design rating is calculated on the basis of building plans, whereas the asset rating is calculated using data for the building as actually constructed.

3.4
tailored rating
rating based on calculations of the energy used by the building for heating, cooling, ventilation, hot water and lighting, with actual climate and occupancy data

3.5
operational rating
rating based on measured energy use

NOTE The operational rating is the weighted sum of all energywares used by the building. It is a measure of the in-use performance of the building. This is particularly relevant to certification of actual performance The operational rating represents the sum per energyware of the total energy used by the building, as measured by meters or other means described in Annex B. This rating quantifies the total actual energy use of the building.

3.6
building
inhabited construction as a whole, including its envelope, and heating, ventilation and air conditioning systems

3.7
new building
building at design stage or under construction or (for operational rating) too recently constructed to have reliable records of energy use

3.8
existing building
building that is erected, for which actual data necessary to assess the energy use according to this standard are known or can be measured

3.9
building calculation model
mathematical model of the building used to calculate its energy use

NOTE Most models used in this standard are defined in international standards. Several models may be necessary to assess the energy use for all purposes.

3.10
validated building calculation model
building calculation model in which one or more parameters are adjusted so that its results do not significantly differ from the measured reality

3.11
confidence interval
interval that has a high probability (e.g. 95 %) to include the actual value

NOTE Annex D provides ways to assess such intervals.

3.12
reasonably possible
can be achieved at a reasonable cost

3.13
reasonable cost
investment that is accepted by all parties to reach a given purpose

NOTE This cost strongly depends on the purpose of the effort. For example, the cost of a rating could be relatively large if it is to provide an official certificate to put the building on the market or for displaying the building performance to the public, but reduced if it is simply for statistical purpose.

3.14
energy carrier
substance or phenomenon that can be used to produce mechanical work or heat or to operate chemical or physical processes [ISO 13600:1997]

3.15
energyware
tradable commodity used mainly to produce mechanical work or heat, or to operate chemical or physical processes, and listed in Annex A of ISO 13600. [ISO 13600:1997]

NOTE Energywares form a proper subset of energy carriers. The set of energy carriers is open.

3.16
energyware consumption system
technical energy system consuming energyware and in many cases also other energy carriers and producing products and services [ISO 13600:1997]

NOTE Buildings are such systems.

3.17
renewable energy
energy from sources that will not be exhausted during the lifetime of mankind, such as solar energy (thermal and photovoltaic), wind, hydraulic, biomass

NOTE In ISO 13602-1:2002, **renewable resource** is defined as 'natural resource for which the ratio of the creation of the natural resource to the output of that resource from nature to the technosphere is equal to or greater than one.

3.18
primary energy
energy that has not been subjected to any conversion or transformation process

NOTE For a building, it is the energy used to produce the energy delivered to the building. It is the delivered energy divided by the conversion or transformation factor of each form of energy.

3.19
delivered energy
energy supplied to the building from the last market agent

NOTE The boundaries of the building include all internal and external areas associated with the building, where energy is consumed or produced (see 5.1). The energy produced by the building itself, for example using solar water heater, photovoltaic systems or co-generation and delivered back to the market is reported separately. Delivered energy is presented per energyware.

3.19
energy use of a building
total energy per energy carrier delivered to the energy systems for heating, cooling, ventilation, hot water heating, lighting, appliances, etc.

NOTE Appliances are not explicitly included in the asset rating and in the 'inter alia' subset of energy end uses in Article 2 of the EPBD[2)] , but they are in fact included in the total energy use of the building.

3.20
auxiliary energy
energy used by heating, cooling, domestic water, lighting and ventilation systems to transform the delivered energy into the useful energy

NOTE This includes energy for fans, pumps, pilot flames, electronics, etc., but not the energy that is transformed.

3.21
calorific value
quantity of heat produced by complete combustion, at a constant pressure equal to 101 320 Pa, of a unit amount of fuel

NOTE The gross calorific value includes the heat recovered when condensing the water vapour resulting from the combustion of hydrogen. The net calorific value does not take account of this latent heat.

4 Symbols and abbreviations

Table 1 —Symbols and units

Symbol	Quantity	Unit
A	area	m²
c	concentration	-
C	cost	€
DD	accumulated temperature differences (degree-days)	K d
f	factor	-
I	solar irradiance	J/m²
E	energyware amount	kg, m³, kWh, MJ, etc.
O	occupancy	h, h/d, %
Q	quantity of heat or energy	J
t	time, time interval	d, h, s
$\dot{V}$	airflow rate	m³/h, m³/s
Φ	heat flow rate, power	W
GCV	gross calorific value of an energyware	MJ/unit, kWh/unit
θ	Celsius temperature	°C

2) DIRECTIVE 2002/91/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2002 on the energy performance of buildings

NOTE Hours can be used as the unit of time instead of seconds for all quantities involving time (i.e. for time periods as well as for air change rates), but in that case the unit of energy is Watt-hours [Wh] instead of Joules.

Table 2 — Subscripts

a	automation and control	m	measured
c	cooling	n	net
CO2	related to CO_2 emissions	o	operational
d	Delivered, day	p	primary
E	electricity	rc	recovered
e	external	rn	renewable
ex	exported	s	system
g	Related to gains	st	standard
h	heating	t	total
i	internal	v	ventilation
i,j,k	numbering indices	w	hot water
L	limit	Y	year, annual
l	lighting		

5 Assessment of energy use of buildings

5.1 Building boundaries

The boundaries for the energy performance assessment shall be clearly defined for all energy carriers before the calculation. It includes all inside and outside areas associated with the building, where energy is consumed or produced.

For insulated buildings, it is defined by the building envelope for heat flows, the main building meters for gas, electricity, district heating and water, the loading port of the storage facility for liquid and solid energywares, and the smoke exhaust of chimney and connection to main wastewater duct for losses.

If a part of a building system (e.g..boiler, chiller, cooling tower, etc.) is outside the building envelope, it is nevertheless considered to be inside the boundaries.

A building may refer to a group of adjacent buildings as a whole or parts thereof that have been designed or altered to be used separately. If one building in a row of similar buildings are to be assessed, heat flows through partition walls are neglected in the balance.

If adjacent buildings do not have the same type of use, and hence not the same internal design or actual temperature, heat flows through partition walls are taken into account in the balance.

NOTE In many cases, buildings in rows have the same use and, for calculation purposes, the internal temperature of all the buildings can be assumed to be the same, and these partition walls can be taken to be adiabatic. However, if the external envelope is well insulated and partition walls are not, these heat flows can contribute an appreciable amount of heat gains and losses.

The way the building envelope is considered to calculate heat flows is defined in prEN wi 14.

5.2 Types of ratings

This standard proposes two principal options for energy rating of buildings, the first being calculated, the second being based on measurements. These options are the asset rating and the operational rating.

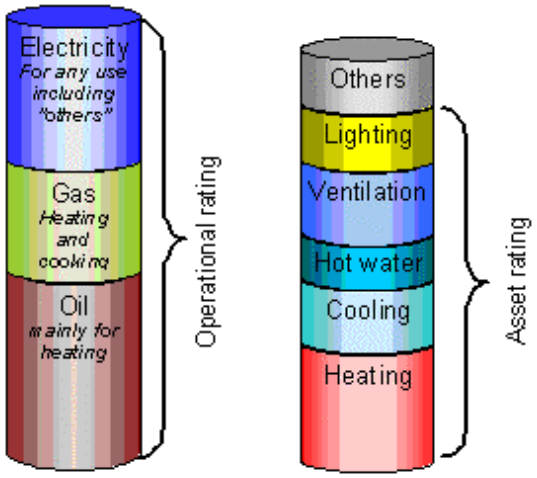

Figure 1 — The operational rating includes all energy uses under actual conditions, while the asset rating includes only some uses, and for standard conditions

The asset rating is based on calculations of the energy used by the building for heating, cooling, ventilation, hot water and lighting, with standard input data related to climate and occupancy (see 7.2). This rating provides an assessment of the energy efficiency of the building under standardised conditions that enables a comparison to be made between different buildings within climatic main regions and with identical or at least similar activities.

The operational rating is based on measurement of energy use (see Clause 8). The operational rating measures the in-use performance of a building, including all deviations between theoretical properties in calculations and realised properties (air-infiltration, heat transfer, generation efficiency, control, etc.) and is influenced by the way the building is maintained and operated. It cannot therefore be used to provide prospective purchasers or tenants with like-for-like comparisons between buildings. It assists those trying to improve the efficiency of building operation and allows displaying the actual energy performance of a building. It can also provide useful feedback to the owners, occupiers and designers of new buildings if assessed a few years after occupation and compared to the calculated asset rating, for the same set of energy end uses.

Only asset rating and operational ratings are used for building energy performance certification.

The design rating is similar to the asset rating, but based on building drawing and design intentions. It can be used to get a building permit.

The tailored rating is an asset rating, in which either actual climatic data or actual occupancy related data or both are used instead of standard ones. This can be used to compare two buildings having different climates or different uses, to compare retrofit scenarios, to optimise energy performance, etc.

The calculation models and input used for the asset rating can be validated against the operational rating, providing more confidence in the model (see Clause 9). The validated model can then be used to compute a more accurate asset rating, or to study the effect of retrofit scenarios.

The types of rating are summarised in Table 3. The type of rating (asset rating or operational rating) to be used for certification of different building types is defined in national regulations.

Table 3 —Types of ratings

		Input data			
	Name	**Use**	**Climate**	**Building**	**Utility or purpose**
Calculated	Design	Standard	Standard	Drawings	Building permit
	Asset	Standard	Standard	Actual	Certificate, regulation
	Tailored	Depending on purpose		Actual	Optimisation, comparisons, retrofit planning
Measured	Operational	Actual	Actual	Actual	Certification, regulation

5.3 Input and output

5.3.1 General

This standard needs and provides the following information:

5.3.2 Necessary inputs

5.3.2.1 Inputs for calculated ratings

a) Annual energy use for heating, calculated according to prEN wi 14;

b) Annual energy use for cooling, calculated according to prEN wi 14;

c) Annual energy use for hot water, calculated according to prEN wi 11;

d) Annual energy use for lighting, calculated according to prEN wi 13;

e) Annual energy use for ventilation, calculated according to prEN wi 20;

f) Effect of automation and controls, assessed according to prEN wi 22;

g) Conversion factors from delivered energy to primary energy and CO_2 production, according to prEN wi 2.

5.3.2.2 Inputs for operational rating and calculation model validation

h) Metered energy use for all energywares.

5.3.3 Additional inputs

The following information is normally provided on a national level:

i) Gross calorific value of energywares;

j) Standard data related to occupancy (temperature, humidity, airflow rate, internal gains, hot water use, and standard energy use for appliances other than heating, cooling, ventilation, hot water and lighting);

k) Standard climatic data.

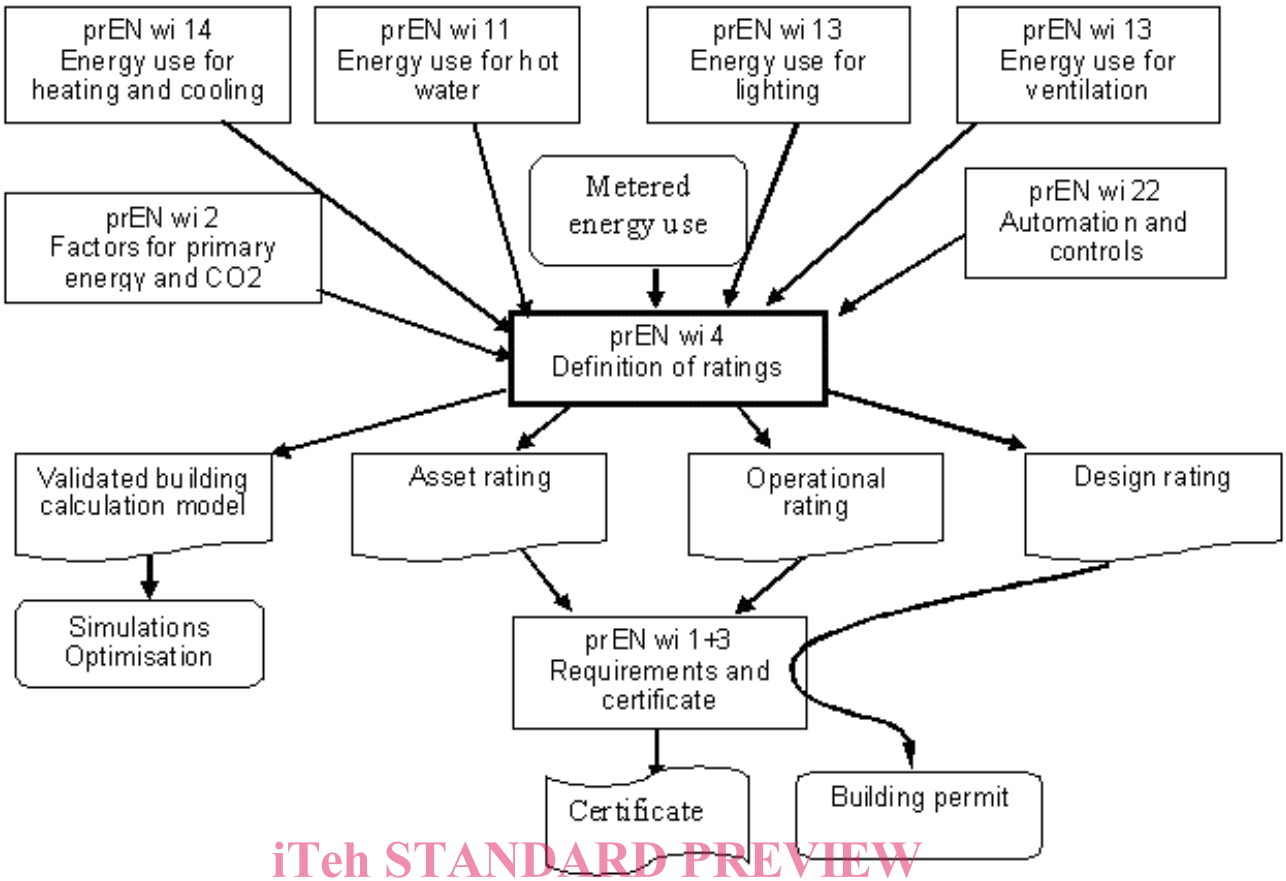

Figure 2 — Inputs to this standard and outputs from this standard

5.3.4 Provided output

For certification and regulation purposes this standard provides:

l) Asset rating: the calculated energy use of the building under standard conditions;

m) Operational rating, based on metered energy use;

For obtaining building permits this standard provides:

n) Design rating;

For other purposes this standard provides:

o) Validated building calculation model that can be used to assess the effect of measures to be taken for improving the energy performance, including combinations thereof;

p) Tailored rating.

These outputs are used for expressing the energy performance of the building and establishing energy performance requirements according to prEN wi 1+3.