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Energy performance of buildings — Overarching EPB assessment —

Part 3:

General Principles for determination and reporting of Primary Energy Factors (PEF) and CO₂ emission coefficients

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Contents

Page

| | |
|---|-----------|
| Foreword..... | iv |
| Introduction..... | vii |
| 1 Scope..... | 1 |
| 2 Normative references..... | 1 |
| 3 Terms and definitions..... | 1 |
| 4 Symbols, subscripts and abbreviations..... | 4 |
| 4.1 Symbols..... | 4 |
| 4.2 Subscripts..... | 4 |
| 4.3 Abbreviations..... | 4 |
| 5 General description of the methods and choices..... | 5 |
| 5.1 Basic principles of the assessment methods..... | 5 |
| 5.1.1 Primary Energy Factors (PEF)..... | 5 |
| 5.1.2 CO ₂ emission coefficient..... | 7 |
| 5.1.3 Assessment boundary..... | 7 |
| 5.1.4 Origin of delivered energies..... | 8 |
| 5.1.5 Accounting methods..... | 9 |
| 5.2 Short description of the choices..... | 10 |
| 6 Set of different choices related to PEF and CO₂ emission coefficient..... | 11 |
| 6.1 Choices related to the perimeter — Geographical perimeter..... | 11 |
| 6.2 Choices related to calculation conventions..... | 11 |
| 6.2.1 Time resolution..... | 11 |
| 6.2.2 Sources (time horizon) of the data used..... | 12 |
| 6.2.3 Net or gross calorific value..... | 12 |
| 6.3 Choices related to the data..... | 12 |
| 6.3.1 Energy sources to be considered (available energy sources)..... | 12 |
| 6.3.2 Type of CO ₂ emission coefficients..... | 13 |
| 6.3.3 Conventions related to energy conversion..... | 14 |
| 6.3.4 Conventions for PEF related to exported energy..... | 15 |
| 6.4 Choices related to the assessment methodologies..... | 15 |
| 6.4.1 Energy exchanges with other geographical perimeters..... | 15 |
| 6.4.2 Calculation approaches for multisource generation mix..... | 16 |
| 6.4.3 Allocation of multi energy output system..... | 17 |
| 6.4.4 Life cycle method..... | 18 |
| Annex A (normative) Template for reporting the choices..... | 20 |
| Annex B (informative) Examples of assessment boundaries..... | 22 |
| Annex C (informative) Additional explanation and reporting..... | 24 |
| Bibliography..... | 36 |

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).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 163, *Thermal performance and energy use in the built environment*.

A list of all parts in the ISO 52000 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Table 1 shows the position (marked by "X") of this document within the modular structure as set out in EN ISO 52000-1.

The modules represent EPB standards, although one EPB standard may cover more than one module and one module may be covered by more than one EPB standard, for instance a simplified and a detailed method respectively.

Table 1 — Position of this document (M1-7), within the modular structure as set out in EN ISO 52000-1

| Submodule | Overarching | | Technical Building Systems | | | | | | | Building automation and control | PV, wind,... | | | | |
|-----------|---|---|---|----|------------------------------------|---------|---------|-------------|----------------|---------------------------------|--------------|------------------|--------------------|----------|----|
| | Descriptions | Building (as such) | Descriptions | M2 | Descriptions | Heating | Cooling | Ventilation | Humidification | | | Dehumidification | Domestic Hot water | Lighting | M9 |
| sub1 | | M1 | | | | M3 | M4 | M5 | M6 | M7 | M8 | M9 | M10 | M11 | |
| 1 | General | General | General | | General | | | | | | | | | | |
| 2 | Common terms and definitions; symbols, units and subscripts | Building Energy Needs | Building Energy Needs | | Needs | | | | | | | | | | |
| 3 | Applications | (Free) Indoor Conditions without Systems | (Free) Indoor Conditions without Systems | | Maximum Load and Power | | | | | | | | | | |
| 4 | Ways to Express Energy Performance | Ways to Express Energy Performance | Ways to Express Energy Performance | | Ways to Express Energy Performance | | | | | | | | | | |
| 5 | Building categories and Building Boundaries | Heat Transfer by Transmission | Heat Transfer by Transmission | | Emission and control | | | | | | | | | | |
| 6 | Building Occupancy and Operating Conditions | Heat Transfer by Infiltration and Ventilation | Heat Transfer by Infiltration and Ventilation | | Distribution and control | | | | | | | | | | |

The shaded modules are not applicable.

Table 1 (continued)

| Submodule | Overarching | | Building (as such) | | Technical Building Systems | | | | | | | | | | |
|-----------|--|----|----------------------------------|----|----------------------------|---------|-------------|----------------|------------------|--------------------|----------|---------------------------------|--------------|--|--|
| | Descriptions | M1 | Descriptions | M2 | Heating | Cooling | Ventilation | Humidification | Dehumidification | Domestic Hot water | Lighting | Building automation and control | PV, wind,... | | |
| sub1 | | | | | M3 | M4 | M5 | M6 | M7 | M8 | M9 | M10 | M11 | | |
| 7 | Aggregation of Energy Services and Energy Carriers | X | Internal Heat Gains | | | | | | | | | | | | |
| 8 | Building zoning | | Solar Heat Gains | | | | | | | | | | | | |
| 9 | Calculated Energy Performance | | Building Dynamics (thermal mass) | | | | | | | | | | | | |
| 10 | Measured Energy Performance | | Measured Energy Performance | | | | | | | | | | | | |
| 11 | Inspection | | Inspection | | | | | | | | | | | | |
| 12 | Ways to Express Indoor Comfort | | BMS | | | | | | | | | | | | |
| 13 | External Environment Conditions | | | | | | | | | | | | | | |
| 14 | Economic Calculation | | | | | | | | | | | | | | |

The shaded modules are not applicable.

Introduction

This document belongs to a series of standards aiming at international harmonization of the methodology for the assessment of the energy performance of buildings.

For the correct use of this document, a normative template is given in [Annex A](#) to report the choices.

The target group of this document are all the users of the set of standards related to the assessment of the energy performance of buildings and especially national standardization experts or building authorities who are in charge of defining the PEFs and CO₂ emission coefficients.

In view of the complexity of the issue, the need for contextual knowledge and practicality of use, it is useful to mention necessary comments and explanations directly in the standard. For the same reasons, parts taken from other standards are appropriate to have in this document.

The document can be applied for different time intervals (annual, monthly, hourly).

This document is a new standard.

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Energy performance of buildings — Overarching EPB assessment —

Part 3: General Principles for determination and reporting of Primary Energy Factors (PEF) and CO₂ emission coefficients

1 Scope

This document provides a transparent framework for reporting on the choices related to the procedure to determine primary energy factors (PEFs) and CO₂ emission coefficients for energy delivered to and exported from the buildings as described in EN ISO 52000-1.

It does not include considerations on other problems like nuclear waste, atmospheric particulate matter, deforestation, food and bioenergy competition, depletion of raw material resources, depletion of the soil, etc.

This document specifies the choices to be made to calculate the PEF(s) and CO₂ emission coefficients related to different energy carriers. PEFs and CO₂ emission coefficients for exported energy can be different from those chosen for delivered energy.

This document is primarily intended for supporting and complementing EN ISO 52000-1 as the latter requires values for the PEFs and CO₂ emission coefficients to complete the EPB calculation. But it can also be used for other applications.

NOTE The CO₂ emission coefficients allow calculating greenhouse gas emissions. According to the choices made, the CO₂ emission coefficients represent only CO₂ emissions or also other greenhouse gases. If other greenhouse gases are considered in the CO₂ emission coefficients, the emission coefficient should be termed “eq” (equivalent) to not be mistaken.

2 Normative references

The following documents are referred to in the text in such a way that some or all their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN ISO 7345, *Thermal performance of buildings and building components - Physical quantities and definitions (ISO 7345)*

EN ISO 52000-1:2017, *Energy performance of buildings - Overarching EPB assessment - Part 1: General framework and procedures (ISO 52000-1:2017)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 7345, EN ISO 52000-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at <https://www.iso.org/obp>

— IEC Electropedia: available at <https://www.electropedia.org/>

3.1

primary energy

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

Note 1 to entry: Primary energy may be related to non-renewable energy and renewable energy. If both are taken into account, it is called “total primary energy”.

[SOURCE: EN ISO 52000-1:2017, 3.4.29, modified note – “includes” is replaced by “may be related to”]

3.2

energy carrier

substance or phenomenon that can be used to produce mechanical work, electricity or thermal energy or to operate chemical or physical processes

[SOURCE: EN ISO 52000-1:2017, 3.4.9, modified – “or heat” has been replaced by “electricity or thermal energy”.]

3.3

primary energy factor

ratio of the primary energy to the energy delivered to or exported from the assessment boundary

Note 1 to entry: Primary energy factor can refer to the total primary energy or to the renewable, or non-renewable primary energy. To be more precise it should be specified (e.g. non-renewable primary energy factor).

3.3.1

non-renewable primary energy factor for delivered energy carrier

non-renewable primary energy for a given energy carrier, including the delivered energy and the considered non-renewable energy overheads of delivery to the points of use, divided by the delivered energy

[SOURCE: EN ISO 52000-1:2017, 3.5.17 modified – the term is completed by “for delivered energy carrier” and in the definition “non-renewable” is added before “energy overhead”]

3.3.2

non-renewable primary energy factor for exported energy carrier

non-renewable primary energy for a given energy carrier, including the exported energy and the considered non-renewable energy overheads of producing and exporting to the collection points, divided by the exported energy

3.3.3

renewable primary energy factor for delivered energy carrier

renewable primary energy for a given energy carrier, including the delivered energy and the considered renewable energy overheads of delivery to the points of use, divided by the delivered energy

[SOURCE: EN ISO 52000-1:2017, 3.5.21, modified – the term is completed by “for delivered energy carrier” and in the definition for “an energy carrier” the words “distant or nearby” have been deleted.]

3.3.4

renewable primary energy factor for exported energy carrier

renewable primary energy for a given energy carrier including the exported energy and the considered renewable energy overheads of producing and exporting to the collection points, divided by the exported energy

3.3.5

total primary energy factor

sum of non-renewable and renewable PEFs for a given energy carrier

[SOURCE: EN ISO 52000-1:2017, 3.5.25]

3.4**CO₂ emission coefficient**

coefficient that describes the amount of CO₂ that is released from doing a certain activity

EXAMPLE Burning one tonne of fuel in a furnace is an example of application.

Note 1 to entry: The CO₂ emission coefficient can also include the equivalent emissions of other greenhouse gases (e.g. methane). To be more precise it should be specified by adding “equivalent” (e.g. CO₂ eq).

[SOURCE: EN ISO 52000-1:2017, 3.5.4, modified – The original note 1 and note 2 have been deleted. In note 3 the second sentence has been added.]

3.5**assessment boundary**

boundary where the delivered and exported energy carriers are measured or calculated

[SOURCE: EN ISO 52000-1:2017, 3.4.2, modified – “energy” has been replaced by “energy carriers”. Note 1 has been added]

3.6**energy flow**

quantity of energy going from the energy source to the energy use

3.7**greenhouse gas**

gas, that absorbs and emits radiation at specific wavelengths within the spectrum of infrared radiation emitted by the earth's surface, the atmosphere, and clouds

Note 1 to entry: Greenhouse gas may have natural and anthropogenic origins.

[SOURCE: EN ISO 14067:2018, 3.1.2.1, modified – “gaseous constituent of the atmosphere” is simplified into “gas”. The notes have been deleted, because they are not of interest for the application of the term here Note 1 used to be part of the definition.]

3.8**biogenic carbon**

carbon derived from biomass but not fossilised

[SOURCE: EN ISO 14067:2018, 3.1.7.2]

3.9**fossil carbon**

carbon that is contained in fossilized material

Note 1 to entry: Examples of fossilized material are coal, oil, natural gas and peat.

[SOURCE: EN ISO 14067:2018, 3.1.7.3]

3.4.10**energy from renewable sources (renewable energy)**

energy whose source is naturally renewed and does not run out, namely wind, solar, aerothermal, geothermal, ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases

3.4.11**energy from non-renewable sources (non-renewable energy)**

energy from a source which is depleted by extraction, namely oil, natural gas, coal, uranium

4 Symbols, subscripts and abbreviations

4.1 Symbols

[SOURCE: EN ISO 52000-1:2017]

For the purposes of this document, the symbols listed in [Table 2](#) apply.

The following text includes symbols that are not used in this document, but that are needed for overall consistency in the set of EPB standards.

Table 2 — Symbols and units

| Symbol | Quantity | Unit |
|----------|---|----------------------|
| <i>c</i> | coefficient | various ^a |
| <i>E</i> | energy in general ^b | kW·h |
| <i>f</i> | factor (e.g. primary energy factor, ...) | – ^a |
| <i>H</i> | calorific value, net or gross (NCV or GCV), | kW·h/kg |
| <i>K</i> | CO ₂ emission coefficient | kg/(kW·h) |
| <i>Q</i> | quantity of heat | kW·h |
| <i>η</i> | efficiency (factor) | – ^a |
| <i>ε</i> | expenditure factor | – ^a |

^a Coefficients have dimensions; factors are dimensionless.

^b Including primary energy; note that for heat the symbol *Q* and for auxiliary energy and work the symbol *W* is used.

4.2 Subscripts

[SOURCE: EN ISO 52000-1:2017]

For the purposes of this document, the subscripts listed in [Table 3](#) apply.

The following text includes subscripts that are not used in this document, but that are needed for overall consistency in the set of EPB standards.

Table 3 — Subscripts

| Subscript | Term | Subscript | Term |
|-----------------|--------------------------|-----------|----------------------------------|
| CO ₂ | CO ₂ emission | nren | non-renewable |
| cr | energy carrier | ntdel | net delivered |
| del | delivered | P | primary energy |
| dis | distribution | Pnren | non-renewable primary energy |
| el | electricity | pr | produced |
| exp | exported | pv | solar electricity (photovoltaic) |
| gen | generation | ren | renewable energy |
| <i>i, j, k</i> | indexes | tot | total |
| in | input | we | weighting |
| ls | losses | | |

4.3 Abbreviations

For the purposes of this document, the abbreviations listed in [Table 4](#) apply.

Table 4 — Abbreviations

| Abbreviation | Term |
|--------------|---------------------------------|
| CHP | Combined Heat and Power |
| EPB | Energy Performance of Buildings |
| GHG | Green House Gases |
| GWP | Global Warming Potential |
| LCA | Live Cycle Analysis |
| PEF | Primary Energy Factor |
| PV | Photovoltaic |

5 General description of the methods and choices

5.1 Basic principles of the assessment methods

5.1.1 Primary Energy Factors (PEF)

5.1.1.1 The three fundamental types of PEF

[SOURCE: EN ISO 52000-1:2017, H.3, modified – More explanation has been added, the order of clauses has been changed.]

For each delivered or exported energy carrier, there are three PEFs (see [Figure 1](#)), related to different energy contents of the energy carrier, to be assessed:

a) Non-renewable PEF ($f_{p,nren}$)

The primary energy taken into account in the non-renewable PEF covers only non-renewable energy flows (possibly including also the non-renewable energy overheads of delivery to the point of use, according to the LCA method, see [6.4.4](#)) required to deliver one unit of energy of the related energy carrier to the building. Therefore, the non-renewable PEF can be less than one if the unit of energy contains also renewable energy. It covers the whole non-renewable primary energies consumption, including those consumed by exploitation of the renewable sources when applicable.

b) Renewable PEF ($f_{p,ren}$)

The primary energy taken into account in the definition of renewable PEF covers only renewable energy flows (possibly including also the renewable energy overheads of delivery to the point of use, according to the LCA method, see [6.4.4](#)) required to deliver one unit of energy to the building per energy carrier. It covers all renewable primary energy including those consumed for the exploitation of the non-renewable sources (e.g. renewable energy used to produce electricity to drive an electric pump for pumping oil through a pipeline).

c) Total PEF ($f_{p,tot}$)

The total PEF is the sum of the non-renewable and renewable PEF.

5.1.1.2 PEF for delivered and exported energy

In line with EN ISO 52000-1, this document defines the PEF for delivered energy to the building through the assessment boundary and the energy produced “on-site” and exported through the assessment boundary.

— **PEF for a delivered energy carrier cr**

The PEF, f_{del} , for a delivered energy carrier cr from on-site, nearby or distant is defined as: