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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 CO<sub>2</sub> emission  
coefficients**

*Performance énergétique des bâtiments — Évaluation cadre PEB —*

*Partie 3: Principes généraux relatifs à la détermination et à la  
déclaration des facteurs d'énergie primaire (PEF) et des coefficients  
d'émission de CO<sub>2</sub>*

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## Foreword

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

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

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

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

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

## Introduction

This document is part of the ISO 52000 series of standards aimed at international harmonization of the methodology for the assessment of the energy performance of buildings (EPB).

For the correct use of this document, a normative template is given in [Annex A](#) to report the choices made on the possible options determining the PEF and CO<sub>2</sub> coefficient.

The target group of this document are all of the users of the series of standards related to the assessment of the EPB and especially national standardization experts or building authorities who are in charge of defining PEF and CO<sub>2</sub> emission coefficients.

In view of the complexity of the issue, the need for contextual knowledge and practicality of use, necessary comments and explanations have been included directly in the document. For the same reasons, parts taken from other standards are appropriate for inclusion in this document.

[Table 1](#) shows the position (marked by “X”) of this document within the modular structure as set out in 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.

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

| Submodule | Overarching   | Building (as such)                            |                                    | Technical building systems         |         |             |                |                  |                    |          | Building automation and control | PV, wind,... |     |     |     |
|-----------|---|---|------------------------------------|------------------------------------|---------|-------------|----------------|------------------|--------------------|----------|---------------------------------|--------------|-----|-----|-----|
|           |   | Descriptions                                  | Descriptions                       | Heating                            | Cooling | Ventilation | Humidification | Dehumidification | Domestic hot water | Lighting |                                 |              | M10 | M11 |     |
| sub1      |   |   | M1                                 |                                    | M2      |             | 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      | 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                 | Emission and control               |                                    |         |             |                |                  |                    |          |                                 |              |     |     |     |
| 6         | Building occupancy and operating Conditions                 | Heat transfer by infiltration and ventilation | Distribution and control           |                                    |         |             |                |                  |                    |          |                                 |              |     |     |     |

The shaded modules are not applicable.

Table 1 (continued)

| Submodule | Overarching  |                                  | Technical building systems |    |   |         |         |             |                |                  |                    |          |                                 |              |
|-----------|--|----------------------------------|----------------------------|----|---|---------|---------|-------------|----------------|------------------|--------------------|----------|---------------------------------|--------------|
|           | Descriptions                                       | Descriptions                     | M1                         | M2 | Descriptions                              | 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 | Internal heat gains              | X                          |    | Storage and control                       |         |         |             |                |                  |                    |          |                                 |              |
| 8         | Building zoning                                    | Solar heat gains                 |                            |    | Generation and control                    |         |         |             |                |                  |                    |          |                                 |              |
| 9         | Calculated energy performance                      | Building dynamics (thermal mass) |                            |    | Load dispatching and operating conditions |         |         |             |                |                  |                    |          |                                 |              |
| 10        | Measured energy performance                        | Measured energy performance      |                            |    | Measured energy performance               |         |         |             |                |                  |                    |          |                                 |              |
| 11        | Inspection   | Inspection                       |                            |    | Inspection                                |         |         |             |                |                  |                    |          |                                 |              |
| 12        | Ways to express indoor comfort                     |                                  |                            |    | BMS                                       |         |         |             |                |                  |                    |          |                                 |              |
| 13        | External environment conditions                    |                                  |                            |    |   |         |         |             |                |                  |                    |          |                                 |              |
| 14        | Economic calculation                               |                                  |                            |    |   |         |         |             |                |                  |                    |          |                                 |              |

The shaded modules are not applicable.

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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 CO<sub>2</sub> 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 CO<sub>2</sub> emission coefficients for energy delivered to and exported from the buildings as described in ISO 52000-1.

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

This document specifies the choices to be made to calculate the PEFs and CO<sub>2</sub> emission coefficients related to different energy carriers. PEFs and CO<sub>2</sub> emission coefficients for exported energy can be different from those chosen for delivered energy.

This document is primarily intended for supporting and complementing ISO 52000-1 as the latter requires values for the PEFs and CO<sub>2</sub> emission coefficients to complete the EPB calculation, however it can also be used for other applications.

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## 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.

ISO 7345, *Thermal performance of buildings and building components — Physical quantities and definitions*

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

## 3 Terms and definitions

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

ISO and IEC maintain terminology 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 can be related to non-renewable energy and renewable energy. If both are taken into account, it can be called “total primary energy”.

[SOURCE: ISO 52000-1:2017, 3.4.29, modified — “includes” is replaced by “can be related to” in Note 1 to entry.]

**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: ISO 52000-1:2017, 3.4.9, modified — “or heat” has been replaced by “electricity or thermal energy”.]

**3.3  
primary energy factor**

**PEF**  
ratio of the *primary energy* (3.1) to the energy delivered to, or exported from, the *assessment boundary* (3.5)

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* (3.1) for a given *energy carrier* (3.2), including the delivered energy and the considered non-renewable energy overheads of delivery to the points of use, divided by the delivered energy

[SOURCE: 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* (3.1) for a given *energy carrier* (3.2), 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* (3.1) for a given *energy carrier* (3.2), including the delivered energy and the considered renewable energy overheads of delivery to the points of use, divided by the delivered energy

[SOURCE: 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* (3.1) for a given *energy carrier* (3.2) 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 renewable and non-renewable PEFs for a given *energy carrier* (3.2)

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

**3.3.6  
renewable energy from renewable sources**

energy whose source is naturally renewed and does not run out

EXAMPLE wind, solar, aerothermal, geothermal, ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases.

**3.3.7****non-renewable energy  
energy from non-renewable sources**

energy from a source which is depleted by extraction

EXAMPLE Oil, natural gas, coal, uranium.

**3.4****CO<sub>2</sub> emission coefficient**

coefficient that describes the amount of CO<sub>2</sub> 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 CO<sub>2</sub> 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. CO<sub>2</sub> eq).

Note 2 to entry: In general, CO<sub>2</sub> emission coefficients from specific energy consumption (ISO 50001:2018, 3.5.2) are quantified based on CO<sub>2</sub> emission factors for use of the energy.

Note 3 to entry: CO<sub>2</sub> emission coefficients can differ by year.

Note 4 to entry: The CO<sub>2</sub> emission coefficient can also include the equivalent emissions of other greenhouse gases (e.g. methane).

[SOURCE: ISO 52000-1:2017, 3.5.4, modified — "such as burning one tonne of fuel in a furnace" has been moved from the end of the definition to an EXAMPLE. The original Notes 1 and 2 to entry have been deleted. Note 3 to entry is now Note 1 to entry with a new second sentence.]

**3.5****assessment boundary**

boundary where the delivered and exported *energy carriers* (3.2) are measured or calculated

[SOURCE: ISO 52000-1:2017, 3.4.2, modified — "energy" has been replaced by "energy carriers".]

**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 can have natural and anthropogenic origins.

[SOURCE: ISO 14067:2018, 3.1.2.1, modified — "gaseous constituent of the atmosphere, both natural and anthropogenic" is simplified into "gas". Notes 1 to 3 to entry have been deleted and a new Note 1 to entry was added.]

**3.8****biogenic carbon**

carbon derived from biomass, but not fossilised

[SOURCE: ISO 14067:2018, 3.1.7.2, modified — "but not fossilised" has been added.]

**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: ISO 14067:2018, 3.1.7.3]

## 4 Symbols, subscripts and abbreviated terms

### 4.1 Symbols

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

[Table 2](#) includes symbols that are needed for overall consistency in the ISO 52000 series.

**Table 2 — Symbols and units**

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

<sup>a</sup> Coefficients have dimensions; factors are dimensionless.  
<sup>b</sup> Including primary energy; Note that for heat the symbol *Q* and for auxiliary energy and work the symbol *W* is used.

### 4.2 Subscripts

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

[Table 3](#) includes subscripts that are needed for overall consistency in the ISO 52000 series.

**Table 3 — Subscripts**

| Subscript       | Term                     | Subscript | Term                             |
|-----------------|--------------------------|-----------|----------------------------------|
| CO <sub>2</sub> | CO <sub>2</sub> emission | nren      | non-renewable                    |
| cr              | energy carrier           |           |                                  |
| del             | delivered                | P         | primary energy                   |
| dis             | distribution             | nren      | 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                   | Out       | output                           |

### 4.3 Abbreviated terms

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

**Table 4 — Abbreviated terms**

| Abbreviated term | Term                            |
|------------------|---------------------------------|
| CHP              | combined heat and power         |
| EPB              | energy performance of buildings |
| GHG              | greenhouse gases                |

Table 4 (continued)

| Abbreviated term | Term                     |
|------------------|--------------------------|
| GWP              | global warming potential |
| GCV              | gross calorific value    |
| LCA              | live cycle analysis      |
| NCV              | net calorific value      |
| PEF              | primary energy factor    |
| PV               | photovoltaic             |
| RES              | renewables               |

## 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 Three fundamental types of PEF

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 energy 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

##### 5.1.1.2.1 General

In accordance with 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.