prEN 17423 Reporting of Primary Energy Factors and CO_2 emission coefficient

for a correct estimation of the real impact of building on energy and climate change

Introduction

The scope of prEN 17423:2019 is the reporting of the choices related to determine Primary Energy Factors (PEF) and CO_2 Emission factors for energy delivered to or exported by buildings to be used in EN ISO 52000-1. The standard has passed with success the public enquiry stage in October 2019 and will be proposed for formal vote in 2020.

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Policy support

One reason for drafting this prEN 17423 is related to the Energy Performance of Buildings Directive (EPBD). The Directive requests in Article 9 that the definition of nearly zero energy buildings shall include a numerical indicator of primary energy use expressed in kWh/m² per year. The primary energy factors used for the determination of the primary energy use considered relevant European standards referred to in this article.

The building energy performance rating based on primary energy allows considering the global impact of the building related to energy. Primary energy rating is the latest stage of building codes requirements starting with energy losses related to products, energy needs of buildings, energy use of the building systems and energy carrier.

Today, with the primary energy indicator, the requirements of buildings are no longer the expression of means (e.g. the type of windows) but performance orientated. This allows building professional to optimize the building e.g. according to its localization, and to determine the best solution for each building. The primary energy rating is often considered as technically neutral, establishing a level playing field between all building technical solutions. It is depending on choices made regarding the determination of PEF (see below) because some equipment losses may be outside the building. For example, the distribution and generation losses of district heating or when using electrical heating are occurring outside the building. But if technical solutions, with parts of the systems located outside the building perimeter should be taken in into account at building level, also the related losses should not be forgotten when evaluating the real impact of the building. This makes the difference between primary energy and final energy, where in case of the final energy approach, the losses outside the building are neglected.

The other reason for drafting this prEN 17423 is related to Climate Change. The climate change impact of a building is measured by its CO_2 emissions, and buildings should evolve towards nearly zero emissions, in order to contribute to the objective of carbon neutrality being pursued by a growing number of countries. The CO_2 emissions of a building are as important to consider as its energy consumption. Similarly, CO_2 emissions should be considered whether they occur outside or inside the building perimeter (district heating or electricity generation, vs gas boiler).

The impact of PEF and CO_2 emission coefficient

Primary Energy Factors (PEF) and CO_2 emission coefficients impact strongly the expression of the energy performance of the buildings as they are the multiplication factor for the whole calculated building energy use and CO_2 emissions.

Table 1 indicates the PEF used in the building regulation of several European Member States (MS) and the default values of EN-ISO 52000-1 "Energy performance of buildings – Overarching EPB assessment".

Table 1 shows that for these two examples, for natural gas, the non-renewable PEF (f_{Pnren}) varies from 1.09 (MS1) to 1.17 (MS2). Only due to the different PEF's,

Table 1. *PEF used in building regulations of European Member States (MS) and in EN-ISO 52000-1.*

Energy carriers		Primary energy factors								
		Member State 1			Member State 2			EN ISO 52000-1		
		f_{Pnren} [1)]	f_{Pren} [1)]	f_{Ptot} [1)]	f_{Pnren}	f_{Pren}	f_{Ptot}	f_{Pnren}	f_{Pren}	f_{Ptot}
Fossil fuels	Solid	1.11	-	1.11	1.46	-	1.46	1.1	0	1.1
	Liquid	1.11	-	1.11	1.11	-	1.11	1.1	0	1.1
	Gaseous	**1.09**	-	1.09	**1.17**	-	1.17	1.1	0	1.1
Bio fuels	Solid	0.20	-	-	0.2	-	-	0.2	1.0	1.2
	Liquid	0.50	-	-	0.3	-	-	0.5	1.0	1.5
	Gaseous	0.18	-	-	-	-	-	0.4	1.0	1.4
Electricity		**1.90**	0.60	2.50	**2.60**	0.40	3.00	2.3	0.2	2.5

[1)] f_{Pnren} = non-renewable PEF; f_{Pren} = renewable PEF; f_{Ptot} = total PEF

the buildings in MS1 heated by natural gas have a lower primary energy consumption of around 7% in comparison with MS2.

The differences are much higher for electricity. For electricity the non-renewable PEF ranges from 1.9 (MS1) to 2.6 (MS6) which is a variation of around 37%.

These variations impact international benchmark and the definition of nearly zero energy buildings. According to the PEF's, the nZEB level will be reached more or less easily by certain technologies.

The ratio of the PEF between energy carriers is also a key element in the competitiveness of the technical building systems. In MS1 the ratio between electricity to natural gas is 1.74 whereas in MS2 it is 2.2. This means that in MS1 it would be easier to sell electrical solutions.

A similar analysis could show that CO_2 emission coefficients are different across countries because for example, the energy systems are different, but also because of differences in approaches or assumptions for the determination of the CO_2 coefficients.

These few examples clearly show that there is a need for transparency in order to:

- make international benchmark of building on energy and CO_2 performance more credible and reliable;
- make the energy performance and CO_2 emissions requirements technically neutral and fair.

Therefore, the determination of the PEF and CO_2 emission coefficient should be based on transparent assumptions. Of course, there could be a national political preference for one or another energy carrier depending on the national energy context (e.g. energy independency). But this preference should be explicitly expressed in the building code requirements and not hidden in factors. Otherwise the real consequence of the choices will also be hidden, introduce a wrong metrics leading strong difference between calculation and reality.

The objective and the content of prEN 17423

The standard prEN 17423 provides a transparent framework for reporting the choices to determine PEFs and CO_2 emission coefficients for energy delivered-to and/or exported-by the buildings as described in EN ISO 52000-1:2017. The PEFs and CO_2 emission coefficients of exported carriers can be different from those chosen for delivered energy. This standard can be considered as a supporting/complementing standard to EN ISO 52000-1, as it requires values for the PEFs and CO_2 emissions factors to complete the EPB calculation.

The target group of this standard are the users of the set of EPB standards, for example national standardization experts, building authorities in charge of defining the PEFs and CO_2 -emission coefficients, but also building professional (e.g. designers) using these values in their calculation. The understanding of the underlying choices related to PEF and CO_2 values, for example if and how exported energy is taken into account, is important for the optimisation of buildings.

In prEN 17423 there are new and more choices, but some PEF and CO_2 emission coefficient are already determined and reported in other standards (e.g. EN 15316-4-5 district heating, EN ISO 52000-1 overarching standard). The choices have been summarized in prEN 17423. Therefore, chapters of these other standards have been copied into prEN 17423 to make a consistent, easy to read standard, without the need to consult additional documents.

The outcome of the whole standard is resumed in the normative Annex A (see **Table 2**). It provides a template to report the main methodological choices that impact PEF and CO_2 emission coefficient values. No mandatory quantitative reporting of data is requested. Please note that **Table 2** is related to the version sent out for public enquiry. It is not the final version and may again change depending on the comments received.

Future transposition of CEN prEN 17423 on ISO level

By the extensive adoption and use of International Standards in the built environment considerable savings in energy, CO_2 emissions and finance can be achieved. Especially through the application of standards for energy efficient design of buildings, energy and CO_2 emissions could be reduced significantly.

Therefore, during the last ISO/TC 163 & 205 meetings held in Seoul, Republic of Korea, September

2019, the prEN 17423 has been presented in the ISO Joint Working Group related to Building Energy Performance. This presentation got a positive echo. It was decided to launch an enquiry for a new Work Item related to this topic also on ISO level and on the basis of CEN prEN 17423 standard. ■

Table 2. *prEN 17423 A.2 Reporting template for choices per energy carrier.*

Reference document (document describing the quantification of PEF and CO_2)			
(ref)			
Energy carrier	$f_{P;nren}$	$f_{P;ren}$	$f_{P;tot}$

Choices related to the perimeter of the assessment (6.1)					
Geographical Perimeter	☐ European	☐ National	☐ Regional	☐ Local	☐ Other[1)]

Choices related to calculation conventions (6.2)				
Time resolution	☐ Hourly	☐ Monthly	☐ Annual	☐ Other
Data source value	☐ Real historic	☐ Simulated historic	☐ Forward looking	☐ Other
Net or Gross Calorific Value	☐ Net calorific Value		☐ Gross calorific value	

Choices related to the input data (6.3)					
Available energy sources	☐ include all energy sources	☐ exclude self-consumed on-site generation	☐ exclude dedicated delivery contracts		☐ Other
GHG considered	☐ CO_2 only	☐ CO_2 equivalent 20 years	☐ CO_2 equivalent 100 years		☐ Other
Biogenic carbon	☐ carbon neutrality		☐ biogenic CO_2, CH_4 accounted		☐ Other
Conventions energy conversion	☐ Zero equivalent ($f_{P;nren}$=0)	☐ Direct equivalent ($f_{p;y}$=1)	☐ Technical efficiencies	☐ Physical energy content	☐ Other
Conventions PEF exported energies	☐ resources used to produce		☐ resources avoided		☐ Other

Choices related to the assessment methods (6.4)						
Energy exchanges	☐ ignoring exchanges		☐ net exchanges	☐ exchanges with different associated PEF and CO_2		☐ Other
Multisource generation	☐ Average calculation approach			☐ Other (e.g. marginal) specify approach and technical reference		
Multisource energy output system	☐ Power loss method	☐ Carnot method	☐ Alternative production method	☐ Residual heat method	☐ Power loss ref method	☐ Other
Life cycle method (LCA)	☐ no LCA			☐ full LCA		☐ Other

[1)] when the "other" tick box is used, one should specify this.

References

For an overview of all EPB standards see www.epb.center

prEN 17423 Energy performance of buildings - Determination and reporting of Primary Energy Factors (PEF) and CO_2 emission coefficient — General Principles, Module M1-7 : 2019.

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

EN 15316-4-5 Energy performance of buildings - calculation of system energy requirements and system efficiencies - Part 4-5: District heating and cooling ; Module M3–8-5, M4–8-5, M8–8-5, M11–8-5 : 2017.