STATUS OF THE DEVELOPMENT OF THE CEN AND ISO STANDARDS ON ENERGY PERFORMANCE OF BUILDINGS ASSESMENT PROCEDURES

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Abstract
The Recast-EPBD[1] requires an update of the current (2007/2008) set of CEN-EPB standards. This update work started in 2012 and will result in a new set of CEN-EPB standards.. Where possible this work will be done parallel with ISO. This project is based on EU-Mandate 480. This mandate accepted by CEN, requires a really out of the box thinking approach of the standard developers. This project is coordinated by CENTC371 the "Program Committee on EPBD" and is considered to be a step forward in progressing towards European Energy Codes for Buildings. This second generation of EPB standards aims on more comprehensive standards, a clear split between informative text in Technical Reports and normative text in Standards, attached excel files to illustrate the calculation procedures etc.. The EPB set of standards and technical reports will support the holistic approach needed for the Nearly Zero Energy Buildings (nZEB) and high performance energy renovation of the existing building stock. CEN proposes a nZEB definition, worked out a common, clear, unambiguous assessment structure and the related standards to calculate the very limited amount of (primary) energy required by nZEB.
The modular structure of EPB standards is flexible in order to take into account national, regional and regional choices. An approach has been introduced, via the so-called Annex A and B in all EPB standards. Annex B is an informative Annex and includes all default values, choices and options needed to use the standard. Normative Annex A includes empty tables for these needed values, choices and options, this empty template shall be used by National Standard Bodies (NSB) (or recognised local, regional or national authorities) to declare these values, choices and options to be followed under their jurisdiction. This approach allows maximal

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[1] EPBD: DIRECTIVE 2002/91/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2002 on the energy performance of buildings.
Recast-EPBD: DIRECTIVE 2010/31/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 May 2010 on the energy performance of buildings; (recast).

flexibility and transparency in applying the EPB standards. If published by the NSB's These filled in Annexes conform Annex A are indicated as National Annexes.
It is expected that Formal Voting drafts of all EPB standards will be ready before April 2016. After the EPB standards are accepted the publication by the end of 2016 seems possible.

Keywords: EU Energy Performance Buildings Directive; CEN ISO Standards EPBD EPB

1. Introduction

Analyses regarding the use of the in 2007/2008 published set of CEN-EPB[2] standards and the requirements set out in the recast-EPBD showed the clear need for a second EU mandate to CEN in order to improve these standards. The revision will improve the accessibility, transparency, comparability and objectivity of the energy performance assessment in the Member States, as mentioned in the EPBD.
The "first generation" CEN-EPB standards were implemented in many EU Member States "in a practical way". Typically: partly copied in "all in one" national standards or national legal documents, mixed with national procedures, boundary conditions and input data.
For a more direct implementation of the EPB standards in the national and regional building regulations, it is necessary to reformulate the content of these standards so that they become unambiguous (the actual harmonized procedures), with a clear and explicit overview of the choices, boundary conditions and input data that can or needs to be defined at national or regional level. This implies that the current set of CEN-EPB standards is improved and expanded on the basis of the recast-EPBD.
The standards shall be flexible enough to allow for necessary national and regional differentiation to facilitate Member States implementation. Such national or regional choices remain necessary, due to differences in climate, culture & building tradition and building typologies, policy and/or legal frameworks.

2. Work in progress, the last phase of the on-going work on the EPB standards

The EPB standards have been developed by the following CEN/TC's:

- TC 089 Thermal performance of buildings and building components;
- TC 156 Ventilation for buildings;
- TC 169 Light and lighting systems;
- TC 228 Heating systems for buildings;

[2] In this paper EPB stands for "Energy Performance of Buildings" the D for the EU-Directive is intentional deleted in relation to the standards. The EU-directive is of great importance for the EU-member states however these CEN standards could become ISO standards as well and it is more appropriate to use just EPB.

- TC 247 Building automation, control and building management;
- TC 371 Project Committee on Energy Performance of Buildings.

These TC's are responsible for the technical content of EPB standards to be revised. CEN/TC 371, the overall responsible coordinating committee, also ensuring that the timetable will be met and that the basic principles and rules, the modular approach and the foreseen improvements of the current set of EPB standards, are in line with the targets indicated and meeting the expectations of the end users.
CEN/TC 371 formulated common Basic Principles (CEN/TS 16628:2014) on the required quality, accuracy, usability and consistency and a common format for EPB standards, including a systematic, hierarchic and procedural description of options, input/output variables and relations with other standards and elaborated a unique hierarchic system for the EPB standards.
CEN/TC 371[3] prepared the Basic Principles (BP) and the supporting Detailed Technical Rules (DTR) (CEN/TS 16629:2014), as basis and guidance for the total set.

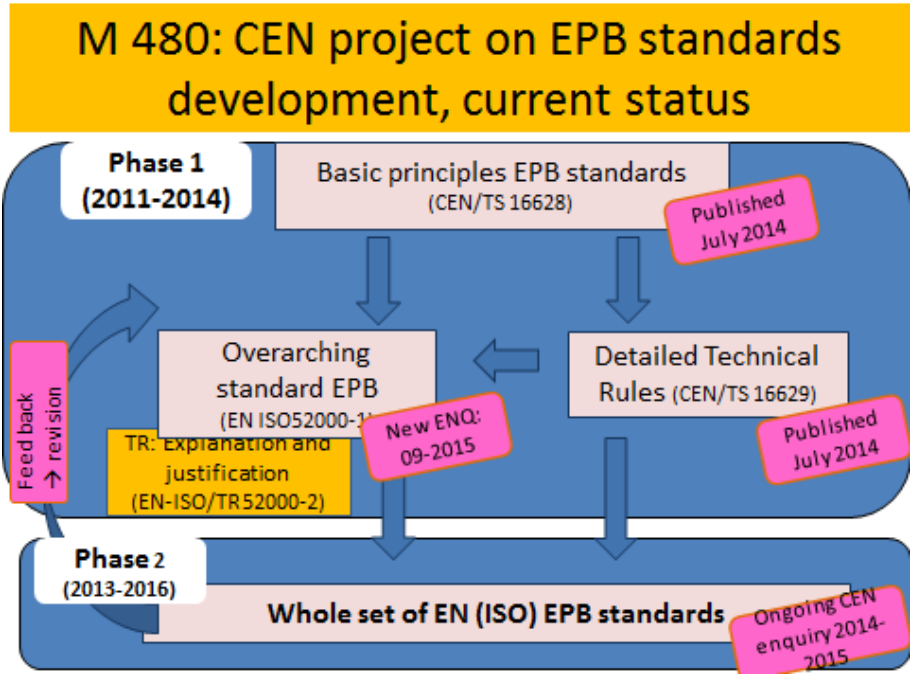

Figure 1 Current status

[3]CEN/TS 16628:2014 Energy Performance of Buildings - Basic Principles for the set of EPBD standards
CEN/TS 16629:2014 Energy Performance of Buildings - Detailed Technical Rules for the set of EPB-standards

3. The Process

The mandate M/480 explicitly requests for identification and prioritisation of items for revision and gaps in the current set of standards in consultation with the EU member states (MS).
The expert team working on the program within the CENTC371, the core group of the CEN/TC team-leaders responsible for the EPBD work in these 5 TC's and TC371, here indicated as the CTL, works closely together with experts from Building Regulators side (the Liaison Committee (LC)).
This close cooperation made it possible to focus at the requirements to be fulfilled to make the standards fit for referencing by legislative authorities.
Based on this working structure CEN/TC 371 prepared the general frame for the package of standards. This includes both the standardised calculation structure and the guidance for the drafting the individual EN EPB standards..

The following, general principles are valid for the set of EPB standards :

1. The complexity of the building energy performance calculation requires a good documentation and justification of the procedures. Informative text is required but it will be separated from actual normative procedures to avoid confusion and unpractical heavy documents. Therefore, each EPB standard (or sometimes a close connected set of) shall be accompanied by a Technical Report where all related informative material will be concentrated.[4]
2. The complexity of the building energy performance calculation requires also a very good coordination and testing of each calculation module. Therefore, each EPB standard shall be accompanied by a spread-sheet where the proposed calculation algorithms and data input/output are tested and proved to be consistent. A Software Tool team checks the calculation modules of the total set of EPB standards. With this excel based software it will be possible to assure that the in/output files of the various connected EPB standards are valid. The relation of the above mentioned set of draft documents and the process setup is illustrated in figure 2

[4] Either as a separate TR or if very limited as an informative annex to the standard. It is also possible that a TR will cover more standards.

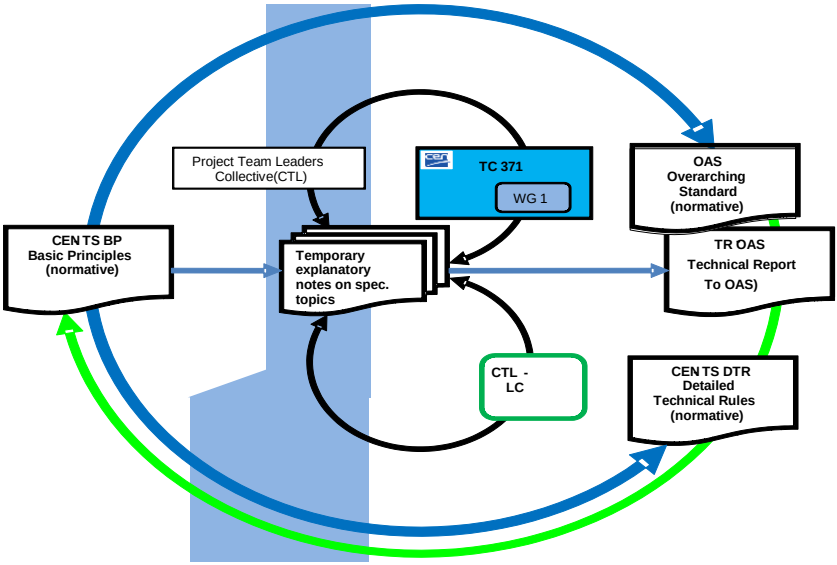

Fig. 2 – Iterative development process around the coordinating CENTC371 and inter-relation between the documents as has been developed.

4. The deliverables of CENTC371

4.1 CEN/TS Basic Principles

CEN/TS 16628:2014 Energy Performance of Buildings - Basic Principles for the set of EPBD standards. This TS provides a record of the rationale, background information and all choices made in designing the EPB package. These basic principles are based on the analysis of the weak points within the first generation EPB package and on an evaluation of requirements by the Regulating Authorities and the outcome of the IEE-project CENSE (see http://www.buildup.eu and http://www.iee-cense.eu/).
The TS Basic Principles provides guidance on the required quality, accuracy, usability and consistency of each standard and the rationalisation of different options given in the standards, providing a balance between the accuracy and level of detail, on one hand, and the simplicity and availability of input data, on the other.

4.2 CEN/TS Detailed Technical Rules

CEN/TS 16629:2014 Energy Performance of Buildings - Detailed Technical Rules for the set of EPB-standards. This TS is based on the CEN/TS BP and provides mandatory detailed technical rules to be followed in the preparation of each individual EPB standard. This is in addition to the CEN drafting rules and complementary to the

Overarching Standard (former prEN15603 and current draft-ISO 52000-1) in this article indicated as OAS. The OAS, containing the common terms, definitions and symbols and the overall modular structure for the set of EPB standards.The DTR gives a common format for each standard, including a systematic and hierarchic structure to pinpoint the position of the standard within the framework of EPB standards and procedural description of options, input/output variables. THE CEN/TS DTR includes guidance for:

-a clear separation of the procedures, options and default data to be provided as default CEN option in an annex B but also allowing for national or regional choices conform the normative annex A of each of the EPB standard (where appropriate);

-a specification of the input data, also indicating the source of the data if this is the output calculated according to another EPB standard or related product standard;

-a specification of the intended output that is intended to provide the energy performance assessment results, the related data necessary for their proper interpretation and use, and all relevant information documenting the relevant boundary conditions and calculation or measurement steps.

-an informative CEN Technical Report, accompanying each standard[5], according to a common structure, comprising at least the results of internal validation tests (such as spread sheet calculations for testing and demonstrating the procedures), examples and background information. Almost all informative parts of EPB standards will be in these technical reports.

4.3 Energy performance of buildings-Overarching standard EPB; the former FprEN 15603: 2014 and current ISO DIS 52000-1

This standard (OAS) specifies a general framework for the assessment of the overall energy use of a building, and the calculation of energy ratings in terms of primary energy, using data from other EPB standards, providing methods for calculating the energy use of services within a building (heating, cooling, humidification, dehumidification, domestic hot water, ventilation, and lighting). This assessment is not limited to the building alone, but takes into account the wider environmental impact of the energy supply chain.

The OAS handles the framework of the overall energy performance of a building, covering inter alia:

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[5] This to significantly reduce the length of the standards and strengthen their focus, thus facilitating the adoption (including translation) in national/regional regulations.

1. common terms, definitions and symbols;
2. building and system boundaries;
3. building partitioning;
4. unambiguous set of overall equations on energy used, delivered, produced and/or exported at the building site, near-by and distant;
5. unambiguous set of overall equations and input-output relations, linking the various elements relevant for the assessment of the overall energy performance of buildings which are treated in separate standards;
6. general requirements to standards dealing with partial calculation periods;
7. general rules in setting out alternative calculation routes according to the calculation scope and requirements;
8. rules for the combination of different partitioning.

The OAS provides a systematic, clear and comprehensive, continuous and modular overall structure on the integrated energy performance of buildings, unlocking all standards related to the energy performance of buildings.
The overall framework provided by the OAS will work as the "***Backbone"*** (see figure 3) of the set of EPB standards, it facilitates a step-by-step implementation by the user, taking also into account the nature of each procedure identifying the typical type of user. More information is given in a Technical Report accompanying the OAS. The justification for the CEN defaults and options are provided in this TR (draft ISO TR 52000-2).

Current (July 2015) status: this ISO DIS 52000-1 will be published for enquiry by September-2015. The Enquiry will close by December 2015, after processing the possible comments it is expected that a Formal Voting draft will be ready before April 2016. After the standard is accepted publication by the end of 2016 seems feasible .

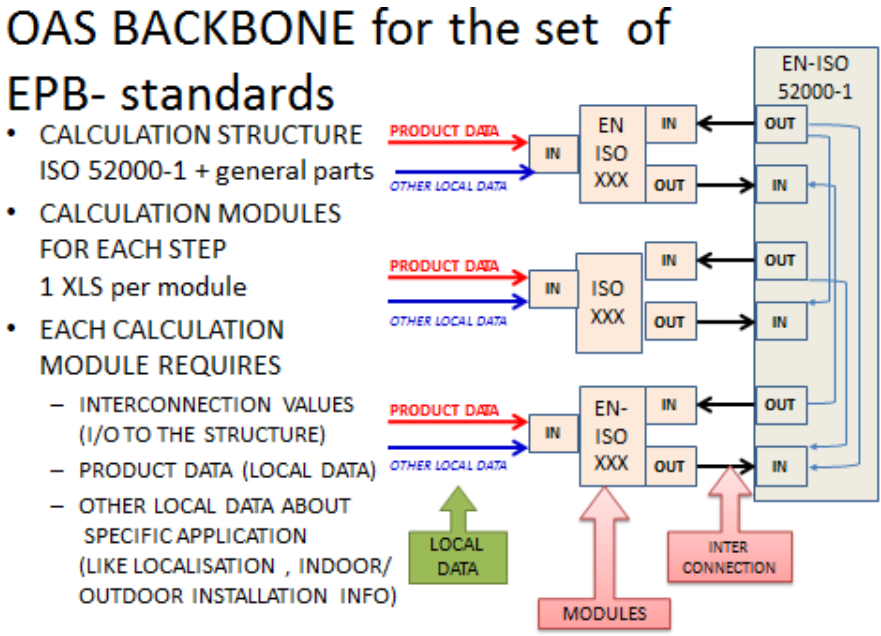

Figure 3 The OAS as backbone for the set of EPB standards

4.4 Draft ISO TR 52000-2 (former prCEN/TR 15615:2014) Energy Performance of buildings - Accompanying Technical Report on draft OAS.

This draft-TR contains information to support the correct understanding, use and national implementation of this standard.
This draft is expected to be published at the same time as the ISO-DIS OAS.

5. Hierarchic numbering system - Modular structure

The setup of a coherent and hierarchically numbered system of EPB standards is a requirement. Given the fact that not all standards will be ready for parallel ISO enquiry or publication and that standard numbering system in CEN doesn't allow this, a modular structure was developed, allowing for addressing documents given hierarchic positioning in that structure. By adding the identification code of a specific

cell of the modular structure (see Figure 4 & 5) the purpose of a standard (and/or specific clauses of the standard) can be identified easily.

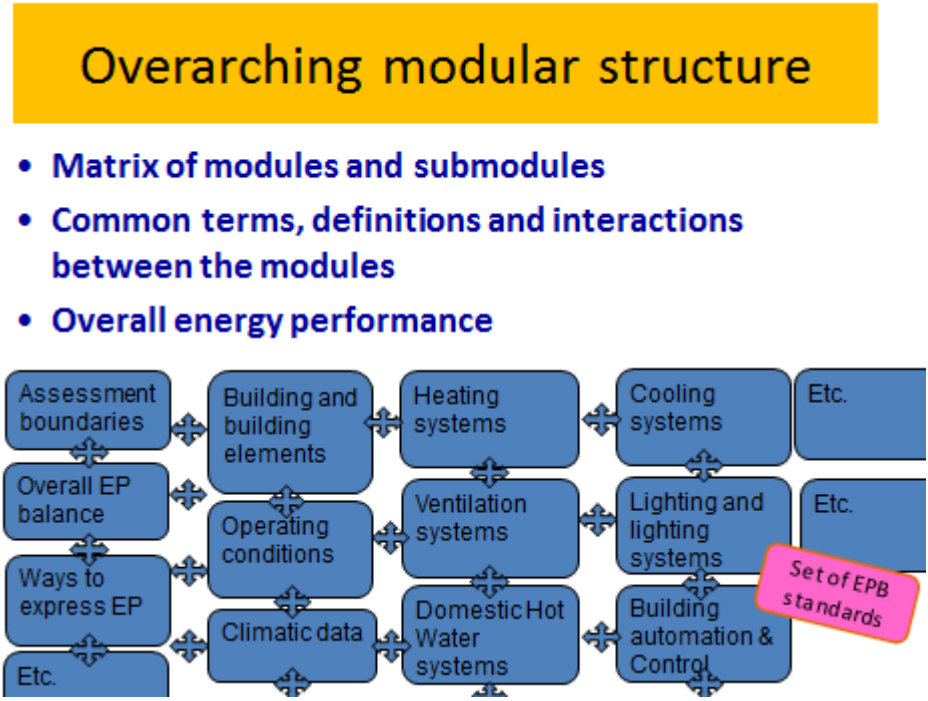

Figure 4 Overarching Modular structure

Overarching		Building (as such)		Technical Building Systems										
	Descriptions		Descriptions		Descriptions	Heating	Cooling	Ventilation	Humidification	Dehumidification	Domestic Hot water	Lighting	Building automation & control	PV, wind, ..
sub	M1	sub	M2	sub		M3	M4	M5	M6	M7	M8	M9	M 10	M 11
1	General	1	General	1	General									

2	Common terms and definitions; symbols, units and subscripts	**2**	Building Energy Needs	**2**	Needs										
3	Applications	**3**	(Free) Indoor Conditions without Systems	**3**	Maximum Load and Power										
4	Ways to Express Energy Performance	**4**	Ways to Express Energy Performance	**4**	Ways to Express Energy Performance										
5	Building Functions and Building Boundaries	**5**	Heat Transfer by Transmission	**5**	Emission & control										
6	Building Occupancy and Operating Conditions	**6**	Heat Transfer by Infiltration and Ventilation	**6**	Distribution & control										
7	Aggregation of Energy Services and Energy Carriers	**7**	Internal Heat Gains	**7**	Storage & control										
8	Building Partitioning	**8**	Solar Heat Gains	**8**	Generation & control										
9	Calculated Energy Performance	**9**	Building Dynamics (thermal mass)	**9**	Load dispatching and operating conditions										
10	Measured Energy Performance	**10**	Measured Energy Performance	**10**	Measured Energy Performance										
11	Inspection	**11**	Inspection	**11**	Inspection										
12	Ways to Express Indoor Comfort			**12**	BMS										
13	External Environment Conditions														
14	Economic Calculation														

Fig. 5 – The overarching modular structure of EPB standards

6. Calculation tool and Module description

The complexity of the building energy performance calculation requires also a very good coordination and testing of each calculation module to ensure coherence and the software-proof of the set of EPB standards. Therefore, each EN EPB standard shall be accompanied by a spread sheet in which the proposed calculation algorithms and data input/output are tested and proved coherent.

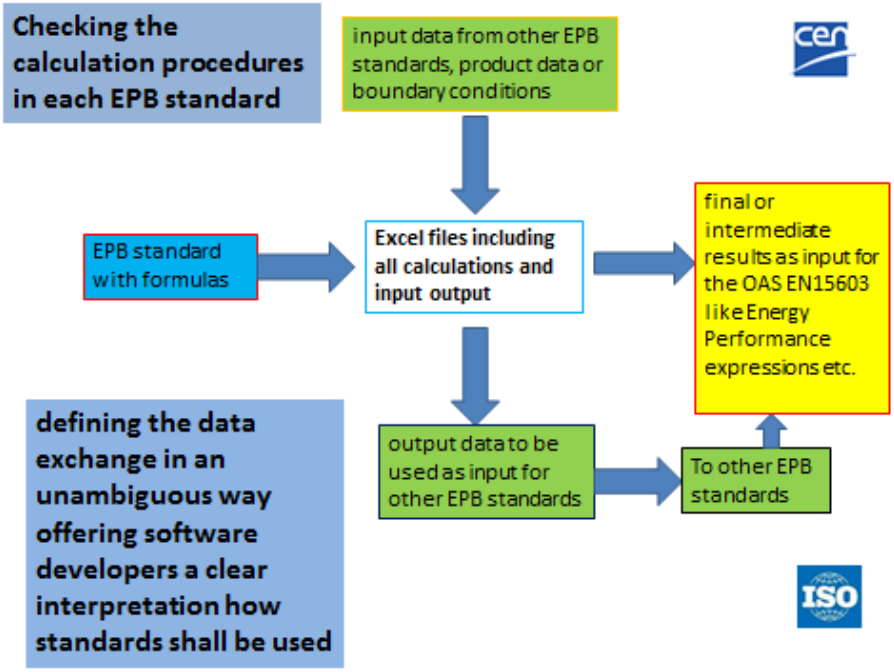

Figure 5 Software check of the excel sheets of the EPB standards

7. How the EPB standards interacts with the relevant product standards

Saving energy in the build environment requires not only that products consuming electricity and fuels are designed to be intrinsically more energy efficient. The

interaction of a product with the rest of the system or installation in a building into which it is fitted plays an important role. This appears obvious for a number of product categories such as building equipment for ventilation, heating, cooling, lighting and control and automation. With the increasing application of electronic and communication technologies, this is also increasingly true for many other products, used in buildings but not considered as EPB related, that become 'smart' and 'networked', and can be controlled through wider systems.

When EU-policies such as the Ecodesign Directive use a too narrow product-based view, products are considered irrespective if their surroundings and tested in standard conditions. If only their technical efficiency is considered, this approach may look straightforward but misses the savings that can be expected from ensuring that the product is also correctly sized, fitted and controlled to render its service optimally in a well-designed building installation. While it may not be difficult to reach an EU regulation of systems under product policies, it may be possible to find creative ways for tackling at least a part of the energy savings.

On one hand we have the Ecodesign Directive requiring through EU regulation minimal energy performances of energy using products. On the other side we have the EPBD where the EU Member States are obliged to require minimal target values for the energy performance of buildings, also having specific requirements for the overall thermal performance and the energy performances of the heating, ventilation lighting and cooling systems

The CEN expert teams working on the different EPB-system standards have to check if the product data available on basis of product standards and/or related EU regulations are sufficient as input for their system standards. At the same moment the CEN and ISO product Technical Committees and/or experts have to be convinced that using the EPB system approach, to describe and test the products, is the most efficient way to ensure effective energy performance targets for products, systems and finally the buildings (see figure 6).

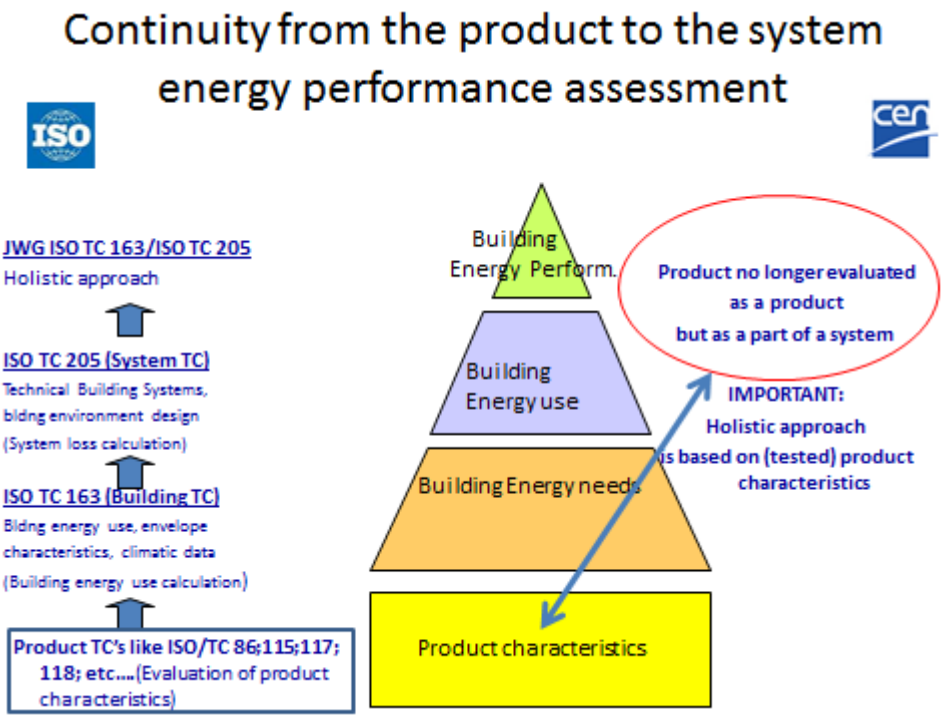

Figure 6 Products not longer evaluated as products but as part of the system.

8. Co-operation with ISO

An active process of interaction for the Overarching Type of standards through the JWG of ISO TC 163 & 205, for the other CEN-EPB standards via the different WG's of ISO TC 163 and 205. Since many years CEN and ISO share early prelim draft texts. Experts in the ISO and CEN teams are working on these standards, with the ultimate goal to agree on EN-ISO standards. A challenge given the geographic and other differences in the building sector and given the very tight time scale at CEN level. For EPB standards under some of the CEN TC's the cooperation with ISO is still informal. This means that for these standards no parallel voting is expected before 2016.

However when the EN standards are accepted by the relevant ISO TC's later steps will lead to publication as EN-ISO standards.
In ISO, a series of numbers has been reserved for all EPB standards (52000----52150). Several (11 of the 42) first generation of EBP standards are already EN-ISO standards. They have been developed under the Vienna Agreement. Revision of these standards requires co-operation with the responsible ISO/TC. The central co-ordination of the preparation of a set of international standards on the energy performance of buildings at the ISO level is in the hands of ISO /TC 163/WG 4, *Joint Working Group of ISO TC 163 and TC 205 on energy performance of buildings using a holistic approach*.
The main leading and active experts in CEN (members of the CTL of CENTC371) and ISO are among the main leading and active members of this ISO Joint Working Group. In order to co-ordinate revisions of EN-ISO standards required under mandate M/480 and the activities within the responsible ISO/TCs, CEN/TC 371 established a liaison with ISO/TC163/WG4 (see Figure 7). This co-operation with ISO aims to avoid serious duplication of work, to avoid incompatibilities in (input) product data, procedures and (output) energy performance data.

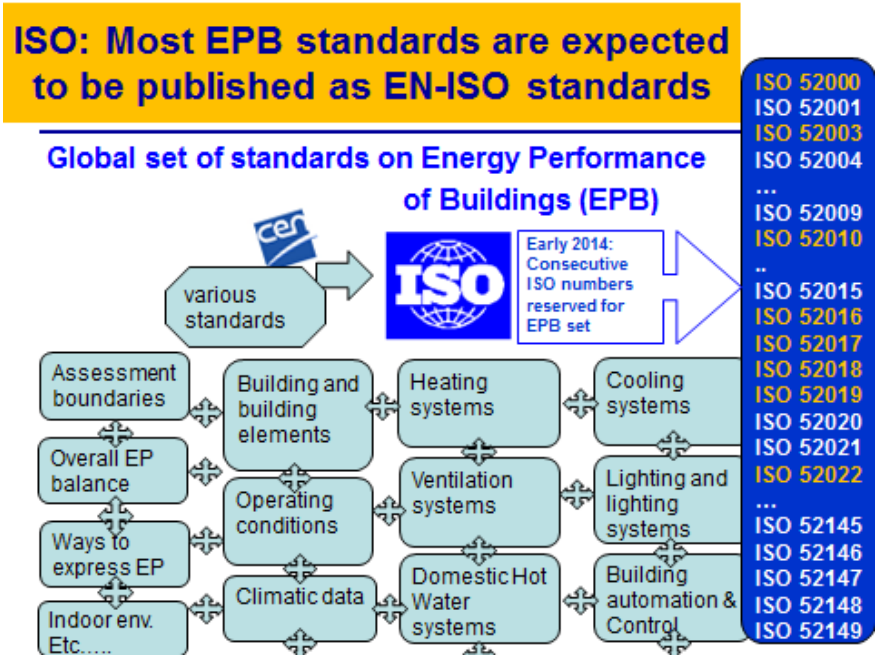

Figure 7 Schematic operational structure.