Roadmap for the set of EPB standards with regard to the key global challenges

Version: 2024-02-24 *)

prepared by:

ISO/TC 205 & 163 Joint Advisory Group on coordination of the ISO 52000 family EPB standards
and
CEN/TC 371 Task Group on Systematic Review/Standardization Request & EPBD4

Contact persons:

Dick van Dijk
- Convenor ISO/TC 205 Joint Advisory Group with ISO/TC 163, *Coordination of ISO 52000 family of EPB standards*
- Convenor of CEN/TC 371/TG *on SR/SReq and EPBD*

EPB-research@dickvandijk.nl

Jaap Hogeling
- Chair of CEN/TC 371, *Energy Performance of Buildings*
- Member of ISO/TC 205&TC 163 JAG, *Coordination of ISO 52000 family of EPB standards*

j.hogeling@isso.nl

*): *It is anticipated that this document will be regularly updated to reflect new developments.*

EXECUTIVE SUMMARY

This document outlines a roadmap for upgrading the set of Energy Performance of Buildings (EPB) standards, including the reasons and goals for the upgrade. It discusses the need for updating in response to the stakeholders feedback and the EPBD revision in Europe. This includes updating of specific technical content as well as upgrading of the set as a whole, leading to better accessibility and usability, global relevance, and overall quality assurance for these standards.

Key points from the document include:

INTRODUCTION

- In 2017, a set of EPB standards was published to collectively assess the overall Energy Performance of Buildings, encompassing both EN ISO and CEN only standards.
- Many of these standards were subject to systematic review in 2022. To maintain the overall quality and coordination of these standards, coordinating teams in CEN and ISO initiated efforts to review not only individual standards but also the holistic set as a whole.
- Stakeholder feedback indicated the need for upgrading the standards to address global challenges.
- Simultaneously, the revision of the EPBD (Energy Performance of Buildings Directive) in Europe necessitates the upgrading of the EPB standards.

GOALS AND ACTIVITIES

The primary objectives for the major upgrade of the EPB standards include:

i. Updating the set of EPB standards in response to stakeholder feedback and EPBD revision in Europe.
ii. Enhancing accessibility and usability of the standards.
iii. Increasing global relevance.
iv. Ensuring overall consistency and uniform quality.

These goals will be achieved through the following activities:

1. Updating the technical content.
2. Transitioning to global (EN ISO) standards.
3. Making the standards software-ready.
4. Developing a reference software tool to primarily check the quality and usability of the set of EPB standards as a whole.

GOALS

Goal I: Updating in Response to Stakeholders Feedback and EPBD Revision in Europe:

- Stakeholder feedback, obtained during systematic reviews, underscores the need for substantial upgrades to address global challenges and enhance specific EPB standards
- The revised EPBD introduces key changes, including a shift from Zero Energy Buildings to Zero Carbon Emission Buildings, an increased emphasis on Indoor Environment Quality (IEQ), Energy Performance Certification and Roadmaps for Renovation.
- The importance of links to standardized techniques to assess actual energy performance and Life Cycle Global Warming Potential (GWP) is highlighted.

- The document also mentions the need to be more specific on the interaction with the energy grid and the role of Building Automation and Control systems (BACs).

Goal II: To Enhance Accessibility and Usability of the Set of EPB Standards:

- A software tool is primarily needed to reinforce and demonstrate the uniform quality and overall interoperability of the total set of EPB standards containing calculation procedures. More in general, a lack of open-source software tools impedes the widespread acceptance of EPB standards..
- Making the standards software-ready, accompanied by technical reports for human readers, will pave the way for software development and improved consistency and uniform quality.
- Additionally, rationalizing the subdivision of the set of EPB standards into less separate standards could reduce duplications and interactions between individual documents.
- Spreadsheet tools will remain essential for transparent calculation demonstrations of the standards and validation of application tools.
- Having software validation procedures in the set could also widen the accessibility of the set of EPB standards.

Goal III: Increasing Global Relevance:

- The document emphasizes the importance of global convergence and harmonization of terms, definitions, and assessment procedures to address the global challenges of reducing reliance on non-renewable sources.
- Collaboration with ISO is viewed as essential to keep the European approach relevant at the global scale and have the global world benefit from the work done in Europe.

Goal IV: Ensuring Overall Consistency and Uniform Quality:

- Measures to achieve consistent quality assurance are outlined, with specific objectives on making them more digitalized ("software ready") and having an overall open source software tool to verify and demonstrate the set.
- Additional objectives to reach this goal are:, establishing a coherent set of national ("Annex B") choices, and implementing a Quality Assurance Group to check draft standards for compliance and consistency.

ACTIVITIES

Activity 1: to Upgrade the Technical Content:

- Various aspects of the technical content that require upgrading or addition are listed in the document, such as improving coordination with product standards, clarifying assessment boundaries, and enhancing consistency among services.
- Also mentioned are: incorporating Building Automation and Control (BAC) functions into EPB standards, introducing thermal and electric energy storage and thermal and electric grid interaction strategies.
- Furthermore: Enhancing output information for energy, Indoor Environmental Quality (IEQ), and design and exploring life-cycle Global Warming Potential (GWP) opportunities.
- Creating a comprehensive standard for building operational ratings as well as investigating software validation procedures for validated software use.
- And creating a consistent set of default national ("Annex B") choices to facilitate regulatory implementation of the EPB standards and to stimulate further harmonization.

Activity 2: to Complete the Transition to global (EN ISO) Standards:

- In particular in the subset of technical building systems, the set of EPB standards at global level is still far from complete. This is due to lack of resources in the past and due to a progressive interest in the holistic approach.

Activity 3: to Upgrade the EPB Standards from Software Proof to Software Ready:

- The third activity aims to move EPB standards from "software proof" to "software ready". This implies e.g. the introduction of unique identifiers for all variables, numeric and non-numeric (e.g. typologies).
- This will be supported by categorizing of input data, updating example case calculations, and describing a logical overall calculation order for the different modules
- Rationalization of the subdivision of the set of EPB standards into a lower number of separate standards will, where applicable, simplify the connections.

Activity 4: to develop an Overall Reference Software Tool:

- The absence of an overall open source EPB calculation software tool is noted as a major hindrance to wide implementation of the EPB standards. Consequently, the fourth activity involves developing an open-source reference software tool, primarily to reinforce the uniform quality and overall interoperability of the set of EPB standards.
  This will also be useful for certification of commercial software and to provide end-users with a practical tool.

Access to the Standards:

The document also notes that open access to standards is also highly desirable for the fast and wide roll-out, acceptance and implementation of the standards and for getting researchers, students and teachers at academic or higher education institutes involved.

WORKPLAN, in case of (adequate) resources:

Prioritization:

- The document suggests that all EPB standards need to be upgraded at the same time to maintain overall quality, but some standards require specific attention and prioritization.

Organization:

- The workplan aims at a project consisting of two phases
- Phase 1 focuses on the general and overarching aspects of the project and is expected to take one to two years. Phase 1 also include setting up pilots and a quality assurance group and preparing a first draft set of consistent default national ("Annex B") choices.
- Phase 2 addresses the detailed upgrade of individual EPB standards and takes two to three years.
- The EPB Center is proposed to play a crucial role in managing the project, coordinating expert teams, and supporting CEN and ISO working groups. To assist in the preparation and revision of draft standards and quality requirements and to organize the software development and other aspects of the project.

Costs and benefits:

- Major efforts are needed for technical content upgrading, software readiness, and the development of the reference software tool. Therefore, the upgrading of the EPB standards and the development of a reference software tool is estimated to require significant resources.

However, the benefits will be enormous: executing the plan will yield a high quality, transparent, reliable and consensus based methodology that will significantly contribute to optimized overall energy performance, indoor environment quality and reduced carbon emissions in buildings and districts. It will be ready-to-use in a regulatory context and significantly promote transparency and reliability and boost market confidence.

Contents

1 Introduction 7
2 Goals 8
2.1 Goal I: to update in response to stakeholders review and the EPBD revision in Europe 8
2.2 Goal II: to enhance accessibility and usability of the set of EPB standards 10
2.3 Goal III: to increase the global relevance 11
2.4 Goal IV: to ensure the overall consistency and uniform quality 12
3 Activities 12
3.1 Activity 1: upgrade the technical content 12
3.2 Activity 2: complete the transition to global (EN ISO) standards 14
3.3 Activity 3: upgrade from “software proof” to “software ready” 15
3.4 Activity 4: develop overall reference software tool 15
4 Workplan, in case of (adequate) resources 16
4.1 Prioritization 16
4.1.1 General 16
4.1.2 The EPB standards that most urgently need to be significantly upgraded with respect to their technical content 16
4.1.3 The core of EPB standards to be made software ready 18
4.2 Organization 19
4.2.1 Preparation 19
4.2.2 One project, two phases 19
4.2.3 Role EPB Center 20
4.3 Costs and benefits 21
4.4 Cooperation with adjacent or overlapping standardization areas 22
4.5 Communication plan 22
Bibliography 24

1 Introduction

In 2017 a high number of (EN) ISO and CEN standards were published to collectively assess the overall Energy Performance of Buildings: the set of EPB standards.

Although the set of EPB standards in 2017 were developed under an EC Mandate (M/480 [2]), quite a number of these EPB standards were developed not only at European (CEN) level, but also at global (ISO) level and this number is gradually increasing ([1], [5].

These standards constitute an integrated and coordinated package that needs to be maintained and kept coordinated.

In the course of 2022 (5 years after publication) many of these documents have, individually, been subject to systematic review (SR). The coordinating teams in CEN and ISO prepared and distributed a guidance document [6] to call upon National Standards Bodies and other stakeholders to review not just the individual standards, but also the holistic set as a whole, to avoid the risk of degradation of the overall quality, consistency and interoperability.

At the same time, the revision of the EPBD [7] requires upgrading the set of EPB standards.

The responses received from a variety of national standards bodies and other stakeholders[1] confirmed that there is a strong need for upgrading the set of EPB standards, with regard to the key global challenges, in addition to specific improvements of individual EPB standards.

These responses, in combination with the needs to support the revised EPBD in Europe have led to the drafting of this roadmap.

The ISO/TC 205 & 163 *Joint Advisory Group on the ISO 52000 family EPB standards* and CEN/TC 371, *Energy Performance of Buildings* are responsible for the overall quality of the set of EPB standards. Together with the *Overarching EPB standard* EN ISO 52000-1, the following documents have been developed to specify the common EPB quality criteria and processes: CEN/TS 16628 (Basic Principles) [3] and CEN/TS 16629 (Detailed Technical Rules) [4][2].

This document:

This document has been prepared by a Task Group consisting of 15 experts from CEN/TC 371 (*Energy Performance of Buildings Project Group*), together with the Joint Advisory Group from ISO/TC 205 and ISO/TC 163, responsible for the coordination of the (EN) ISO 52000 family of EPB standards.

Goals and activities:

The main goals for a major upgrading of the set of EPB standards are:

- To update the set in response to stakeholders feedback and the revision of the EPBD in Europe.
- To make the set of EPB standards easier accessible and usable.
- To increase the global relevance of the set of EPB standards.

[1] The detailed responses will be used as valuable input when working out the details of the plan.
[2] CEN/TS 16629 is also the basis for a common template for each EPB standard, containing specific editorial rules complementing the ISO and CEN internal principles and rules. This template is in the process of being revised based on the feed back and future needs.

- To ensure the overall consistency and uniform quality

These goals will be achieved by means of the following activities:

- Upgrade the technical content of the set of EPB standards.
- Complete the transition to global (EN ISO) standards.
- Upgrade the set of EPB standards from (individually) "software proof" to (individually and collectively) "software ready"[3].
- Develop an overall reference software tool to reinforce and demonstrate the uniform quality and overall interoperability.

Each activity may serve several goals as illustrated in the following cross reference table:

Activities: / **Goals:**	**1. Upgrade technical content**	**2. Complete the transition to global (EN ISO) standards**	**3. Upgrade from "software proof" to "software ready"**	**4. Develop overall reference software tool**
I. To update in response to stakeholders review and the revision of the EPBD in Europe	**Very relevant**	Relevant	Relevant	Relevant
II. To make the set of EPB standards easier accessible and usable	Relevant	Relevant	**Very relevant**	**Very relevant**
III. To increase the global relevance	Relevant	**Very relevant**	Relevant	**Very relevant**
IV. To ensure the overall consistency and uniform quality	Relevant	Relevant	**Very relevant**	**Very relevant**

These goals and activities are successively discussed in the next chapters.

2 Goals

2.1 Goal I: to update in response to stakeholders review and the EPBD revision in Europe

Stakeholders feedback:

The feedback received from a variety of stakeholders in the context of the Systematic Review (see Introduction) identified a real need for upgrading the set of EPB standards, with regard to the key global challenges, in addition to specific improvements of individual EPB standards.

[3] Meaning that all normative elements in the standard(s) can be unambiguously converted to software.

Revision of the EPBD in Europe:

The set of EPB standards and accompanying technical reports was established by the European Commission and are managed by CEN to support the EPBD[4].

It is expected that the revised EPBD will be formally adopted and published in spring 2024[5].

The most relevant novelties in the EPBD:2024 are:

- The focus moves from Zero Energy Buildings to Zero Carbon Emission Buildings.
- Stronger emphasis on the Indoor Environment Quality (IEQ): this requires additions in the (hourly!) calculation procedures, in the specification of conditions of use and the specification of indicators.
- The introduction and use of terms and definitions such as total and (non-)renewable primary energy, final energy, ambient energy, etc., in a variety of contexts, with various options of assessment boundaries and perimeters (e.g. on-site, nearby, distant) calls for precise clarification to ensure an effective, physically responsible, equal and unambiguous implementation aiming at an energy efficient building stock.
- The links between energy performance certification of buildings, renovation passports, smart readiness indicators and system inspections require a consistent set of calculation procedures suited for a variety of applications and users.
- Renovation of existing buildings:
    - Renovation Passports: the tailored roadmap for building renovation requires a tailored EPB calculation that is compatible with the standard EPB calculation.
    - Incentives and financial support for energy renovations shall be effectively put in place. Methods to verify the actual savings would serve as a big stick.
    - A sufficient workforce needs to be ensured, with the appropriate level of skills corresponding to the needs in the building sector, with a special focus on the underrepresented groups. This requires addressing skills gaps and promoting education, targeted training, upskilling and reskilling in the construction, sector and energy efficiency and renewable energy sectors. To get the best out of their skills, it is important that calculation tools can be made widely available for those practitioners and educators that are in line with the set of EPB standards.
    - Better understanding is needed of the gap between actual EP versus calculated EP by standardized techniques to assess actual (measured) EP (operational rating), including definition of specific indicators to facilitate comparison with calculated EP; This will lead to a better roadmap for improvement of the building and higher confidence (therefore value and authority) in the energy performance calculation.
    - Having hourly measured data during operation (respecting relevant data protection regulations such as GDPR and Data Act) would provide significant added value to the analysis.
- Life-cycle Greenhouse Gas (GHG) emissions: a strong liaison with the CEN and ISO teams working on sustainability is required, to discuss how the interfacing with the EP calculations can be enabled.
- Extension of EP certificates: the EPB calculation procedures need to facilitate that all relevant information can be extracted for producing user-centred EPCs for the different types of users.

[4] https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/energy-performance-buildings-directive_en#energy-performance-of-buildings-standards

[5] https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/energy-performance-buildings-directive_en#revised-energy-performance-of-buildings-directive

- Interaction with the energy grid: evaluation of the interaction with the grid (demand flexibility) requires an hourly or sub-hourly (15 or 10 minutes) calculation interval. Electric storage (incl. smart car recharging) needs to be included. More attention to thermal storage integration is needed.
- Member States should enable and encourage architects, planners and engineers to properly consider the use of district heating and cooling when planning, designing, building and renovating industrial or residential areas, including building modelling and simulation technologies. To ensure that these models yield the legally required or expected overall energy performance, it is important to bridge any gap between these simulation tools and set of EPB standards.
- Smart Readiness of buildings to become operational: EPB standards should provide a *specific and quantitative* evaluation of SRI (Smart Readiness Indicator) functions, which is far more realistic than a *generic qualitative* evaluation as provided by a checklist-based SRI.
- More prominent role of Building Automation and Control systems (BAC's): they should be able to advice the building user about EP improvement actions and where relevant the IEQ performance.
- Databases for energy performance: information from national databases can only be exchanged if terms and definitions, typologies, indicators and the engine behind the metric (the calculation methodology) are harmonized, with national or regional choices clearly identified to enable conversion and benchmarking.
- The relevant EPB standards shall be aligned with the required optimization of the solar energy generation potential for new buildings.
- A basic set of definitions is needed to ease the integration and compatibility with Levels and Taxonomy and with the EU directives in the field of energy and GHG emission (EED, RES, EPBD).

Several details of the revised EPBD will be worked out in Delegated Acts and Guidance documents to be adopted and issued by the Commission in the coming years. It will therefore also be important to find mechanisms to continuously ensure and strengthen compatibility between these documents and the set of EPB standards.

2.2 Goal II: to enhance accessibility and usability of the set of EPB standards

For the overall consistency and uniform quality, the EPB (calculation) standards need to become "**software ready**" (see 3.3). This will also be an effective investment to facilitate the development of software.

As a consequence of the standards being optimized to become "software ready", the **accompanying technical reports** will play an increasingly important role for the human readers: for justification, explanation and demonstration of the calculation procedures.

The **spreadsheet tools** will remain important for a step-by-step transparent demonstration of the calculation procedures of individual EPB calculation standards, in example case studies, including stress tests.

For the usage of end users (engineers), the vast number of standards and all their connections is not easy, to get a comprehensive overview. Therefore, where possible from the perspective of coherency of scope and usage, **some of the standards** should be **merged together** into a lower number of standards, resulting in less duplications and interactions between individual documents.

Software **validation procedures** including acceptance criteria could provide an opening for the use of other -validated- software, as a complementary means to make the set of EPB standards more accessible and usable.

For the assessment of the overall EPB, **the end user** of the EPB calculation standards does **not use the standards** themselves, but **a software tool** that applies the methods described in the standards.

A country considering the adoption of the EPB standards and incorporation (referencing) these in the building regulations needs to be sure that a software tool is available to apply the EPB standard(s). Currently, many EU-countries choose to stick to national calculation procedures that (presumingly) are close to the calculation procedures of the EPB standards or they choose the simple monthly calculation procedures, because the transition to the hourly calculation procedures would require to change the national software (or impact the national software market) used to assess the energy performance of buildings.

> NOTE To avoid any obstacle for the end user to use the hourly calculation procedures of the EPB standards: even in EN ISO 52016-1 (calculating the energy needs and indoor temperatures), the core standard for the overall EP calculation (see 4.1.3), it has been ensured that the input data that has to be acquired by the end user for the hourly calculation procedures is the same as (and not more than) for the monthly calculation procedures.

The absence of an open source overall software tool is by several **stakeholders** in various countries mentioned as the main hindrance for the fast and wide roll-out, acceptance and implementation of the set of EPB standards.

So, an **open source software tool** is essential to verify the uniform quality and overall interoperability of the set of EPB standards and as a spin-off for certification of commercial software, also to increase the global relevance.

2.3 Goal III: to increase the global relevance

The **global challenges** to reduce the dependency on non-renewable sources are huge. It is in the interest of all countries and stakeholders to combine forces and facilitate cross-border trade and knowledge exchange.

Therefore, it is a positive trend that an increasing number of EPB standards are becoming available not only at European (CEN) level, but also at global (ISO) level. Most core EPB standards are already EN ISO standards. But at global level other essential links in the chain are still missing.

The benefits of global convergence and harmonization of terms and definitions and assessment procedures impact a wide variety of **stakeholders**:

— National and international policymakers.
— National and international regulators and energy agencies.
— EPB assessors.
— Manufacturers and component suppliers.
— Building designers and system engineers.
— Software developers.
— Project developers and building companies.
— Financial institutes.
— Research and education.

Some CEN and ISO working groups have decided, for practical reasons (e.g. for the time being), to work in parallel on separate CEN and ISO EPB standards.

Also the limited availability of resources hinders the preparation of EPB standards at global level, even where CEN standards are already available.

The EPB standards aim for **harmonization at global level**, but at the same time allowing for **specific national and regional differentiation** to facilitate implementation in different countries, climates and for different building usage and e.g. the setting of national or regional energy performance requirements.

Although from European perspective the main objective was and is to support the implementation of the EPBD, also from a European **strategic perspective** a cooperation with ISO is vital. The rest of the world will by-pass the European approach if they are not pro-actively kept involved. The current starting position with respect to the cooperation is excellent: most of the core EPB standards are already combined EN ISO standards and the key experts on the EPB standards in CEN are also active at the relevant levels in ISO.

2.4 Goal IV: to ensure the overall consistency and uniform quality

Overall consistency and uniform quality assurance needs to be assured.

This concerns a variety of different aspects:

- More digitalized standards (in conjunction with CEN and ISO "SMART" initiatives), in particular: to make the EPB standards that are involved in the overall EPB calculation software ready (see 3.3)
- Having an open source overall EPB calculation software tool for verification and demonstration of the uniform quality and overall interoperability.
- Having an up-to-date common template for all EPB (notably: calculation) standards.
- Having an overall coherent set of national ("Annex B") choices
- Guaranteed overall consistency (e.g. unambiguous mutual links), coming out of the digitalization and verification software.

Having a Quality Assurance Group operational, to (thoroughly) check each draft standard in terms of compliance with the common rules for all EPB standards and to check overall consistency.

3 Activities

3.1 Activity 1: upgrade the technical content

Technical content that needs to be upgraded or added[6]:

- Improve the coordination with product standards to ensure that the required product data are available. This may require coordination with the relevant product standard committees to ensure that the needs of system performance assessments are considered in defining product properties. This is critical for energy performance calculation of buildings and digitalization (digital twins).
- Check and improve or clarify assessment boundaries and perimeters (e.g. on-site, nearby, distant) and terms and definitions such as total and (non-)renewable primary energy, final

[6] Subject to further structuring, refinement and review

energy, ambient energy, etc., for an effective, physically responsible, equal and unambiguous implementation of the revised EPBD in Europe in practice.

- In this respect: also consider the (high level) interactions with other European Directives in the energy and GHG emission field, especially EED and RES, as well as the need for a common terminology. Terminology is now fragmented and only slowly converging, see the use of "final energy" in the EED, the distinction in origin of renewable energy in the RES, etc.
- Ensure that BAC functions (EN ISO 52120-1) are identified and implemented in the EPB standards on needs and systems, and vice versa. BAC functions cover all practical control options.
- Make the coverage of the various services (Heating, Cooling, Ventilation, etc..) more uniform and integrated.
- To further detail the hourly calculation procedures, in particular regarding the interactions between the various elements of the EPB assessment. Make the standards ready for sub-hourly time intervals in the future (to match the time intervals used for electricity and controls and to enable digital twins). (Sub-)hourly calculations are essential for e.g. a realistic assessment of IEQ, impact of energy storage and grid interaction.
  Note that for monthly methods , a reference hourly method is needed anyway to generate monthly correlation factors.
- Add electric energy storage and the evaluation of the possible strategies for interaction with the grid and with bidirectional car (dis)charging.
- Improve the use of thermal storage systems locally but also in connection with thermal grids.
- Fill specific lacunas in technologies (e.g. electric storage, people transport in buildings, waste water heat recovery, hydrophore installations, waste water pumps, energy use by control systems)
- Upgrade output information and reports, for energy, IEQ, design and verification purpose, more specifically:
    - Upgrade overall and partial performance indicators for EP and IEQ Requirements and benchmarking.
    - Upgrade output for EP Certificates.
    - Identify and present relevant output for design purpose.
    - Identify partial performance indicators to be used for (e.g. technical building systems) monitoring purpose (see e.g. new requirements of EPBD in Europe about monitoring efficiency of products).
- Upgrade specifically all key EPB standards based on feedback from the users (2017-2023)
    - incl.: combined standard for air/water HP and chiller;
    - incl. improved IEQ input data;
    - etc.
- Better understanding gap calculated – measured EP and use added value of having hourly measured data during operation, respecting relevant data protection regulations (e.g. in Europe: GDPR and Data Act).
- Highlighting data and indicators suitable for a measurement and verification plan of the measured energy performance.
- Develop a comprehensive standard for buildings operational rating, to improve understanding of actual energy use and to support recommendations for improvement.

- Pay extra attention to (showing) the impact of nationally chosen EP metrics (normalization, notional building, assumed versus actual systems, coverage versus compensation with renewable sources) on the quality of evaluation of the assessed EP and IEQ.
- Where feasible, enable data-interfacing for life-cycle Global Warming Potential (GWP).
- Make full use of any opportunities that coupling with Building Information Models (BIM) can offer, utilizing the more detailed input information that may automatically be available, notably on geometrical / constructional details.
- Explore the development of software validation procedures including acceptance criteria, to provide an opening for the use of other -validated- software (partial or as a whole).

Coherent set of national choices

To provide flexibility in the application of the set of EPB standards, clearly identified options and national data are assumed to be necessary due to differences in climate, culture and building tradition, building typologies, policy and legal frameworks.

The harmonized procedures in the EPB standards need to be separated from the national or regional options (choices). This has been achieved by the "Annex A/Annex B" approach.

This approach needs to be rationalized:

- The kind and number of choices shall be further rationalized.
- On the other hand there need to be enough choices to remain or become inclusive for a variety of climates, not only in Europe.
- The template of the choices needs to be improved for better understanding and wider usability
- Instead of the current default national choices in each Annex B of each individual EPB standard, a consistent overall set (or a few sets) of ("default") national choices for the set of EPB standards as a whole needs to be made, to facilitate regulatory implementation of the EPB standards, to stimulate further harmonization and to enable intercomparison.

3.2 Activity 2: complete the transition to global (EN ISO) standards

In particular in the subset of technical building systems, the set of EPB standards at global level is still far from complete. This is due to lack of resources in the past and due to a progressive interest in the holistic approach.

For strengthening and consolidation of the global relevance, the following **activities** should be noted as well:

- Get non-European experts interested in reviewing methodologies currently available in European only standards, with the goal of elaborating International (ISO) standards.
- Promote the active participation of developing countries for which our work should also be valid (inclusiveness) and ensure that it is usable and affordable, by providing a open source software tool (see chapter 2.1).

3.3 Activity 3: upgrade from "software proof" to "software ready"

The current EPB standards (calculation modules) are already 'software proof', in the sense that they contain unambiguous calculation procedures, tested and demonstrated in a spreadsheet[7], with a complete overview of input and output data to check the overall consistency.

However, there are a wide variety of non-numeric parameters that are defined and specified in various EPB standards that also need to be consistent for the whole set (e.g. type of building, space and user, type of objects, chosen submethod, control, …). These have to be made explicit and uniquely identified to enable an overall cross check and to make the standards software ready.

The various kinds of input data need to categorized, e.g. distinguishing between project specific data (location, building, spaces, components, products, …), input from other EPB standards and national parameters.

Example case calculations, using the spreadsheets or equivalent tools[8], need to be updated, including stress tests on the individual EPB standards.

The set of EPB standards does not yet describe the logical calculation order of the different modules (lighting, DHW, etc.). Describing these connections and interactions in an explicit manner (including iterative steps where needed) is necessary to make the set of EPB standards absolutely univocal, and to allow for uniform software development.

To merge specific EPB standards, where possible from the perspective of coherency of scope and usage, could lead to a lower number of standards with less duplications and interactions and easier to use.

A Quality Assurance Group needs to be established to (thoroughly) check each draft standard in terms of compliance with the common rules for all EPB standards and to check overall consistency.

3.4 Activity 4: develop overall reference software tool

An open source software tool is essential to verify the uniform quality and overall interoperability of the set of EPB standards and as a spin-off for certification of commercial software, also to increase the global relevance.

Also regarding the use of the EPB standards the biggest problem is the lack of an overall EPB calculation software tool according to these standards.

For the development of a software tool there are a few aspects:

- Which EPB standards are (most) relevant to be taken into account? See 4.1.3
- What is needed to upgrade these standards from "software proof" to "software ready"? This question is linked to the ISO and CEN SMART Programmes that aim at digitalization of the standards, and to the issue of the overall quality of the set. See 2.4 and 3.3.

Such a tool will also be a basis for tools with a wider application:

- To lower the high threshold for using the EPB standards.

[7] https://epb.center/support/documents/?title=&group=3
[8] See https://epb.center/support/case-studies/

- To increase the awareness and interest in the set of EPB standards, starting with the educational institutes, etc.[9]
- To use the tool as the basis for the national application; to use a tool where the user interface is added to include the typical national (or regional) choices as allowed in the EPB standards….

4 Workplan, in case of (adequate) resources

4.1 Prioritization

4.1.1 General

All EPB standards have to be upgraded to the same level at the same time, in order to maintain and reinforce the overall quality and consistency.

Some actions need priority implementation, notably:

- Crucial revisions of specific important errata or lacuna (e.g. in formulas, or calculation specifications).
- Important upgrading with respect to the technical content (due to novelties in the EPBD or otherwise).
- Actions to enable and facilitate the development of an overall reference software tool.
- Establishment of a overall consistent ensemble of all EPB calculations standards.

This concerns in principle all EPB calculation standards.

> NOTE: It should be discussed if in a first phase the improvements could be laid down in the form of provisional working drafts for practical use (to replace the current standards). In a second phase the full standards and supporting documents can be revised (new template, etc.) and all elements of the provisional working drafts can be properly integrated.

However, some EPB standards require specific attention, because of:

- Important upgrading needed with respect to the **technical content** (due to novelties in the EPBD, or otherwise);
- Strong need for the overall EPB calculation **to be prepared for an overall software tool**, to make these easier accessible and usable, while maintaining and further improving the overall quality and consistency. This concerns the main and interacting EPB calculation standards together with the overall pre- and postprocessing standards.

4.1.2 The EPB standards that most urgently need to be significantly upgraded with respect to their technical content

To start with, all EPB standards ([1], [5]) that play a role in the overall and partial EPB calculation need to be reviewed with respect to e.g. the overall consistency, connectivity (mutually and with respect to the product data), overall consistent set of default national (Annex B) choices and software readiness, as discussed in chapter 3.

[9] Open access to standards is also highly desirable for the fast and wide roll-out, acceptance and implementation of the standards and for getting researchers, students and teachers at academic or higher education institutes involved.

As a first step towards a more detailed analysis, the following table presents a few examples of EPB standards that will probably be identified for the most urgently need to be significantly upgraded with respect to their technical content:

EPB standard	**A few examples of actions** *(as first step towards a more detailed analysis)*
EN ISO 52000-1: overarching EPB standards with the common terms and definitions, overall energy balance and interaction with the grid	To review terms and definitions, for effective and unambiguous implementation of revised EPBD in practice and to promote conversion with other directives. To include energy storage To include procedure and profiles for smart (dis-)charging of electric vehicles or other electric storage capabilities.
EN ISO 52003-1: Overall energy performance indicators, requirements and ratings	To review the list and specification of indicators, requirements and ratings in the context of the revised EPBD and its instruments (EP certificate, renovation passport. IEQ, …)
ISO 17772-1 and EN 16798-1(or successors) on indoor environment input parameters:	To cover all IEQ aspects, with an emphasis on thermal comfort indicators and IAQ.
EN ISO 52016-1 on energy needs for heating and cooling and indoor temperatures	To unambiguously specify the interaction with other EPB standards (systems, ventilation) To integrate thermal comfort indicators (from ISO 17772-1 or EN 16798-1 or successors)
EN 16798-7 on air flow rates	To specify the interaction with the energy need calculation
EN 16798-5-1 on ventilation systems	To improve connection with product data
EN 16798-9 on cooling systems – general	To merge with EN 15316-1 (on hydronic heating and cooling systems - general)
EN ISO 52018-1 on indicators for partial EPB requirements (thermal balance and fabric)	To review needs for specific information for EP certificates
EN 15316-4-2 (or successor): on heat pump systems	To extend with chillers and simultaneous heating and cooling (taking over from EN 16798-13) To improve the link with product data
EN xxx on waste water heat recovery (WWHR)	Add a new module for this technology
EN ISO 52120-1: on BAC and building management	To make the links to and inside the system standards more concrete

4.1.3 The core of EPB standards to be made software ready

Not each EPB standard contains EPB calculation procedures.

EPB standards cover the following **themes**:

1) (EPB) Calculation procedures (core or other)
2) EPB pre-processing (indoor and outdoor conditions)
3) EPB post-processing (EP indicators, requirements or ratings)
4) (EPB) Measurement procedures
5) Building, system or component design procedures
6) Inspection procedures
7) Certification procedures
8) Other

Also different **typical users** can be recognized:

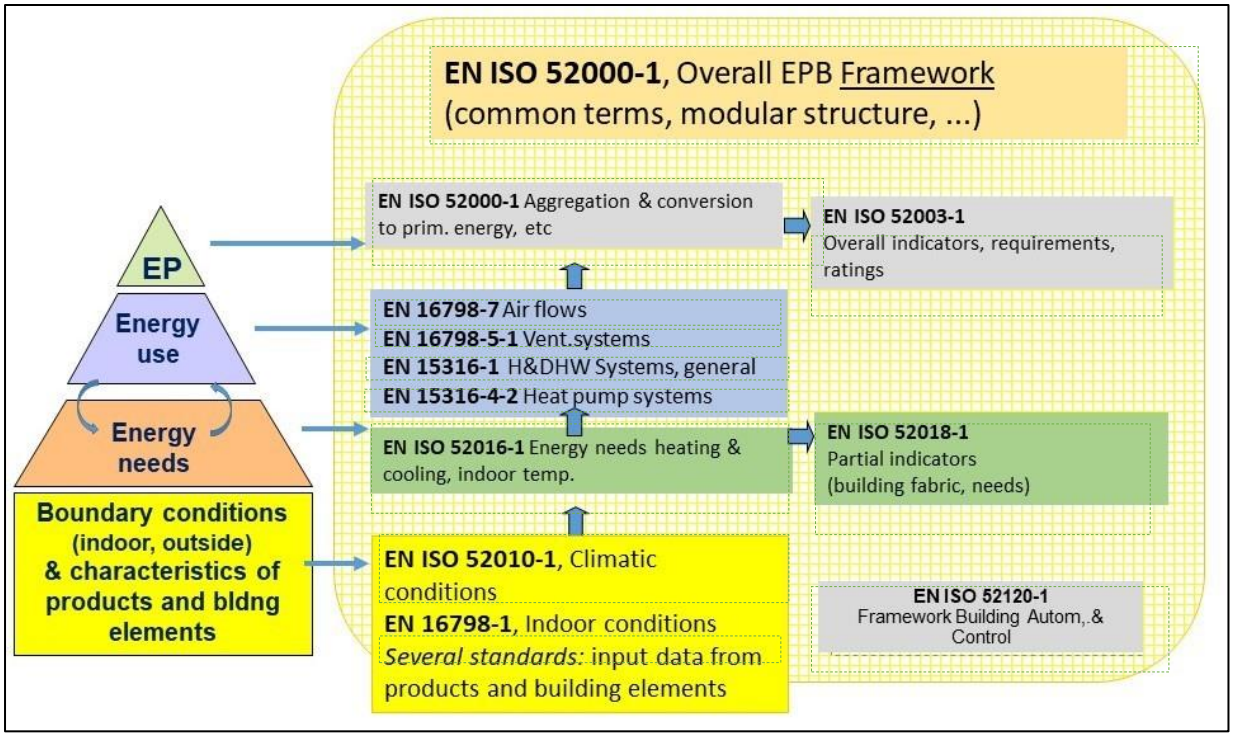
a) Regulator
b) EPB assessor
c) Designer
d) Product/component manufacturer or supplier
e) (EPB) standard writers (incl. reference procedures)
f) Other

All EPB calculation related standards (covering themes 1, 2 and 3) need to be made "software ready". The number of EPB standards under themes 1, 2 and 3 is about 37.

However, about 12 of these concern the assessment of properties of building or system elements that are usually invariable and therefore pre-calculated.

From the remaining 25 EPB standards that are important for the integrated overall software development, about 10 standards form the core of the EPB calculation including pre- and postprocessing and have a strong dynamic (hourly) interaction.

The diagram below shows this core set, with the comment that 'behind' the 4 system related standards that are listed under Energy Use, there are about 15 other EPB calculation standards describing specific elements of technical building systems.



4.2 Organization

4.2.1 Preparation

As explained in the Introduction, this document has been prepared by a Task Group of CEN/TC 371 and the ISO Joint Advisory Group on the ISO 52000 family of standards, following rounds of discussions within the coordinating EPB teams in CEN and ISO.

4.2.2 One project, two phases

In case there are adequate resources to carry out the activities, a project can be set up. For the overall management of such a project two phases seem necessary, within the project:

Phase 1: General and overarching (1-2 years)

Upgrading of the overall framework (technical, editorial, organizational) is essential, before each individual EPB standard can be updated.

This requires a significant amount of work and time (including discussions, communication, pilots, …), so this can only be done as part of a project with adequate resources and with the means to prepare subcontracting for phase 2.

But also work needs to be done on specific revisions of the technical content that cannot wait until the whole set has been upgraded. So, the anticipated work under phase 1 comprises:

- Work out detailed plan for phase 2, taking into account that the standards should not be revised too often.
- Set up and execute pilots on making the standards software ready.
- Set up the quality assurance group.
- Update the common quality rules for all EPB standards where necessary.

- Make inventory which EPB standards can be merged, while keeping coherence of scope and usage.
- Make urgent revisions on individual EPB standards, on the basis of the stakeholders review and revised EPBD in Europe.
- Prepare a first draft of a overall consistent set of default national ("Annex B") choices.
- Define the set-up and technical and organizational requirements for the software development.
- Make inventory of bottlenecks in the availability of product data required for EPB assessment.
- Explore validation procedures for opening up for use of other validated software

Phase 2: Whole set (2-3 years for the core activities)

- The main part of the work, based on the detailed plan worked out in phase 1.

4.2.3 Role EPB Center

Since 2017, the EPB Center plays a crucial role as international platform for information and guidance on the set of EPB standards.

In 2018, the European Commission awarded a three years' service contract for the EPB Center to be the platform to support the uptake of the Energy Performance of Buildings standards: by providing services such as tailored information, technical assistance and capacity building services for involved stakeholders. At the end of this contract, the EPB Center had developed into the Core Service Center for information and technical support on the use of the set of EPB standards.

The mission remains to focus on the international harmonized set of EPB assessment methods and their implementation at national and regional levels. The EPB Center is dedicated to provide stakeholders and interested parties with technical support for the implementation and dissemination of information on the set of EPB standards at national and regional level. While providing this support the EPB Center also aim to assist with formulating needs in order to further develop and improve this set of EPB standards.

The EPB Center experts have all been working since many years, individually and as a team, on the development of the set of EPB standards and related activities, including the implementation at national level.

Consequently, the EPB Center is well-equipped and prepared for the overall project management to coordinate a project team of experts that will support the CEN and ISO working groups and committees in the preparation/revision of the draft standards and technical reports, in the common quality and consistency requirements, in the formulation of the organizational and technical requirements for the software development, etc.

4.3 Costs and benefits

Execution of the workplan, to upgrade the technical content, to achieve software readiness and to develop a reference software tool, requires **significant efforts** and, as a consequence, **significant resources**.

Significant efforts are needed for:

- Important upgrading of specific technical content, to respond to the stakeholders review, to support the implementation of the revised EPBD in Europe and to respond to new technological developments and challenges.
- To specify the connections and interactions between the EPB calculation standards in an explicit manner to enable an unambiguous calculation process.
- To provide intensive support to the software development team.
- Digitalization of the standards. This investment will pay off in the end.
- Mutual consultations to achieve maximum added value for and from -and compatibility with- e.g. product data, and specifically for Europe: compatibility with Levels, Taxonomy, Sustainability, EPB certificates and Renovation passport.
- To complete the transition to global (EN ISO) standards.
- To develop an open source operational software tool to test and demonstrate the interoperability of the set.

  There will be a trade-off between the software development and making the standards software ready.

However, the **benefits will be enormous**: executing the plan will yield a high quality, transparent, reliable and consensus based methodology that will significantly contribute to optimized overall energy performance, indoor environment quality and reduced carbon emissions in buildings and districts. It will be ready-to-use in a regulatory context and significantly promote transparency and reliability and boost market confidence:

- The upgraded set of EPB standards will facilitate the development of more energy-efficient buildings worldwide. By incorporating the latest technological advancements, best practices, and scientific research, the standards will help optimize overall energy performance and reduce carbon emissions. It will account for advancements in renewable energy, smart technologies including grid interaction and building automation systems and other innovations to ensure that buildings remain adaptable, resilient, and capable of meeting future energy demands.
- It will eliminate discrepancies and promote a level playing field, fostering fair competition and ensuring that all buildings meet high-quality energy performance standards, while respecting national or regional differences in climate and policy choices. It will help countries with less financial resources to develop the same high quality and effective EP regulations as others.
- It will boost market confidence by providing fully documented, consensus based, clear, transparent and reliable guidelines for energy performance assessments. Standardized methodologies and metrics will enable accurate comparisons between buildings, facilitating informed decision-making for regulators, investors, developers and occupants. This increased transparency will foster trust and drive investments and innovations in the green building sector.

4.4 Cooperation with adjacent or overlapping standardization areas

Important adjacent standardization areas are (see also CEN/DTS 16628 & 16629, [3], [4]):

- Assessment of **product data as input** for specific EPB standards:
  - CEN:
    - Sector Forum on Construction
    - CEN/TC 088 Thermal insulating materials and products
    - All relevant ISO and CEN committees providing test methods for building components and services included in the EPB assessment

EXAMPLE CEN/TC 312 Thermal solar systems, CEN/TC 113 Heat pumps and air conditioning units

  - ISO:ISO/TC 59 Buildings and civil engineering works, ISO/TC 86, Refrigeration and Air-conditioning.

- Assessment of **carbon footprint or sustainability** of a building or the built environment, using **output** of the set of EPB standards as input:
  - CEN: TC 350 Sustainability of construction works
  - ISO: ISO/TC 59/SC 17 Sustainability in buildings and civil engineering works

NOTE In general, for this purpose, all data needed for life-cycle greenhouse gas (GHG) emissions (such as: amount, thickness, length, are, weight, density) have to be available for all products dealt with in the EPB calculation. This includes heat pumps and it's refrigerants, pumps, etc. Many of these are not needed for the EPB assessment.

- **Energy managemen**t:
  - CEN/CENELEC: CEN/CLC/TC 14 - Energy management, energy audits, energy savings
  - CENELEC: CLC/TC 205 Home and Building Electronic Systems (HBES)
  - ISO: ISO/TC 301 Energy management and energy savings

- Building Information Modelling (**BIM**):
  - CEN: CEN/TC 442 Building Information Modelling
  - ISO: ISO/TC 59/SC 13 Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM)

In most of these areas the work is done in collaboration between CEN and ISO.

Cooperation between these committees shall aim to increase the relevance of the set of EPB standards. The technical bodies shall do their best to achieve awareness and recognition of the set of EPB standards.

4.5 Communication plan

The ISO 52000 family is a strong brand mark, provided that the high level of quality for each standard in the set is safeguarded, also for future developments (see also CEN/DTS 16628 & 16629, [3], [4]).

In order to maximize the relevance and impact, the set of EPB standards, and in particular the ISO 52000 family, needs to be continuously promoted externally. The set of EPB standards, and in particular the ISO 52000 family, should be promoted externally at a regular basis and at special occasions.

For instance in case of publication of a new or revised EPB standard, in case of related international policy changes or events the following options are available:

- the CEN and ISO communication and marketing department;

- conference and journal papers;

— the public part of the relevant CEN and ISO committee websites;

— the website of the EPB Center.

The coordinating CEN and ISO committees should serve as the CEN and ISO focal points for interfacing with Energy Performance of Buildings bodies from the United Nations Economic Commission for Europe (UNECE), and other recognized organizations, including consortia.

A detailed communication plan needs to be prepared.

Bibliography

[1] EPB Center website
General: https://epb.center/
Overview of EPB standards & technical reports, tools and presentations:
https://epb.center/support/documents/

[2] Mandate M/480: Mandate to CEN, CENELEC and ETSI for the elaboration and adoption of standards for a methodology calculating the integrated energy performance of buildings and promoting the energy efficiency of buildings, in accordance with the terms set in the recast of the Directive on the energy performance of buildings (2010/31/EU), December 14, 2010

[3] CEN/DTS 16628:2024, Energy Performance of Buildings - Basic Principles for the set of EPB standards, 2024, in preparation (to supersede CEN/TS 16628:2014)

[4] CEN/DTS 16629:2024, Energy Performance of Buildings - Detailed Technical Rules for the set of EPB standards, 2024, in preparation (to supersede CEN/TS 16629:2014)

[5] Dick van Dijk and Jaap Hogeling, *Overview of the set of EPB standards, including all numbers of the ISO 52000 family*, February 21, 2024 (or later update).
Available as N document in the relevant CEN and ISO committees

[6] ISO/TC 205/AG1 and CEN/TC 371 TG on Systematic Review and EPBD revision, *Informal guidance document on the Systematic Review (SR)of EPB standards published in 2017*, July 12, 2022
Available as N document in the relevant CEN and ISO committees

[7] European Energy Performance of Buildings Directive (EPBD).
https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/energy-performance-buildings-directive_en#revised-energy-performance-of-buildings-directive