Report on the contribution to standardization v2

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DELIVERABLE D7.12 Report on the contribution to standardization v2

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v	Author	Date	Brief Description
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1.4	Aitor Aragón, All Authors	14.07.2023	Updated information based on input from partners
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2.0	Aitor Aragón	25.08.2023	Final version of D7.12

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Executive Summary

Two of the main results of D^2EPC are related with standardisation:

- The **creation of a permanent standardisation working group** dealing with operational energy performance: CEN/TC 371/WG 5, *Energy performance of buildings. Operational rating of energy performance of buildings*. See 3.3.3.
- The **drafting of a European Standard** dealing with operational energy performance: *Energy Performance of Buildings. Operational rating. Requirements for assessing operational rating* (WI=00371012). See 3.3.4.

In addition, the standardisation system has been used to gather information about *state of the art* in industry in relation with energy assessment and digital models applied to buildings (see 3.1), and to have a peer-review of the results from relevant stakeholders.

D^2EPC has a strategy to continue with the standardisation activities (the WG and the drafting of the European standard) once the project is finalised (see 3.3.5 and 3.3.6).

As a result of these activities, D^2EPC has been nominated for the **Standards+Innovation Awards 2023** of CEN/CENELEC, in the category **Project award** in June, 2023. See clause 4 for more information.

This deliverable summarises the work made during these years to achieve the goals established by the project and also proposes the steps ahead to complete some of the tasks (like the European Standard) which will require some additional years to be completed.

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List of Acronyms and Abbreviations

Term	Description
BAC	Building Automation and Control
BIM	Building Information Modelling
CD	International Committee Draft (stage in ISO)
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardisation
CIB	Committee Internal Ballot (internal ballot in a standardisation technical body, i.e. TC or SC)
CWA	CEN Workshop Agreement (document issued by CEN)
DHW	Domestic Hot Water
DIS	Draft International Standard (stage in ISO)
EN	European Standard issued by CEN and/or CENELEC
EPB	Energy Performance of Buildings
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performance Certificate
ESO	European Standardisation Organizations
ESS	European Standardisation System
FDIS	Final Draft of an International Standard (stage in ISO)
FprEN	Final Draft of a European Standard (stage in CEN)
GIS	Geographic Information System
H&C	Heating and Cooling

IEC	International Electrotechnical Commission; and International standard issued by IEC
ISO	International Organization for Standardization; and International standard issued by ISO
IWA	International Workshop Agreement (type of standardisation document in ISO)
LCA	Life Cycle Assessment
NSB	National Standardisation Body
NWI	New Work Item
PAS	Publicly Available Specification (type of standardisation document in ISO)
prEN	Draft of a European Standard (in CEN and CENELEC)
SC	Subcommittee
TC	Technical Committee
TR	Technical Report
TS	Technical Specification
UNE	Spanish Association for Standardization; and Spanish standard issued by UNE
WD	Working Draft
WG	Working Group
WI	Work Item (stage in which a standardisation document is registered and the drafting starts)

1 Introduction

1.1 Scope and objectives of the deliverable

This deliverable explains the work developed within D^2EPC regarding contributions to the standardisation system and in particular Task 7.3, in order to facilitate and promote the acceptance and utilisation of the project results.

The dissemination in European and International standardisation committees was considered a primary objective, to make available the information generated by the project to industry (manufacturers, construction companies, etc.), architects/planners, facility managers, public administrations/authorities and the end users of the building.

The standardisation system has been used as:

a) a source of information, including in-force standards applicable to D^2EPC;
b) a source of feedback and peer-review of the research; and
c) a vector for dissemination of the project results.

D7.4 "Report on the contribution to standardization v1" [19] presented:

1. A description of the standardisation system at European and international level, including its relationship with EU legislation such as the EPBD.
2. The *state of the art* for Energy Performance Certificates, identifying the relevant standardisation documents, projects and committees.
3. The identified options to contribute to the standardisation system with D^2EPC results.
4. The work made until M24.
5. Proposals to continue working within the standardisation system until M36.

This deliverable D7.12 is the update of D7.4 (i.e. v2) and focuses on the work developed until the end of the project (M36) but also contains the actions taken to ensure the success of one of the main D^2EPC results: a European Standard on operational rating of buildings.

1.2 Structure of the deliverable

This deliverable contains a summarised information of the standardisation system and its relationship with the EPBD (clause 2). A more detailed information can be found in D7.4 [19] .

The results of this task T7.3 are summarised in clause 3, which contains a brief explanation of the strategy followed (a description of the methodology to develop the strategy can be found in D7.4) and the actual participation in standardisation committees. In particular, the creation of a permanent WG within CEN/TC 371 to develop a European standard for operational energy performance rating.

1.3 Relation with other tasks and deliverables

Task 6.1 "Updating of current standards towards dynamic EPCs", led by ASI, has a strong relation with T7.3. Coordination with that task has been crucial for the results of T7.3.

The first draft of the European standard sent to CEN/TC 371/WG 5 (see 3.3.4) has been based on the results of the technical tasks of D^2EPC.

2 The standardisation system

2.1 Content of D7.4

D7.4 "Report on the contribution to standardization v1" [19] contains the following information, which in general will not be *repeated*, to make a more useful document:

1. Description of the standardisation system
2. European standardisation bodies
3. International standardisation bodies
4. Cooperation between European and international standardisation bodies
5. National standardisation bodies
6. Standardisation documents
7. Standardisation and EU regulations
8. Standardisation and the EPBD

2.2 Standardisation and the EPBD

2.2.1 EPBD published standards

In December 2010, the European Commission approved the Mandate M/480 (see reference [7]) 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 Directive 2010/31/EU. The previous Mandate M/343 produced the first generation of EPBD standards, published in 2007-2008.

The set standards published defined a clear and comprehensive:

- field of application (i.e. scope);
- specification of the input data, also indicating the source of the data if this is the output calculated according to an other standard;
- specification of the 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;
- structure, with a common format, including a systematic, hierarchic and procedural description of options, input/output variables and relations with other standards.

The standards are categorized based on the technical systems covered, in particular the following modules:

- **M1** Overarching standards, containing calculation procedures
- **M2** Building level (indoor and outdoor conditions)
- **M3** Heating
- **M4** Cooling
- **M5** Ventilation
- **M6** Humidification
- **M7** Dehumidification
- **M8** Domestic hot water
- **M9** Lighting
- **M10** Building automation and control (BAC)

- **M11** Electricity production
- **M12** Transport
- **M13** Appliances and other equipment

The following figure provides a detailed overview of EPB standards, i.e., those directly used for the overall EPB assessment by calculation and those containing EP calculation, pre-processing procedures or post-processing procedures.

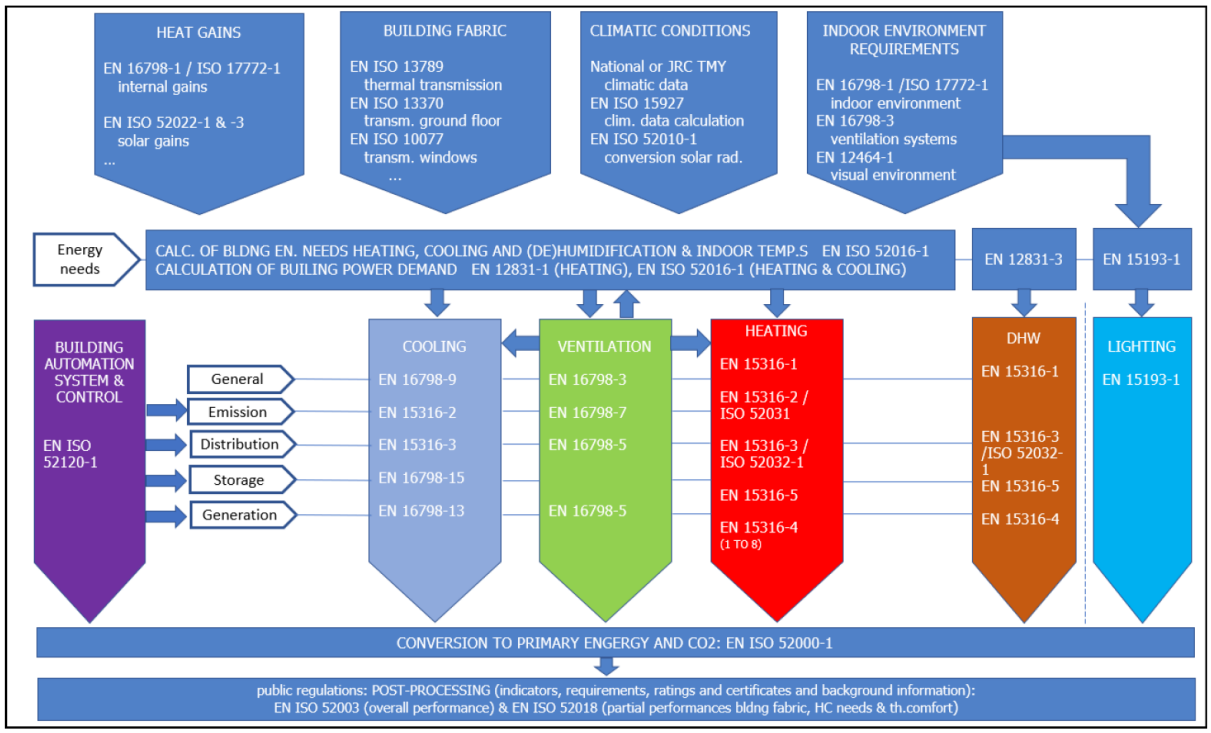

Figure 1. Overview of EPB standards needed for the overall EPB assessment by calculation. Source: [18]

The list of standards supporting the EPBD were identified in table 4 of D7.4 [19], to allow the use of these documents within D^2EPC technical tasks.

Table 1. Updated list of European standards linked to the EPBD

Reference	Title
CEN/TS 16628:2014	Energy Performance of Buildings - **Basic Principles for the set of EPB standards**
CEN/TS 16629:2014	Energy Performance of Buildings - **Detailed Technical Rules for the set of EPB-standards**
EN 17423:2020	Energy performance of buildings - Determination and reporting of Primary Energy Factors (PEF) and CO2 emission coefficient - General Principles, Module M1-7

Reference	Title
EN ISO 52000-1:2017	Energy performance of buildings - **Overarching EPB assessment - Part 1: General framework and procedures** (ISO 52000-1:2017)
CEN ISO/TR 52000-2:2017	Energy performance of buildings - Overarching EPB assessment - Part 2: Explanation and justification of ISO 52000-1 (ISO/TR 52000-2:2017)
CEN ISO/TR 52003-2:2017	Energy performance of buildings - Indicators, requirements, ratings and certificates - Part 2: Explanation and justification of ISO 52003-1 (ISO/TR 52003-2:2017)
CEN ISO/TR 52010-2:2017	Energy performance of buildings - External climatic conditions - Part 2: Explanation and justification of ISO 52010-1 (ISO/TR 52010-2:2017)
CEN ISO/TR 52016-2:2017	Energy performance of buildings - Energy needs for heating and cooling, internal temperatures and sensible and latent heat loads - Part 2: Explanation and justification of ISO 52016-1 and ISO 52017-1 (ISO/TR 52016-2:2017)
CEN ISO/TR 52018-2:2017	Energy performance of buildings - Indicators for partial EPB requirements related to thermal energy balance and fabric features - Part 2: Explanation and justification of ISO 52018-1 (ISO/TR 52018-2:2017)
CEN ISO/TR 52019-2:2017	Energy performance of buildings - Hygrothermal performance of building components and building elements - Part 2: Explanation and justification (ISO/TR 52019-2:2017)
CEN ISO/TR 52022-2:2017	Energy performance of buildings - Thermal, solar and daylight properties of building components and elements - Part 2: Explanation and justification (ISO/TR 52022-2:2017)
EN ISO 10077-1:2017	Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 1: General (ISO 10077-1:2017, Corrected version 2020-02)
EN ISO 10077-2:2017	Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 2: Numerical method for frames (ISO 10077-2:2017)
EN ISO 10211:2017	Thermal bridges in building construction - Heat flows and surface temperatures - Detailed calculations (ISO 10211:2017)
EN ISO 12631:2017	Thermal performance of curtain walling - Calculation of thermal transmittance (ISO 12631:2017)
EN ISO 13370:2017	Thermal performance of buildings - Heat transfer via the ground - Calculation methods (ISO 13370:2017)
EN ISO 13786:2017	Thermal performance of building components - Dynamic thermal characteristics - Calculation methods (ISO 13786:2017, Corrected version 2018-03)
EN ISO 13789:2017	Thermal performance of buildings - Transmission and ventilation heat transfer coefficients - Calculation method (ISO 13789:2017)
EN ISO 14683:2017	Thermal bridges in building construction - Linear thermal transmittance - Simplified methods and default values (ISO 14683:2017)

Reference	Title
EN ISO 52003-1:2017	Energy performance of buildings - Indicators, requirements, ratings and certificates - Part 1: General aspects and application to the overall energy performance (ISO 52003-1:2017)
EN ISO 52010-1:2017	Energy performance of buildings - External climatic conditions - Part 1: Conversion of climatic data for energy calculations (ISO 52010-1:2017)
EN ISO 52016-1:2017	Energy performance of buildings - Energy needs for heating and cooling, internal temperatures and sensible and latent heat loads - Part 1: Calculation procedures (ISO 52016-1:2017)
EN ISO 52017-1:2017	Energy performance of buildings - Sensible and latent heat loads and internal temperatures - Part 1: Generic calculation procedures (ISO 52017-1:2017)
EN ISO 52018-1:2017	Energy performance of buildings - Indicators for partial EPB requirements related to thermal energy balance and fabric features - Part 1: Overview of options (ISO 52018-1:2017)
EN ISO 52022-1:2017	Energy performance of buildings - Thermal, solar and daylight properties of building components and elements - Part 1: Simplified calculation method of the solar and daylight characteristics for solar protection devices combined with glazing (ISO 52022-1:2017)
EN ISO 52022-3:2017	Energy performance of buildings - Thermal, solar and daylight properties of building components and elements - Part 3: Detailed calculation method of the solar and daylight characteristics for solar protection devices combined with glazing (ISO 52022-3:2017)
EN ISO 6946:2017	Building components and building elements - Thermal resistance and thermal transmittance - Calculation methods (ISO 6946:2017, Corrected version 2021-12)
EN 12831-1:2017	Energy performance of buildings - Method for calculation of the design heat load - Part 1: Space heating load, Module M3-3
EN 12831-3:2017	Energy performance of buildings - Method for calculation of the design heat load - Part 3: Domestic hot water systems heat load and characterisation of needs, Module M8-2, M8-3
EN 15316-4-1:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-1: Space heating and DHW generation systems, combustion systems (boilers, biomass), Module M3-8-1, M8-8-1
EN 15316-4-4:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-4: Heat generation systems, building-integrated cogeneration systems, Module M8-3-4, M8-8-4, M8-11-4
EN 15316-4-5:2017	Energy performance of buildings - Method for 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
EN 15378-3:2017	Energy performance of buildings - Heating and DHW systems in buildings - Part 3: Measured energy performance, Module M3-10, M8-10

Reference	Title
EN 15316-4-2:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-2: Space heating generation systems, heat pump systems, Module M3-8-2, M8-8-2
EN 15459-1:2017	Energy performance of buildings - Economic evaluation procedure for energy systems in buildings - Part 1: Calculation procedures, Module M1-14
EN 15316-1:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 1: General and Energy performance expression, Module M3-1, M3-4, M3-9, M8-1, M8-4
EN 15316-2:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 2: Space emission systems (heating and cooling), Module M3-5, M4-5
EN 15316-3:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 3: Space distribution systems (DHW, heating and cooling), Module M3-6, M4-6, M8-6
EN 15316-4-8:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-8: Space heating generation systems, air heating and overhead radiant heating systems, including stoves (local), Module M3-8-8
EN 15316-5:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 5: Space heating and DHW storage systems (not cooling), Module M3-7, M8-7
EN 15378-1:2017	Energy performance of buildings - Heating systems and DHW in buildings - Part 1: Inspection of boilers, heating systems and DHW, Module M3-11, M8-11
CEN/TR 15316-6-7:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 6-7: Explanation and justification of EN 15316-4-4, Module M8-3-4, M8-8-4, M8-11-4
CEN/TR 15316-6-9:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 6-9: Explanation and justification of EN 15316-4-8, Module M3-8-8
CEN/TR 15459-2:2017	Energy performance of buildings - Economic evaluation procedure for energy systems in buildings - Part 2: Explanation and justification of EN 15459-1, Module M1-14
CEN/TR 15378-2:2017	Energy performance of buildings - Heating systems and DHW in buildings - Part 2: Explanation and justification of EN 15378-1, Module M3-11 and M8-11
CEN/TR 12831-2:2017	Energy performance of buildings - Method for calculation of the design heat load - Part 2: Explanation and justification of EN 12831-1, Module M3-3
CEN/TR 12831-4:2017	Energy performance of buildings - Method for calculation of the design heat load - Part 4: Explanation and justification of EN 12831-3, Module M8-2, M8-3

Reference	Title
CEN/TR 15316-6-1:2017	Energy performance of buildings- Method for calculation of system energy requirements and system efficiencies - Part 6-1: Explanation and justification of EN 15316-1, Module M3-1, M3-4, M3-9, M8-1, M8-4
CEN/TR 15378-4:2017	Energy performance of buildings - Heating systems and DHW in buildings - Part 4: Explanation and justification of EN 15378-3, Module M3-10, M8-10
CEN/TR 15316-6-5:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 6-5: Explanation and justification of EN 15316-4-2, Module M3-8
CEN/TR 15316-6-6:2017	Energy performance of buildings - Method for calculation of system energy performance and system efficiencies - Part 6-6: Explanation and justification of EN 15316-4-3, Module M3-8-3, M8-8-3
CEN/TR 15316-6-8:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 6-8: Explanation and justification of EN 15316-4-5 (District heating and cooling), Module M3-8-5, M4-8-5, M8-8-5, M11-8-5
CEN/TR 15316-6-10:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 6-10: Explanation and justification of EN 15316-5, Module M3-7, M8-7
CEN/TR 15316-6-2:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 6-2: Explanation and justification of EN 15316-2, Module M3-5, M4-5
CEN/TR 15316-6-3:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 6-3: Explanation and justification of 15316-3, Module M3-6, M4-6, M8-6
CEN/TR 15316-6-4:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 6-4: Explanation and justification of EN 15316-4-1, Module M3-8-1, M8-8-1
prEN 12831-1 rev	Energy performance of buildings - Method for calculation of the design heat load - Part 1: Space heating load, Module M3-3
prEN 15316-5 rev	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 5: Space heating and DHW storage systems (not cooling), Module M3-7, M8-7
prCEN/TR 15316-6-10 rev	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 6-10: Explanation and justification of EN 15316-5, Module M3-7, M8-7
prEN 12831-3 rev	Energy performance of buildings - Method for calculation of the design heat load - Part 3: Domestic hot water systems heat load and characterisation of needs, Module M8-2, M8-3
EN 15316-4-2:2017/AC:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-2: Space heating generation systems, heat pump systems, Module M3-8-2, M8-8-2

Reference	Title
CEN/TR 15500-2:2016	Energy Performance of Buildings - Control for heating, ventilating and air-conditioning applications â€" Part 2: Accompanying TR prEN 15500-1:2015 - Modules M3-5,M4-5,M5-5
EN 16946-1:2017	Energy Performance of Buildings - Inspection of Automation, Controls and Technical Building Management - Part 1: Module M10-11
EN 15500-1:2017	Energy Performance of Buildings - Control for heating, ventilating and air conditioning applications - Part 1: Electronic individual zone control equipment - Modules M3-5, M4-5, M5-5
CEN/TR 16946-2:2016	Energy Performance of Buildings - Inspection of Building Automation, Controls and Technical Building Management - Part 2: Accompanying TR prEN 16946-1:2015 - Modules M10-11
EN ISO 52120-1:**2022**	Energy performance of buildings - Contribution of building automation, controls and building management - Part 1: General framework and procedures (ISO 52120-1:2021, Corrected version 2022-09)
CEN ISO/TR 52120-2:**2022**	Energy performance of buildings - Contribution of building automation, controls and building management - Part 2: Explanation and justification of ISO 52120-1 (ISO/TR 52120-2:2021)
CEN ISO/TR 52127-2:2021	Energy performance of buildings - Building automation, controls and building management - Part 2: Explanation and justification of ISO 52127-1 (ISO/TR 52127-2:2021)
EN 12098-3:**2022**	Energy performance of buildings - Controls for heating systems - Part 3: Control equipment for electrical heating systems - Modules M3-5,6,7,8
EN 12098-1:**2022**	Energy performance of buildings - Controls for heating systems - Part 1: Control equipment for hot water heating systems - Modules M3-5, 6, 7, 8
CEN/TR 12098-6:2022	Energy performance of buildings - Controls for heating systems - Part 6: Accompanying TR EN 12098-1:2022 - Modules M3-5,6,7,8
CEN/TR 12098-7:2022	Energy performance of buildings - Controls for heating systems - Part 7: Accompanying TR EN 12098-3:2022 - Modules M3-5,6,7,8
EN 12831-1:2017	Energy performance of buildings - Method for calculation of the design heat load - Part 1: Space heating load, Module M3-3
EN 12831-3:2017	Energy performance of buildings - Method for calculation of the design heat load - Part 3: Domestic hot water systems heat load and characterisation of needs, Module M8-2, M8-3
EN 15316-4-1:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-1: Space heating and DHW generation systems, combustion systems (boilers, biomass), Module M3-8-1, M8-8-1
EN 15316-4-4:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-4: Heat generation systems, building-integrated cogeneration systems, Module M8-3-4, M8-8-4, M8-11-4

Reference	Title
EN 15316-4-5:2017	Energy performance of buildings - Method for 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
EN 15378-3:2017	Energy performance of buildings - Heating and DHW systems in buildings - Part 3: Measured energy performance, Module M3-10, M8-10
EN 15316-4-2:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-2: Space heating generation systems, heat pump systems, Module M3-8-2, M8-8-2
EN 15459-1:2017	Energy performance of buildings - Economic evaluation procedure for energy systems in buildings - Part 1: Calculation procedures, Module M1-14
EN 15316-1:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 1: General and Energy performance expression, Module M3-1, M3-4, M3-9, M8-1, M8-4
EN 15316-2:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 2: Space emission systems (heating and cooling), Module M3-5, M4-5
EN 15316-3:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 3: Space distribution systems (DHW, heating and cooling), Module M3-6, M4-6, M8-6
EN 15316-4-8:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-8: Space heating generation systems, air heating and overhead radiant heating systems, including stoves (local), Module M3-8-8
EN 15316-5:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 5: Space heating and DHW storage systems (not cooling), Module M3-7, M8-7
EN 15378-1:2017	Energy performance of buildings - Heating systems and DHW in buildings - Part 1: Inspection of boilers, heating systems and DHW, Module M3-11, M8-11
CEN/TR 15316-6-7:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 6-7: Explanation and justification of EN 15316-4-4, Module M8-3-4, M8-8-4, M8-11-4
CEN/TR 15316-6-9:2017	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 6-9: Explanation and justification of EN 15316-4-8, Module M3-8-8
CEN/TR 15459-2:2017	Energy performance of buildings - Economic evaluation procedure for energy systems in buildings - Part 2: Explanation and justification of EN 15459-1, Module M1-14
CEN/TR 15378-2:2017	Energy performance of buildings - Heating systems and DHW in buildings - Part 2: Explanation and justification of EN 15378-1, Module M3-11 and M8-11

Figure 2 below provides an overview of the key EPB standards and how they relate.

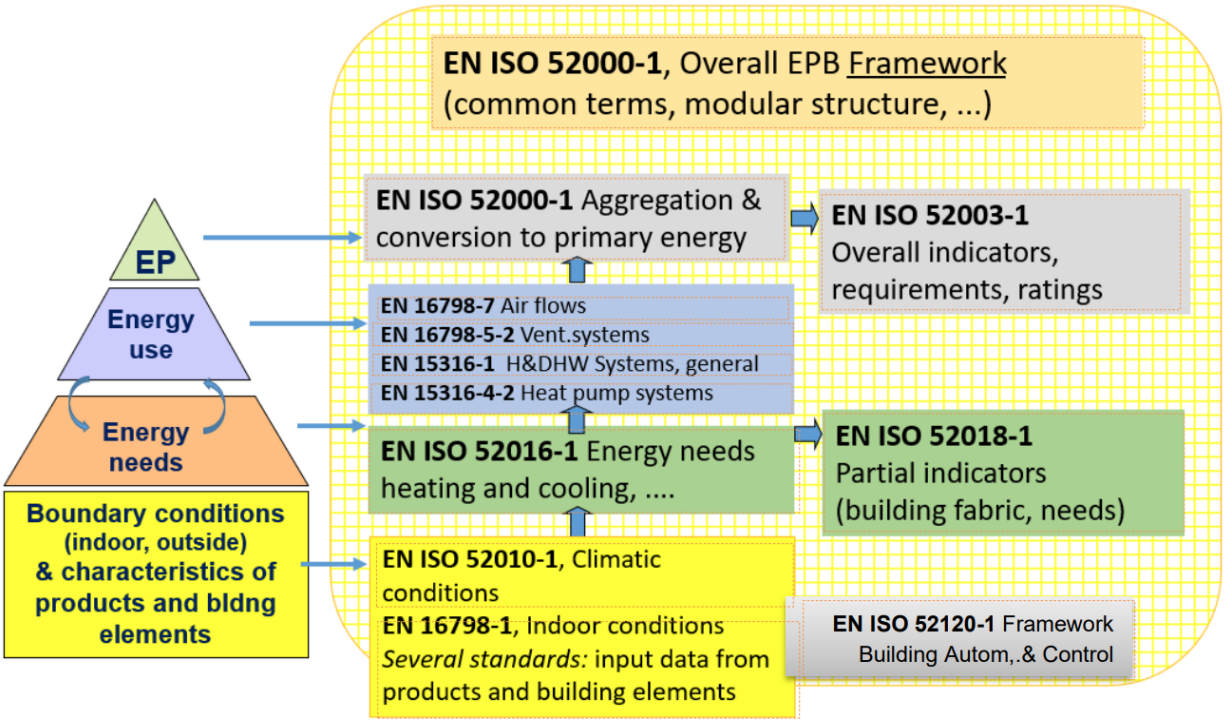

Figure 2. Key EPB standards needed for the overall EPB assessment by calculation. Source: [18]

Some of the EPB standards allow the definition of certain parameters or criteria in national annexes, which provide flexibility with respect to specific national or regional choices. The harmonized procedures in the EPB standards, defined at european level, need to be separated from the national or regional options (choices). There are two annexes:

- Annex A (normative): mandatory (empty) framework template for choices and input data and references to other EPB standards
- Annex B (informative): framework template of Annex A completed with one set of voluntary default choices and input data and references to other EPB standards.

Each NSB, or the relevant national or regional authorities, has the possibility to add or include a National Annex to the EPB standard. As an example, in Spain an annex to be used with the Buildings Techincal Code was published as "Common general framework for the calculation of EPB"[1]. It describes Spain´s national calculation methodology and provides *choices* for the following standards: EN ISO 52000-1, EN ISO 52003-1, EN ISO 52010-1, ISO 52016-1 and EN ISO 52018-1.

2.2.2 EPBD standards under development

The list of ongoing projects standards supporting the EPBD were identified in table 5 of D7.4 [19].

The set of EPBD standards published in 2017 were subject to the systematic review process, which should allow experts to decide whether a standards should be maintained with its current technical content, revised or withdrawn.

A task group with members from:

[1]https://energia.gob.es/desarrollo/EficienciaEnergetica/CertificacionEnergetica/Documentos/Documentos%20informativos/anexo_1_d2018_844_spain_(003).pdf

- CEN/TC 89 Thermal performance of buildings and building components;
- CEN/TC 156 Ventilation for buildings;
- CEN/TC 228 Heating systems and water based cooling systems in buildings;
- CEN/TC 169 Light and lighting;
- CEN/TC 247 Building Automation, Controls and Building Management;
- ISO/TC 163 Thermal performance and energy use in the built environment;
- ISO/TC 163/SC 2 Calculation methods; and
- ISO/TC 205 Building environment design;

in which D^2EPC participated via Aitor Aragón (UNE), made a proposal regarding each standard. In particular, the following question about operational rating, considered relevant for D^2EPC, was included:

Question 4 (operational rating):

> **Consideration:** The set of EPB standards contains only 1 standard on EPB assessment based on measurements (operational rating). This is EN 15387-3, that deals only with heating and domestic hot water systems.
>
> **Question:** is there a need for a more comprehensive EPB standard on overall EPB assessment based on measurements (operational rating) for use in the context of the national or regional building regulations?
>
> **And if so:** is it needed for the prime EP indicator (to check compliance with minimum EP requirements) or only as information for the EP certificate (as information tailored to the actual conditions and use of the building)

T7.3 members reviewed the document and prepared a common reply, to be sent to each national standardisation body. The goal was to highlight the importance of operational EPCs and support the proposal for a new European standard dealing with operational rating. As the result of this consultation was sent to several CEN and ISO technical committes, many experts would the have access to the proposal from D^2EPC.

UNE and CYS sent the following reply to this question:

> *The operational rating is delivered based on the actual performance of the assessed object and results from measurements of the energy consumption of the delivered energy. The operational rating assesses the actual energy performance of a building, during its operational stage, and it is based on the measured performance of the building. Inevitably, the information delivered by the operational rating represents the actual performance of the user, given that it is climate and user corrected, and may constitute an indication of the user behavior. In the same manner as we have buildings with higher and lower energy class, we have more or less conscious building users, with regard to their energy performance. Despite its significance, only twelve EU member states have adopted as of late 2022 the operational rating into their practices. A comparative assessment of the practices followed in the implementation of operational rating in member states, reveals significant deviations (reference to D2EPC project). This requires for actions from the TC 371, towards developing a standard to enable the smooth integration of the operational rating in all member states, to harmonize the conditions under which this assessment scheme is employed, as well as to accelerate its use. The timing for this initiative is ideal, concerning the EU target for installation of 200 million smart meters in all buildings by 2030.*

Other questions relevant for D^2EPC were:

> **Question 9 (digitization, machine readable standards):**

Consideration: in chapter 6 a preliminary outlook is given on the plans for digitization of ISO and CEN standards and how this could become important for the usability and use of the set of EPB standards.

Question: Do you consider it important for the set of EPB calculation standards to become (more) machine readable (with a stronger role for the accompanying technical reports to provide explanation)?

Question 10 (digitization, digitized description of objects):

Consideration: in chapter 6 a preliminary outlook is given on the plans for digitization of ISO and CEN standards and how this could become important for the usability and use of the set of EPB standards.

Question: Do you consider it important for the validation of the set of EPB calculation standards and the conversion into software, that in the future all objects and their (also time varying) properties are described according to data templates and dictionaries that have been developed in the BIM committees ISO/TC 59/SC 13 and CEN/TC 442)?

Question 11 (digitization, software engine):

Consideration: in chapter 6 a preliminary outlook is given on the plans for digitization of ISO and CEN standards and how this could become important for the usability and use of the set of EPB standards.

Question: Do you consider it important for the wide roll-out and implementation of the set of EPB calculation standards, that a common software engine or 'framework' is made available?

The task group assessed possibilities for improvements in the EPBD standards, in particular the inclusion of the latest technological advancements, best practices and scientific research, including improvements in renewable energy, smart technologies, building automation systems, and other innovations to ensure that buildings remain adaptable, resilient, and capable of meeting future energy demands. The following elements will be considered:

- Increase overall consistency between standards and reestructure them to avoid "duplications".
- Check and improve or clarify assessment boundaries and definitions.
- Add overall order of calculations for the various services: DHW, lighting, ventilation, H&C needs, systems & BAC and their interactions and iterations.
- Enabling the use of digital models (BIM and digital twins).
- Make input data ready for enabling LCA calculations.
- Prepare for dynamic primary energy weighting factors, to appreciate optimization of grid interaction
- Prepare an overall consistent set of default national choices, also as reference set for intercomparisons.

Consistency between different EPBD standars is necessary to allow a better understanding of the technical content by different users. In particular, consitency should be ensured in:

- terms, definitions, symbols and subscripts;
- inputs / outputs (no missing data or mismatch of data);
- time span used for the calculations (e.g. annual, seasonal, monthly, hourly);
- conditions of use, for each space category;
- outdoor climatic data;
- subdivision of building spaces.

The ongoing revision of the EPBD into *EPBD IV* will also be a source for revision of current standards. EPBD IV intends to promote the improvement of the energy performance of buildings and the reduction

of greenhouse gas emissions from buildings in the EU, to achieve a **zero-emission building stock by 2050**. The proposal lays down requirements as regards the common general framework for a methodology for calculating the integrated energy performance of buildings and building units, the application of minimum requirements to the energy performance of new buildings and new building units, existing buildings and building units that are subject to major renovation, building envelope elements and technical building systems whenever they are installed, retrofitted, replaced or upgraded.

The list of projects is updated below and includes the project for operational rating proposed by D^2EPC, highlighted in blue.

Table 2. Updated list of European projects linked to the EPBD

Reference	Title
prCEN/TS 16628 rev	Energy Performance of Buildings - **Basic Principles for the set of EPB standards**
prCEN/TS 16629 rev	Energy Performance of Buildings - **Detailed Technical Rules for the set of EPB-standards**
WI=00371012	Energy Performance of Buildings **- Operational rating - Requirements for assessing Operational rating**
prEN 17887-1	Thermal performance of buildings - In situ testing of completed buildings - Part 1: Data collection for aggregate heat loss test
prEN 17887-2	Thermal performance of buildings - In situ testing of completed buildings - Part 2: Steady-state data analysis for aggregate heat loss test
prEN 17888-1	Thermal performance of buildings - In situ testing of building test structures - Part 1: Data collection for aggregate heat loss test
prEN 17888-2	Thermal performance of buildings - In situ testing of building test structures - Part 2: Steady-state data analysis for aggregate heat loss test
prCEN/TR 16798-4	Energy performance of buildings - Ventilation for buildings - Part 4: Interpretation of the requirements in EN 16798- 3 - For non-residential buildings - Performance requirements for ventilation and room-conditioning systems (Modules M5-1, M5-4)
prEN 16798-3	Energy performance of buildings - Ventilation for buildings - Part 3: For non-residential buildings - Performance requirements for ventilation and room-conditioning systems (Modules M5-1, M5-4)
prCEN/TR 15316-6-10	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 6-10: Explanation and justification of EN 15316-5, Module M3-7, M8-7
prEN 12831-1	Energy performance of buildings - Method for calculation of the design heat load - Part 1: Space heating load, Module M3-3
prEN 12831-3	Energy performance of buildings - Method for calculation of the design heat load - Part 3: Domestic hot water systems heat load and characterisation of needs, Module M8-2, M8-3
prEN 15316-5	Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 5: Space heating and DHW storage systems (not cooling), Module M3-7, M8-7

Other EPBD standards will be reviewed once a new Mandate (Standardisation Request) is approved by the European Commission and accepted by the ESOs.

3 Contribution to standardisation activities

3.1 Indentification of standardisation documents and groups

D7.4 "Report on the contribution to standardization v1" [19] identified standardisation groups and documents for the following topics:

- **Energy efficiency** assessment.
- **Building products** relevant for energy efficiency (refrigeration, heating appliances, insultation, etc.).
- **Digitization**: BIM, digital twins, IoT, GIS or energy-related information exchange, among other technologies.
- **Environmental** assessment: sustainability assessment and building level, evaluation of the environmental performance of construction products and buildings, etc.

T7.3 studied the standardisation documents under development and the relevant groups and defined the actions to be taken based on the following criteria:

a) Relevance for the project: relation with D^2EPC results.
b) Relation between particular standards or projects and D^2EPC activities.
c) Ongoing projects and meetings.
d) Potencial impact.

From the list of technical groups included in subclause 3.2 of [19], the following were selected.

CEN/TC 371 Energy performance of buildings

- WG 1 EPBD Standards group
- WG 5 Operational rating (created with a proposal from D^2EPC)

ISO/TC 184 Automation systems and integration

- AG 2 Digital Twin.

ISO/TC 205 Building environment design

- WG 2 Design of energy-efficient buildings.
- WG 3 Building Automation and Control System (BACS) Design.

ISO/TC 211 Geographic information/Geomatics

ISO/TC 268 Sustainable cities and communities

- WG 2 Integration and interaction framework for smart community infrastructures
- WG 4 Data exchange and sharing for smart community infrastructures

CEN/CLC/JTC 14 Energy management and energy efficiency in the framework of energy transition

- WG 1 Energy audits

CEN/TC 156 Ventilation for buildings

- WG 21 Energy performance calculation of ventilation and cooling systems

CEN/TC 228 Heating systems and water-based cooling systems in buildings

- CEN/TC 228/WG 1 General performance requirements of heating systems and sub-systems in buildings
- CEN/TC 228/WG 4 Calculation methods and system performance and evaluation

CEN/TC 247 Building Automation, Controls and Building Management

- WG 4 Open System Data Transmission
- WG 6 Electronic control equipment for HVAC applications, integrated room automation, controls and management systems

CEN/TC 350 Sustainability of construction works

- WG 1 Environmental performance of buildings

ISO/TC 59 Buildings and civil engineering works

- SC 13 Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM):
  - JWG 14 GIS-BIM interoperability.
  - WG 8 Information delivery manual.
  - WG 11 Product data for building services systems model.
- SC 17 Sustainability in buildings and civil engineering works:
  - WG 4 Environmental performance of buildings.

CEN/TC 442 Building Information Modelling (BIM)

- WG 9 Digital twins in the built environment

3.2 Strategy for the participation

Clause 4 of [19] explained the options to participate in the standardisation activities, as also outlined in CEN-CENELEC Guide 23 [20], which explains how to address research and innovation in European standardization activities. A summary:

Via technical committees (TC), subcommittees (SC) or working groups (WG), with the following options:

1) Participation of D^2EPC partners as experts or guests in current standardization working groups, or establishment of a Project Liaison with the Technical Committee for the participation as consortium in their works. This option was used for **CEN/TC 442/WG 9** covering digital twins in the built environment.
2) Proposal (and if relevant, leadership) of modifications to existing EN standards or TS (technical specifications) or TR (technical reports).
3) Proposal (and if relevant, leadership) of the elaboration of new standards. This option was used for **CEN/TC 371/WG 5**, created based on a proposal from D^2EPC.
4) Submission of proposals for future consideration in standardization works.

CEN/CENELEC Workshop Agreement (CWA)

CWAs are the most widely used option for research and innovation projects. It is *designed for them*, due the *fast* drafting and decision process.

A new group (Workshop) is created and the document is approved directly by its members. Relevant TC are informed and any organization can participate.

The resulting document (Workshop Agreements) are published by the CEN/CENELEC and in some cases can be made freely available to the public following the prepayment policy of CEN and CENELEC.

Clause 5 of [19] made a proposal for the development of the standardisation activities based on the following criteria:

a) Relevance for the project: relation with D^2EPC results and forecast needs

b) Relation between each particular standard or project under development in the TC, or intended to be revised soon, and D^2EPC activities and results.
c) Scheduled meetings of the relevant TC, SC or WG.
d) Potential impact for D^2EPC if the inclusion of D^2EPC results is achieved.

Based on the assessment, several actions were proposed.

3.3 CEN/TC 371

3.3.1 Approach

CEN/TC 371 *Energy performance of buildings* is considered the most relevant committee for D^2EPC, as it deals with the *standardization related to the energy performance of buildings (EPB)*.

This TC:

I. develops standards at overarching EPB level; and by
II. coordinates the activities of related and specialized TCs that are responsible for the development of EPB standards within their scope, thereby ensuring harmonisation.

CEN/TC 371 produced and maintains documents providing guidance and requirements to be met by EPB standards.

1. Developing standards at overarching EPB level

The scope of EPB consists of the interrelated energy effects of indoor environmental quality, outdoor climate, thermal properties, heating and cooling (H&C) systems, domestic hot water (DHW), ventilation, lighting, (de)humidification, building automation and control, energy sources and connected energy grid, and related environmental and economic impacts, and not of these topics themselves. CEN/TC 371 focusses on systems' standards limited to buildings and the direct environment of the building if it effects the energy performance of that building.

The following specialised TCs are responsible for the development of the specialized standards that together, using a holistic or systematic approach, make up the set of EPB standards. These TCs have the responsibility for subjects on technical issues that belong exclusively to them even if it is an EPB standard. Requirements for indoor environmental quality (IEQ) parameters are fully within the responsibility of the related and specialized CEN/TCs and are not within the scope of this committee.

CEN/TC 371 is coordinated with the TCs listed below, to prevent overlap of work:

- CEN/TC 089 *Thermal performance of buildings and building components*;
- CEN/TC 156 *Ventilation for buildings*;
- CEN/TC 169 *Light and lighting*;
- CEN/TC 228 *Heating systems and water based cooling systems in buildings*;
- CEN/TC 247 *Building automation, control and building management*.

It was considered that coordination with these TCs can be achieved via CEN/TC 371.

The actions agreed were:

1) Participation in CEN/TC 371 plenary meetings.
2) Participation in its WG 1 *EPBD Standards group*.
3) Follow their documentation to use it as feedback for D^2EPC research activities.
4) Provide input based on D^2EPC results for new or ongoing standardisation projects, via standards to be published by CEN/TC 371 or via CEN Workshop Agreements (CWA).

3.3.2 Proposal for a CWA on operational EPCs

UNE assessed the latest documents issued by CEN/TC 371 to gather information about ongoing activities and shared the information with some D^2EPC partners.

UNE participated in CEN/TC 371 plenary meeting (December, 2021). During the meeting, the revision of the EPBD[2] (because of the European Green Deal and the renovation wave) was covered. Based on the information gathered, UNE and FRC presented, in February 2022, a proposal to develop a CEN Workshop Agreement for operational EPCs. The proposal draft project was developed by Paris A. Fokaides (FRC) and Aitor Aragón (UNE) and was included in D7.4.

In March 2022, Paris A. Fokaides and Aitor Aragón had a meeting with CEN/TC 371 Chairman and Secretariat, to assess possibilities for the development of the CWA. It was agreed that a European Standard or a Technical Specification, developed within CEN/TC 371, was the preferred option.

Even if the elaboration of a European Standard will go beyond the project lifetime of D^2EPC, it was recognized that on a long term this is beneficial for creating a sustainable impact of the project. Once the European Standard, to which D^2EPC has significantly contributed, is developed it has to be implemented by the national CEN members as national standard and any conflicting national standard has to be withdrawn. With this mechanism there will be European wide coherent requirements for operational EPCs with results that are comparable in terms of calculation, rating and presentation/communication to users.

3.3.3 Proposal for a new WG on operational EPCs

Based on that feedback indicated above, a presentation of the proposal to CEN/TC 371 was made during its plenary meeting (March, 2022). The minutes reflect the following in the item "**Presentation of D^2EPC**":

> *Aragón presents the EU project **D^2EPC** aiming at setting the grounds for the next generation of dynamic Energy Performance Certificates for buildings, see N 756.*
>
> *Socal agrees that it is a very important step to relate the design of the building to the actual measurements. The current standard on measurement should be extended. We should standardize how to identify this. If you want to compare measured with calculated, then the measurements should be calibrated, and we need far more information, sensors and other hardware. Also, we need to extract the data that we need, the information needs to be presentable.*
>
> *CEN/TC 247 agrees that these plans are useful, to show the direction. Napar states that the building should not be looked at as a "consumer" but as interactive system where technology can serve to balance with the grid. The technology is not the problem, there are already BACS that can offer real time information on health and comfort, but not all building information can be measured yet. The interaction with the utility is another challenge. Country by country there is a request for different information by national regulation. So, to make a standard for measurement it is nice to have, but not all technology is available. If you miss one variable, you will not have a complete picture.*
>
> *This is accepted by Socal, Napar, Hogeling, Engel, Speelman, Moghtader.*
>
> ***Action:** Aragón to organize an informal meeting about the D2EPC project, be circulated by the TC 371 secretariat. Socal, Napar, Hogeling, Engel, Speelman and Moghtader will join.*

The presentation from D^2EPC was circulated to all members as N756.

[2] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/

As a result of the plenary meeting, UNE convened a dedicated meeting in March, 20th, to assess possibilities for operational EPCs with the members appointed by CEN/TC 371.

After the meeting, **a proposal from D^2EPC for a new working group covering *Operational assessment of buildings energy performance for energy classification purposes*** was circulated within the task group for comments.

The appointed experts from CEN/TC 371 provided feedback, which was assessed by FRC and UNE.

After a revision via email, a final meeting was convened on June, 9th, to approve a proposal for a new working. With the modifications approved during the meeting, the final text was sent to CEN/TC 371 Secretariat the same June, 9th. A summary can be found below:

- **Title:** Operational rating of energy performance of buildings.
- **Scope:** Standardization in the field of the energy assessment of buildings during the use stage (operation), focused on energy use for EPB services.
- **Convenor:** Paris A. Fokaides (FRC).
- **Secretariat:** Aitor Aragón (UNE).

Based on this proposal, a ballot to create the new working group was launched in July, 4th. The deadline was August, 8th.

A T7.3 meeting, dedicated to this potential WG, was convened in July. The scope:

- Gather feedback from D^2EPC members.
- Explain the balloting process in CEN.
- Explain how partners should gather the support of their NSB.
- Explain the process after the ballot, if the WG is approved.

Some partners contacted their national standardisation bodies and/or joined the national mirror committee for CEN/TC 371.

In August, 10th, CEN/TC 371/WG 5 "Operational rating of energy performance of buildings" was approved with 18 positive votes and no negative votes. Some standardisation bodies appointed experts with the ballot and UNE received other requests. Thus, the WG is expected to have an intense activity.

The Secretariat (UNE) launched a poll to define a tentative date for the kick-off meeting in October 2022. Based on the results and the work ahead, the Secretariat and the Convenor (FRC) defined the schedule and drafted a first proposal for standardisation based on D^2EPC results.

CEN/TC 371/WG 5 *kick-off meeting* took place on October, 21st. Eleven experts attended online. A proposal for a new European Standard (New Work Item (NWI) proposal) was presented.

The convenor used a presentation where some elements were highlighted:

- D^2EPC assessed current operational rating methods in Europe and potential gaps in standards. To gather input from other experts in Europe and contribute to the standards, this WG was proposed.
- Operational rating can't replace current rating and should be considered as a complementary tool.
- Currently, there are standards, like EN 15387-3, which includes operational criteria, some topics are missing, and alignment of criteria will also be needed.
- It will be necessary to define the boundaries of the task (scope of the standard) and the indicators to be used to assess the energy efficiency.
- Criteria for a comparison between the operational rating and current EP rating might also considered, including limitations and minimum requirements.
- Normalisation procedures for data should not overlap with those already defined for current rating.

- Guidance should be provided to link the monitoring and a potential assessment based on the data gathered.

During the meeting, the following process to achieve a NWI proposal was agreed:

i. Experts will have a week to send additional comments to the NWI proposal.
ii. With the feedback from the meeting and these comments, the Convenor and the Secretariat will prepare a new version of the NWI, to be circulated for additional comments.
iii. If no major comments are received, the draft will be sent to TC 371 Secretariat, to be balloted as a NWI proposal.
iv. If major comments are received, WG 5 will meet on 2022-12-13.

As no major comments to the proposal were received, the meeting scheduled for December 2022 was considered as not necessary and UNE sent the draft to CEN/TC 371 for activation of the standard.

3.3.4 Development of the EN standard on operational EPCs until M36

A meeting to start the development of the standard on operational energy performance of buildings was convened at DIN (*Deutsches Institut für Normung*), in Berlin, on February, 13th, 2023. Thirteen experts attend *face-to-face* and two experts attended online.

Paris A. Fokaides made a presentation. The interaction with other technical committees dealing with indoor air, elements and systems installe in buildings or automation controls, was discussed and assessed. A link with CEN/TC 442 "BIM" was also considered.

After the meeting, a first draft was circulated to experts.

The first draft was discussed during the meeting convened at NEN (*Nederlands Normalisatie-instituut*) in Delft, on May, 30th, 2023. Some improvements and criteria were accepted:

- Normative elements (using "shall") and informative elements or recommendations (using "should") shall be clearly separated between normative and informative parts. For EPB standards the convention is to have only normative parts in the standard (except for annex B) and all informative text and background information in an accompanying technical report. For the development of the draft, normative and informative parts can be maintained together. Requirements should be expressed as a list, when possible. At the end of the process the "obligations" and the "recommendations" can be separated within the same document or in a separated deliverable (for example, in a technical report).
- Clauses that reflect the formation of national policies, such as the description of the operational rating reference buildings, will be included in annexes.

Several software developers related with operational EPCs were contacted after the meeting, to inform them about the development of the standard. In addition, it was considered interesting to send information to CEN/TC 247 and CEN/TC 442. The Chair of TC 247 is a member of CEN/TC 371/WG 5 and Aitor Aragón is participating in CEN/TC 442 and is the Secretariat of its WG 9 for digital twins.

CEN/TC 371/WG 5 met again in July, 17th, 2023. Eleven experts attended the meeting. The Convenor explained the modifications and improvements made to the draft and the group analysed the comments received.

It was agreed to have a new full draft for the second half of August and next meeting on September, 4th, 2023. The draft was circulated in August.

3.3.5 Development of the EN standard on operational EPCs after M36

D^2EPC project finalises in August but the European standard for operational energy performance assessment will require between two and three more years. The tentative schedule for the project is:

- Final draft for CEN Enquiry: last quarter of 2023
- CEN Enquiry ballot: first quarter of 2024
- Resolution of comments received during the CEN Enquiry: second and third quarter of 2024.
- Final draft for Formal Vote: forth quarter or 2024.
- Formal Vote ballot: first quarter of 2025.
- Standards available for CEN members: second or third quarter of 2025
- Standard published by CEN members in their official language (or ratified): forth quarter or 2025 or first quarter of 2026.

In case of a negative result in one of the ballots or a huge number of comments, an extended period might be required.

Once the standard is published, Member states can define additional requirements, based on national or regional needs, in terms of:

- Calculation
- Rating
- Presentation to users

Industry and service providers will benefit from solutions based on the data assessment, providing digital EPC services, defining improvements in the buildings based on the operational results, creating apps, etc.

3.3.6 Workshop for the handover of standardisation activities

To have the resources needed to complete important task, D^2EPC will coordinate the standardisation activities with two *active sister* projects:

- SmartLivingEPC - End date: 2025-06-30
- Chronicle - End date: 2025-12-30

To make the proper arrangements, **a workshop for the *handover* of the standardisation activities between D^2EPC, SmartLivingEPC and Chronicle is convened for September, 28th**.

During the workshop, the three projects will coordinate the future development of the European standard and allocate the necessary resources for its completion. The tentative agenda is:

- Presentation from D^2EPC. *Representative of D^2EPC.*
- Presentation from SmartLivingEPC. *Representative of SmartLivingEPC.*
- Presentation from Chronicle. *Representative of Chronicle.*
- The European standardisation system and CEN/TC 371/WG 5. Aitor Aragón.
- The proposal for a European standard on operational energy performance assessment. Paris A. Fokaides.

The result of this workshop will be crucial for the proposed European standard.

3.3.7 Other activities within CEN/TC 371

Members of D^2EPC (Paris A. Fokaides, Stavros Koltsios, Dimos Ioannidis and Aitor Aragón) have participated in CEN/TC 731 plenary meetings and/or its WG 1 "EPBD standards group". WG 1 is currently reviing the following technical reports:

- CEN/TS 16628 Energy Performance of Buildings - **Basic Principles for the set of EPB standards**
- CEN/TS 16629 Energy Performance of Buildings - **Detailed Technical Rules for the set of EPB-standards**

In addition, Aitor Aragón from D^2EPC participated in a task group with members from several European and International Committees related with energy efficiency to assess the review of the EPB standards. This task group isssued the document Informal guidance document on the Systematic Review (SR) of EPB standards published in 2017 (CEN/TC 371 - N763). See subclause 2.2.2 for more information.

3.4 Other European technical committees

3.4.1 General

D7.4 [19], clause 5, identified several actions to be developed by D^2EPC. In particular, participation in the future technical report gathering **use cases of digital twins in the built environment** (CEN/TC 442/WG 9) and follow the future standard for **calculation methods of environmental performance of buildings** (CEN/TC 350/WG 1).

All the proposed actions were successful and are explained in the subclauses below.

3.4.2 CEN/TC 442

D^2EPC followed the activities covering BIM and digital twins and, in particular, has participated in several meetings of CEN/TC 442/WG 9 "Digital twins in the built environment". Other relevant working groups were WG 2 "Exchange information" and WG 8 "Competence".

CEN/TC 442 is responsible for the development of standards in the field of structured semantic life-cycle information for the built environment. The committee specify methodologies to define, describe, exchange, monitor, record and securely handle asset data, semantics and processes with links to geospatial and other external data. It focuses on Building Information Modelling (BIM) and recently includes digital twins.

CEN/TC 442/WG 9 is currently developing a Technical Report about "use cases of digital twins in the built environment in Europe". D^2EPC sent two use cases developed during the project:

1. D^2EPC - BIM based DT- nZEB Smarthome DIH (CEN/TC 442/WG 9 – N33).
2. D^2EPC - Mixed-use University building, Nicosia, Cyprus (CEN/TC 442/WG 9 – N34).

WG 9 received 31 use cases including residencial and office buildings, bridges, roads, raiway stations, etc.

A summary of the structured assessment made by WG 9 (applied to all received use cases) can be found in the figure below.

#	DOC	Name	General info	Main use	Description	PHASE	Figure	SotA	Replicatic	Links	Contact
1	33	D2EPC THESS	BUILDING Residential/office	Energy performance	316 m2	Operation	Thassaloniki Thassaloniki	ML, AI	1000	https://www	Dr. Dimosthenis Ioannidis
2	34	D2EPC NICOSIA	BUILDING University	Energy performance	2100 m2	Operation	Nicosia Nicosia2 Nicosia	Dynamic EPC	1000	https://www	Dr. Paris A. Fokaides

Figure 3. Structured assessment of use cases. Source: CEN/TC 442/WG 9

The two use cases have been approved for inclusion in the last draft of the future CEN/TR. The last draft, issued in August while the TS is expected to be published early in 2024.

3.4.3 CEN/TC 350

CEN/TC 350 is responsible for the development of horizontal standardized methods for the assessment of the sustainability aspects of new and existing construction works (buildings and civil engineering works).

The standards drafted by this committee describe a set of coherent methodologies for the assessment of sustainability of construction works covering the assessment of environmental, social and economic performance (aspect and impacts) of buildings and civil engineering works, with a full life cycle approach.

For D^2EPC, the following CEN/TC 350 working groups are highlighted:

- **WG 1 Environmental performance of buildings**
- WG 8 Sustainable refurbishment

The most relevant documents developed in CEN/TC 350 identified in D7.4 [19] were:

- EN 15978:2011 Calculation method for the **assessment of environmental performance of buildings** (CEN/TC 350/WG 1)
- prEN 15978-1 Methodology for the **assessment of the environmental performance of buildings** (CEN/TC 350/WG 1)
- prEN 15941 Data quality for environmental assessment of products and construction works (CEN/TC 350/WG 3)
- EN 15643:2021 Framework for assessment of buildings and civil engineering works (CEN/TC 350/WG 3)
- prEN 17680 Evaluation of the potential for **sustainable refurbishment** of buildings (CEN/TC 350/WG 8)

D^2EPC followed the activities covering sustainability assessment of buildings, in particular the proposed standard **prEN 15978-1**, which should supersede EN 15978:2012 *Sustainability of construction works - Assessment of environmental performance of buildings - Calculation method*. The project contains several improvements in its module B6, *operational energy use*.

It contains the following definition of **operational energy use** , relevant for operational EPCs:

> energy utilised during the use stage for the operation of the building
>
> Note 1 to entry: operational energy use may include energy consumption related to building user activities occurring within the object of assessment

In relation with operational EPCs, main difference between the new project and current published standard is a more detailed defintion of Module B6 (boundary of the operational energy use). prEN 15978-1 divides the Module B6 in three submodules:

- B6.1: energy use of building **integrated** systems or services that are **regulated**.

- B6.2: energy use of building **integrated** systems or services that are **not regulated**.
- B6.3: other energy use related to building user activities, like plug-in appliances.

For prEN 15978-1, "regulated" means energy demand covered by the EU Energy Performance of Buildings Directive (EPBD).

The project also includes **on-site generated energy**, divided in:

- energy used inside the system boundary (self-used part); and
- energy delivered to third parties (exported energy).

A liaison between CEN/TC 350 and CEN/TC 371 has been established.

3.5 Other dissemination activities

3.5.1 CTN-UNE 100

CTN-UNE 100 is the Spanish mirror committee of CEN/TC 371 and other International and European standardisation committees such as:

- CEN/TC 113 Heat pumps and air conditioning units
- CEN/TC 156 Ventilation for buildings
- CEN/TC 228 Heating systems and water based cooling systems in buildings
- CEN/TC 247 Building Automation, Controls and Building Management
- ISO/TC 117 Fans
- ISO/TC 142 Cleaning equipment for air and other gases
- ISO/TC 205 Building environment design

This national committee has a strong relation with D^2EPC scope.

Aitor Aragón (UNE) sent regular updates to the national Secretariat of this committee and made a presentation about the proposal for a new WG on operational energy efficiency assesment during its plenary meeting of 2022.

3.5.2 Presentations to European and National stakeholders

UNE has made presentations about the developments in D^2EPC.

In March 2023, UNE presented CEN/TC 371/WG 5 activities in the **Indata Network**[3] meeting in Córdoba, Spain. The meeting had representatives from the European Commission (DG Growth), the Spanish Ministry for Ecological Transition (MITECO) and the Spanish Ministry in charge of building constructions (MITMA), the German Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR), EPD verification programme operators from countries such as Sweden, Denmark, Germany, Italy, Spain, etc.), research bodies (such as CSIC in Spain), LCA practitioners and other stakeholders.

A summary of the meeting is available (in Spanish) in the website of CSIC (a Spanish State Agency for scientific research and technological development)[4]

[3] https://www.indata.network/

[4] https://www.ietcc.csic.es/noticias/participacion-del-instituto-eduardo-torroja-en-el-workshop-international-indata-workshop-on-harmonization-of-epds-databases/

Figure 4. InData Workshop in Cordoba. March 2023

UNE also made a presentation to the **Spanish Construction Technology Plafform (PTEC)**[5] in May 2023. The presentation was "general" about digitiation applied to the construction sector and one of the topics was energy efficiency and, in particular, the WG proposed by D^2EPC (slides 26 to 28).

[5] https://plataformaptec.es/

4 CEN/CENELEC Standards+Innovation Awards

D^2EPC has been nominated by CYS, Cyprus Organization for Standardisation, **for the Standards+Innovation Awards 2023 of CEN and CENELEC**, in the category **Project award** in June, 2023.

The nomination was supported by the following statement, which is publicly available at https://www.cencenelec.eu/get-involved/research-and-innovation/cen-and-cenelec-activities/s-i-awards/list-of-nominees-2023/:

The current Energy Performance Certificates (EPCs) play a crucial role in assessing the energy efficiency of buildings, primarily relying on the building's design. These certificates adhere to the European standards established by CEN/TC 371 for building-level evaluations. Additionally, various product or systems committees like TC 089, TC 156, TC 169, TC 228, and TC 247 contribute to different aspects of energy performance assessment, such as thermal performance, ventilation, lighting, and heating and cooling systems.

D^2EPC's innovative approach proposes a new generation of EPCs that integrate dynamic sensors and Building Information Modeling (BIM). By leveraging these technologies, D^2EPC enables the creation of a digital twin that accurately represents the building's energy characteristics.

D^2EPC takes a comprehensive perspective by introducing a novel rating system for assessing the energy performance of buildings. This new rating not only considers the energy efficiency aspects but also incorporates indicators related to economic factors, human comfort, and general well-being. By encompassing these broader aspects, D^2EPC aims to provide a more holistic evaluation of a building's energy performance.

Recognizing the significance of operational energy performance, D^2EPC has played a pivotal role in establishing a specialized European working group known as CEN/TC 371/WG 5. This dedicated group focuses on addressing operational energy performance concerns and actively contributes to the advancement of EPCs in this domain.

Through its dynamic approach, integration of sensors and BIM, and emphasis on comprehensive performance indicators, D^2EPC is poised to revolutionize the field of energy performance evaluation for buildings, paving the way for more efficient and sustainable built environments.

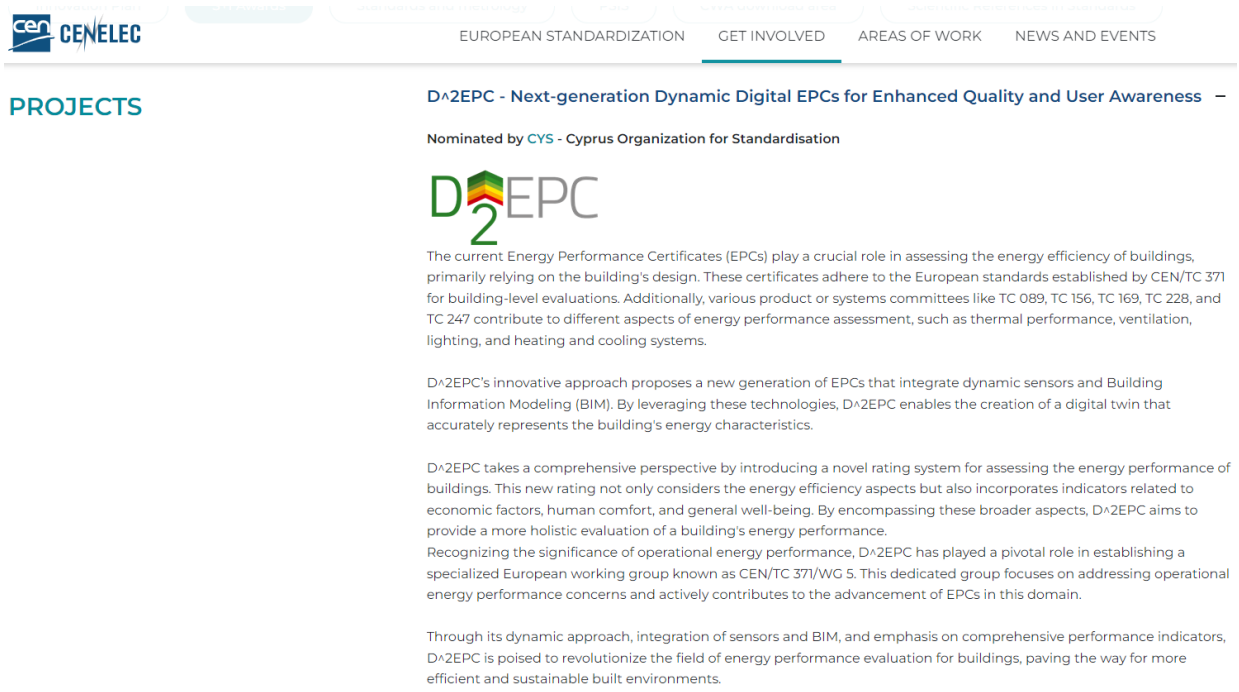

Figure 5. Website of the S+I Awards of CEN/CENELEC

Since CEN/TC 371/WG 5 'Operational rating of energy performance of buildings' was proposed by **D^2EPC** and the secretary of said CEN Working Group is Aitor Aragón from UNE, he was nominated by UNE for the Standards+Innovation Awards 2023 of CEN and CENELEC, in the category **Technical Body Officer** with the following statement:

> *Aitor Aragón stands out for integrating innovative topics and researchers' contributions into his standardization responsibilities as committee manager for Sustainable Construction and Building Information Modelling (BIM) in UNE.*
>
> *He has been responsible for shaping, launching and managing new standardization activities, both at European and national levels, directly related to R&I projects outcomes, such as CEN/TC 442/WG 9 'Digital twins in the built environment' or* ***CEN/TC 371/WG 5 'Operational rating of energy performance of buildings'****.*

The evaluation of the nominees will take place during Q3 2023 and the award ceremony in Q4 2023.

These recognitions are an important result for the dissemination of the works developed by D^2EPC in the standardisation system, in particular the creation of the permanent standardisation working group to develop the first European standard on energy performance rating for buildings.

5 Conclusions

Until M36, task 7.3 successfully performed the main identified actions:

- Assessment of the state of the art to provide input for D^2EPC.
- Identification of working groups and committees, for dissemination of feedback purposes.
- Regular contacts with the main committees or working groups related with the activity and results of D^2EPC.
- Inclusion of aspects of operational EPC in the guidance document for the Systematic Review of the EPB standards.
- Creation of a **new standardisation working group** covering operational rating of energy performance of buildings, with members of D^2EPC acting as Convenor (coordinator) and Secretariat.
- Acceptance of the **project for the first standard on operational energy performance rating for buildings**: *Energy Performance of Buildings — Operational rating — Requirements for assessing Operational rating* (WI=00371012)
- **Drafting** to the standard on operational energy performance rating for buildings (two drafts has been presented to the working group).
- Inclusion of **two pilots of D^2EPC** in the CEN Technical Report covering **use cases of digital twins in Europe** (the TR is still under development; the ballot is expected to start before the end of 2023)

The successful application of the standardisation strategy drafted in D7.4 [19] will have a lasting impact on the building sector in Europe, as CEN/TC 371/WG 5 dealing with operational rating will continue working on the future European standard (see 3.3.5). D^2EPC is also an example of cooperation between research projects, as these standardisation activities will continue due to the cooperation with **SmartLivingEPC** and **Chronicle** (see 3.3.6).

Thus, we can conclude that standardisation has been a particularly useful tool to gather knowledge for D^2EPC and, in particular, to disseminate the results with stakeholders such as energy performance practitioners, manufacturers of products or systems installed in buildings, researchers, public bodies, etc.

6 References

[1] Regulation (EU) No 1025/2012 on European standardisation, amending Council Directives 89/686/EEC and 93/15/EEC and Directives 94/9/EC, 94/25/EC, 95/16/EC, 97/23/EC, 98/34/EC, 2004/22/EC, 2007/23/EC, 2009/23/EC and 2009/105/EC and repealing Council Decision 87/95/EEC and Decision 1673/2006/EC

[2] Directive 2010/31/EU on the energy performance of buildings

[3] Directive 2012/27/EU on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC

[4] Directive (EU) 2018/844 amending Directive 2010/31/EU and Directive 2012/27/EU

[5] Proposal for a Directive on the energy performance of buildings (recast) (COM/2021/802 final)

[6] Regulation (EU) No 305/2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC

[7] 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)

[8] CEN/CENELEC Internal Regulations. Part 1: Organization and Structure (2022)

[9] CEN/CENELEC Internal Regulations. Part 2: Common Rules for Standards Work (2022)

[10] CEN/CENELEC Internal Regulations. Part 3: Principles and rules for the structure and drafting of CEN and CENELEC documents (2019)

[11] CEN/CENELEC Internal Regulations. Part 4: Certification (2018)

[12] CEN/CENELEC Guide 10. Policy on dissemination, sales and copyright of CEN-CENELEC Publications (2017)

[13] CEN/CENELEC Guide 29. A rapid way to standardization. Edition 2 (October 2020)

[14] CEN/CENELEC Guide 30. European Guide on Standards and Regulation - Better regulation through the use of voluntary standards - Guidance for policy makers. Edition 1 (June 2015)

[15] CEN Guide 4: Guide for addressing environmental issues in product standards (2008)

[16] CEN Guide 14: Common policy guidance for addressing standardisation on qualification of professions and personnel (2010)

[17] The Vienna Agreement: CEN Cooperation with ISO. CEN website

[18] Informal guidance document on the Systematic Review (SR) of EPB standards published in 2017. ISO and CEN committee document (May 2022).

[19] D7.4 “Report on the contribution to standardization v1”. D^2EPC

[20] CEN-CENELEC Guide 23: Research Consortium Bridge- Addressing Research and Innovation in European Standardization activities and deliverables (2020)