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PLUG-AND-USE RENOVATION WITH ADAPTABLE LIGHTWEIGHT SYSTEMS

PLURAL

D1.3 CERTIFICATION REQUIREMENTS ACCOUNTING FOR OCCUPANT LEGAL AND PRIVACY MONITORING

Version: 1.0

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Table of contents

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 958218

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 958218

List of figures

List of tables

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 958218

Terms, definitions and abbreviated terms

GA	Grant agreement

1. Publishable summary

PLURAL targets to design validate and demonstrate a palette of versatile, adaptable, scalable, off-site prefabricated plug and play facades accounting for user needs ("Plug-and-Use"- PnU - Kits). In this context of development of innovative constructive solutions, the analysis of the certification framework and associated requirements that will apply to the PLURAL PnU Kits, at the time of their marketing, is a key element to address as far as possible the risk of lack of regulatory technical compliance. To that purpose, in this Deliverable D1.3, the certification schemes potentially applicable to the PnU Kits have been identified and analysed to establish the appropriate certification strategy to facilitate the market penetration of the PLURAL PnU Kits.

The European legislation potentially applicable to the PnU Kits and their components has been mapped and analysed. Then, focussing on the intended use and main feature of each of the PnU Kits, the routes for their certification as construction products has been identified and analysed, also gathering as reference the available harmonised technical specifications related to façade constructive systems under the Construction Products Regulation (CPR) 305/2011. Since one of the main objectives of the PnU Kits is the improvement of the energy efficiency and saving in building renovation, the routes to provide certified sustainability performance of the PnU Kits will also be a key point for the entrance of the PnU Kits into the different markets. The available environmental certifications have been analysed, as well as the legal framework that is being implemented at European level, but it is not in place yet, aiming at anticipating the requirements and procedures that will apply in the near future.

The purpose of the present analysis on the certification schemes and related requirements is a compilation of the relevant technical information with the widest possible approach in order to define the most appropriate certification strategy.

2. Executive summary

PLURAL targets to design validate and demonstrate a palette of versatile, adaptable, scalable, off-site prefabricated plug and play facades accounting for user needs ("Plug-and-Use" - PnU - Kits). For this purpose, PLURAL focuses on three main pillars:

- Assessing different core systems, which couple heating-cooling, ventilation, heat harvesting systems with smart windows, 3D printing, low carbon footprint coating materials and smart control systems towards NZEB status for different European climates and different residential building typologies (<60 kWh/m^2 per year of buildings' total primary energy consumption and >50 kWh/m^2 per year of on-site renewable energy generation).
- Utilizing BIM based big management platform coupled with Decision Support Tool (DST) in order to optimize the component selection and integration, as well as to optimize the PnU Kit design, speed, cost manufacturing and installation (≥ 50% reduction in the time required for deep renovation of e.g. multi-family blocks, 58% reduction in renovation costs through off-site prefabrication lean manufacturing and construction, interactively supported by the BIM based platform and DST)
- Demonstrating the applicability of the PnU Kits by implementing the solutions in three real and three virtual residential buildings evaluating the renovation time and cost reduction, the PnU Kits performance, carbon saving and users' acceptance.

PLURAL will create best practice renovation examples for the residential sector based on innovation and competitiveness, with benefits for the citizens and the environment. It will develop business cases and models for key stakeholders and improves the life cycle based performance standards applied in the building sector.

In this context of development of innovative constructive solutions, the analysis of the certification framework and associated requirements that will apply to the PLURAL PnU Kits, at the time of their marketing, is a key element to address as far as possible the risk of lack of regulatory technical compliance. To that purpose, in this Deliverable D1.3, the certification schemes potentially applicable to the PnU Kits has been identified and analysed to establish the appropriate certification strategy to facilitate the market penetration of the PLURAL PnU Kits.

This research and analysis on certification schemes and requirements have been carried out at different levels:

- Mandatory and voluntary certifications.
- Certifications for the individual components integrated into the PnU Kits as well as for the complete PnU Kit as a whole.
- Certifications applicable at European level and at National level.

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For this purpose, a range of European legislation potentially applicable to the PnU Kits or its components has been analysed in Chapter 5 to identify the requirements for compliance, together with the associated reference standards. As for the individual components integrated into the PnU Kits, the analysis has a double purpose: first, in relation to the manufacturing/assembling and quality control of the PnU Kits production (information on the certifications applicable to the components supplied for their integration into the PnU Kits) and, secondly, related to the final, global certification of the PnU Kits to identify the characteristics of the components that are relevant and can be used in the technical assessment of the PnU Kits.

Regarding the PLURAL PnU Kits as a complete system, the routes to provide certified performance of the PnU Kits as a construction product has been identified and analysed in Chapter 6, under consideration of all the basic requirements established in construction regulations (e.g: Mechanical resistance and stability, Safety in case of fire, Protection against noise or Energy economy and heat retention). The certification of the PnU Kits performance will need to take into account the requirements in the different National building codes, as shown in Chapter 8, so that the technical information provided in the certification can be used to assess and justify at the building project stage the compliance of the PnU Kits with the local regulations. To complete the study of the routes for the PnU Kits as a construction product, the analysis of the available harmonised technical specifications related to façade constructive systems, under the Construction Products Regulation (CPR) 305/2011, has been carried out.

On the other hand, since one of the main objectives of the PnU Kits is the improvement of the energy efficiency and saving in building renovation, the routes to provide certified sustainability performance of the PnU Kits will also be a key point for the entrance of the PnU Kits into the different markets, from a commercial point of view. The available environmental certifications have been deeply analysed in Chapter 7, as well as the legal framework that is being implemented at European level, but it is not in place yet, aiming at anticipating the requirements and procedures that will apply in the near future.

The purpose of the present analysis on the certification schemes and related requirements is a compilation of the relevant technical information with the widest possible approach in order to define the most appropriate certification strategy that will be further and more specifically developed under Task 8.2.

Finally, the Annex to D1.3 contains the outcome of Task 1.4 which describes the legal and privacy monitoring requirements that might be necessary to comply with, in particular at the demonstration countries (Spain, Czech Republic, Greece), during the deep renovation procedures.

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3. Foreword

The PLURAL PnU industrialised Kits are innovative concepts intended for building renovation. In general, national building codes do not explicitly consider such solutions and do not provide the relevant prescriptive rules to justify the technical compliance of the PnU Kits with the regulatory requirements. Innovative construction products and construction systems lack reference product standards against which to characterise and demonstrate their technical performance on the market. In other words, PnU Kits are not standardised products and they will need to be assessed and certified as a constructive product in the framework of the Construction Products Regulation (CPR) 305/2011, following the route of the ETA (European Technical Assessment) for CE marking of non-standardised products. Alternatively, PnU Kits can also be certified by means of a National Approval in those markets of special commercial interest, or as a complement to CE marking for the technical justification of the compliance with National codes. These two certification routes (CE marking according to an ETA or National approvals) are the most adequate ways to introduce on the European market the PnU Kits as whole constructive systems.

PnU Kits, including their integrated components, can be then assessed and certified as constructive products, resulting in the expression of the product performance for the essential characteristics relevant for the intended use, in accordance with the reference harmonised technical specification (hTS) under CPR. Such a hTS (EAD, European Assessment Document) will need to be developed for each of the three PLURAL concepts/PnU kits (SmartWall, HybridWall and ConExWall). In this Deliverable, the available hTS related to façade constructive elements are analysed to establish the basis for the development of the assessment and certification procedures for the PnU Kits (that will be done in Task 8.2).

Regarding the certification of the PLURAL PnU Kits sustainability performance, which is a key element for them taking into account their use in renovation to improve building energy saving and efficiency, the European legislative framework is not yet fully implemented. In this Deliverable, the voluntary certification routes currently most commonly used are described (the so-called ecolabels), as well as the European framework that is being designed and will soon be in place (new CPR, Ecodesign for sustainable products regulation -ESPR- and LEVEL(s)).

The European legislation and certification schemes applicable to the components that will be integrated in the PnU Kits have also been analysed, to identify the relevant requirements that will need to be considered in the technical assessment and certification process of the PnU Kits as constructive systems (both at the level of manufacturing and factory production control, and at the level of performance declaration).

This deliverable is also a compilation and pre-analysis of reference documents which will serve as the basis for the development of assessment and certification procedures specifically developed for PLURAL PnU Kits in Task 8.2.

In must also be understood that certification is mainly linked to a final product to be put on the market and, therefore, it might occur that innovative solutions at the stage of development cannot be fully certified. There must be a high degree of definition for a product to be assessed and certified.

Additionally, due to the purpose of the PnU Kits for use in building renovation, the finally installed constructive system will need to be adjusted to the previously existing building, taking in account the particular characteristics in each case for the PnU system' design and installation. Some ancillary products needed for the PnU Kits installation on site are not necessarily to be part of the PnU Kits that will be assessed and certified (certification must be limited to the PnU Kits integrating the core, essential components that will be part of the prefabricated product as put on the market). Therefore, the compliance with the applicable building code will need to be verified in every project, on the basis of the technical information provided in certification of the PnU Kits as put on the market.

A preliminary evaluation of the regulatory compliance of the PnU systems to be installed in the demo buildings renovation was carried out in the framework of Task 1.2 (see D1.2, Chapter 4). Further development for this technical justification of the suitability of use of the PnU systems to meet regulatory requirements is being made under D2.1 Design of PnU Kits and WP4 Optimisation, in parallel with the final technological development of the PnU Kits. However, this technical justification of regulations compliance shall be separated from a more global, standardised process of constructive products certification.

The next figure shows the structure of chapters of D1.3.

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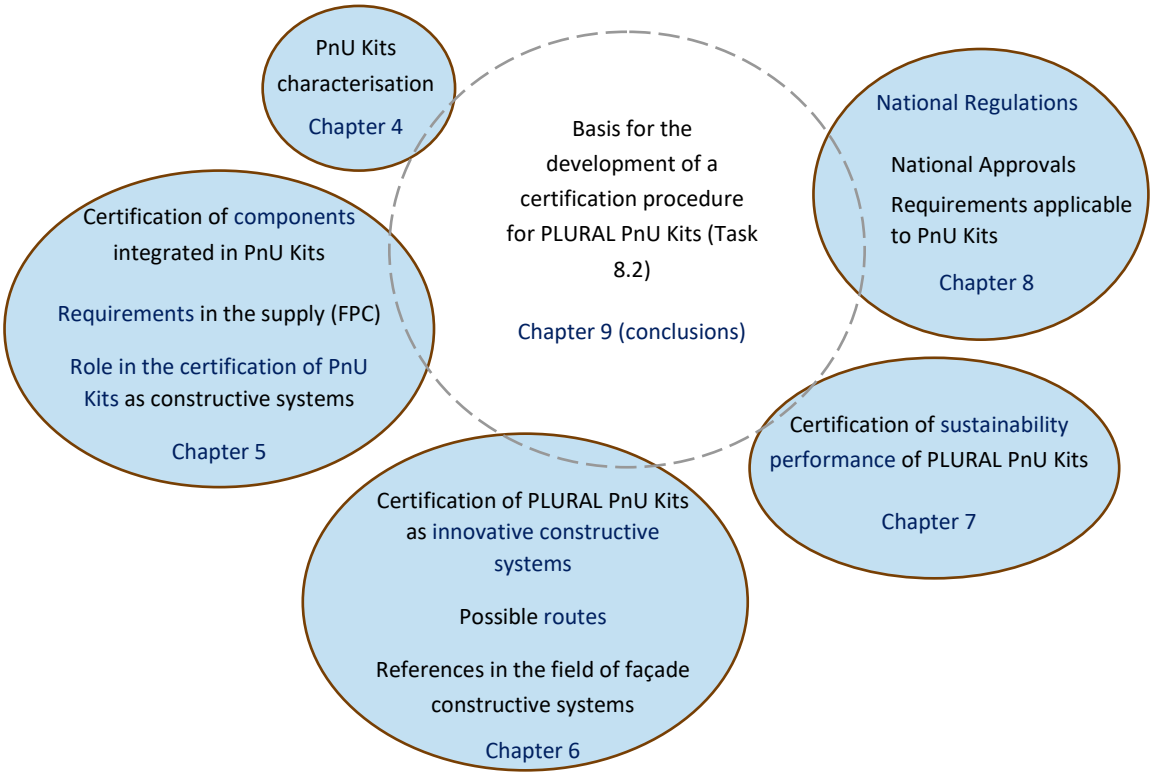

FIGURE 3.1: STRUCTURE OF D1.3

4. PLURAL PnU Kits design

4.1 General

In this chapter, the PLURAL PnU Kits are described, including the integrated components. An initial assessment of the standardisation viability is also given. Finally, some considerations are also given about the use of available certification of commercial products integrated as components into the PnU Kits (subchapter 4.5), as well as considerations on the need of an accurate definition of the constructive systems and their range of variants (subchapter 4.6), in relation to the final certification of the PnU Kits as constructive products.

4.2 SmartWall PnU Kit

The multifunctional wall panel of the "SmartWall" core system was developed in 2019 and combines several technologies including fully prefabricated walls with eco-friendly insulation, slim-type fan coil for heating and cooling, mechanical ventilation, IEQ control system consisting of filters, energy recovery system and batteries, high performance commercial PV panels and heat recovery windows. It can be applied either to the building's exterior as a façade panel, or to the interior as an additional internal component.

FIGURE 4.2-1: INTERNAL AND EXTERNAL SIDE

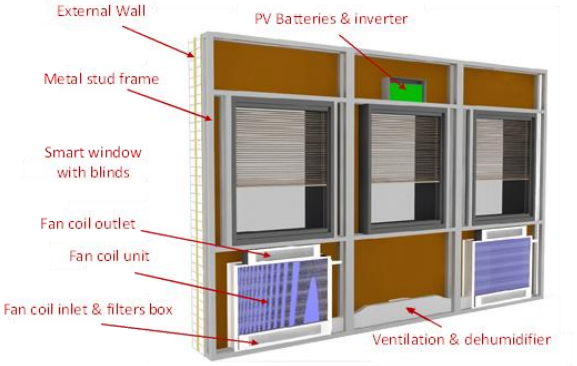

FIGURE 4.2-2: SMARTWALL LAYOUT.

As a Plug and Use panel, "SmartWall" contains flexible pipe and electrical wiring connections that can accommodate the existing or a new heating/cooling system, as well as connections to various electrical services (switches, plugs etc.). Construction materials are selected with respect to the environmental-friendly and high - performance behaviour of the wall. Most elements (98% of the materials, apart from the air filters) forming the "SmartWall" module is eco-friendly, recyclable and non-combustible. The structural

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frame can be composed of several materials such as timber, aluminium, high-performance polymers or even industrial plastics that can be supported from 3D printing technology. The utilization of 120 mm recyclable mineral wool will decrease the wall's U-value to 0.28W/(m^2K). The ventilation system of the "SmartWall" is based on a standard integrated function of modern fan coils, to recycle the air from the interior of the room. However, ventilation is planned to utilize an integrated compact system with heat recovery in order to supply fresh air to the interior through electronically controlled dampers. The air flow and indoor quality can be controlled either manually or automatically via CO_2, temperature and humidity sensors. Furthermore, various combinations of commercial filtration types can be installed in the ventilated unit or the fan coil, depending on the occupants' requirements and the local climatic conditions. In order to further enhance the sustainability of the "SmartWall", the integration of a power energy system with (BI)PV panels and batteries embedded into the wall panel can be applied. The specific core system presents significant advantages for climates with high demand for cooling.

The components integrated into the SmartWall PnU Kit are shown in the next table, together with an initial assessment of their relevance as part of the product to be eventually certified and the viability of their standardisation, taking into account both the available references (which will be compiled and studied in the next chapters) and the need to modify/adjust/select the component according to a defined project/works (thus making more difficult their standardisation and fully certification).

TABLE 1: COMPONENTS OF SMARTWALL PNU KIT AND PRE-ANALYSIS OF THE STANDARDISATION VIABILITY

Component	Core, essential component	Optional, ancillary component	Initial assessment of standardisation viability
Fan coil		X	Standard commercial product
Steel stud frame (RHS)	X		Standard commercial product
Air filter		X	Standard commercial product
Integrated energy storage (batteries)		X	Standard commercial product
PV modules		X	Standard commercial product
Toolbox		X	Customised, innovative product
Multisensor		X	Customised, innovative product
Active fire suppression system		X	Innovative commercial product
Insulation	X		Standard commercial product
Windows	X		Standard commercial product
Windows's blinds		X	Standard commercial product
Cement board	X		Standard commercial product
Gypsum board	X		Standard commercial product
3D printed elements		X	Customised, innovative product
Multifunctional coatings		X	Customised, innovative product
Mechanical fasteners	X		Standard commercial product
Inlet and outlet air grilles	X		Standard commercial product
Antivibration mounts	X		Standard commercial product

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4.3 eAHC PnU Kit- HybridWall

The HybridWall PnU system is a light wall panel with possibility of integration of multiple technologies and cladding materials. The design of the façade is based on the existing components of the Denvelops façade system: the vertical steel lines and connectors, and external cladding, all made of stainless steel. The cladding material has been changed to 1 mm thick aluminium painted from both sided. The system also includes all the components needed to renovate the complete façade, such as thermal insulation, solar shading, windows, PV panels and a ventilation unit. However, the windows and the ventilation unit will be connected with the system only for the transportation and installation, but will be attached directly to the existing wall, as they need to be connected in a stiff way to the building, while the ventilated façade system needs certain flexibility in the fixing.

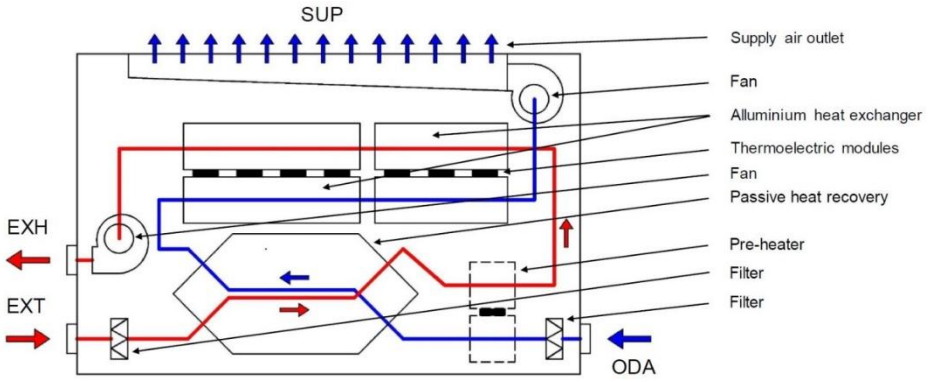

FIGURE 4.3-1: EAHC VENTILATION UNIT

One of its innovative features is the air handling unit (AHU) with an advanced heat/cold recovery system. It combines a patented combination of standard passive heat exchanger in series with active thermoelectric heat exchanger providing the capability of temperature control of supplied air. The active air heat exchanger uses thermoelectric elements to heat up the air in the winter season or cool down the air during the summer. The switching between cooling and heating is simply provided by reversing the current in the thermoelectric modules. The solid-state cooling-heating technology simplifies the AHU and provides a novel solution to be easily integrated in the facade panels. Since there is no compressor circuit, the produced sound from the operation is significantly reduced. eAHC unit is combined with a sensor platform for monitoring and control of Indoor Air Quality.

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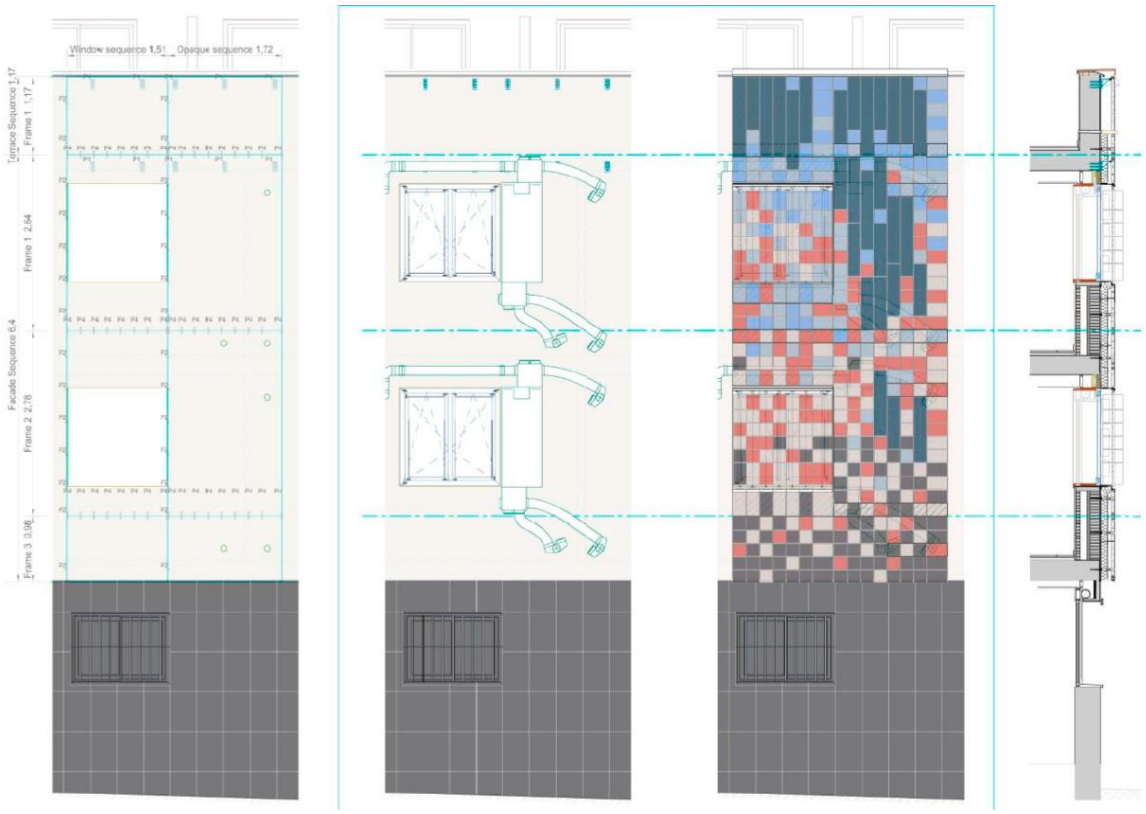

FIGURE 4.3-2: HYBRIDWALL SOLUTION LAYOUT

The integration of PV systems is a mandatory addition to the eAHC unit, since it can provide adequate energy that can be used for cooling - mainly in summer season and especially during daytime. Photovoltaic energy sources can be used for direct heat generation in winter or cold generation in the summer. An important advantage is that the system can operate without using expensive battery energy storage and can adjust the power to the energy generated. The eAHC wall element is applicable only for the external building surface.

The PV panels have special shape of 390*1200 mm in order to be easily integrated into the modulation of the Denvelops system, optimized for aesthetics and performance.

The components integrated into the HybridWall PnU Kit are shown in the next table, together with an initial assessment of their relevance as part of the product to be eventually certified and the viability of their standardisation, taking into account both the available references (which will be compiled and studied in the next chapters) and the need to modify/adjust/select the component according to a defined project/works (thus making more difficult their standardisation and fully certification).

TABLE 2: COMPONENTS OF HYBRIDWALL PNU KIT AND PRE-ANALYSIS OF THE STANDARDISATION VIABILITY

Component	Core, essential component	Optional, ancillary component	Initial assessment of standardisation viability
Ventilation system			
- Ventilation Unit		X	Customised, innovative product
- Pipes and connections		X	Standard commercial product
Fire penetration seal		X	Non-standardised commercial product
PV modules	X		Customized product
Smart Energy Management (SEM)		X	Customised, innovative product
Insulation	X		Standard commercial product
Windows	X		Standard commercial product
DENVELOPS technology			
- Profiles	X		Customized innovative product
- Fixings/connectors/anchors	X		Customized innovative product
- Cladding elements	X		Customized innovative product
- Coatings		X	Standard or non-standardised commercial product

4.4 eWHC PnU Kit- ConExWall

The ConExWall PnU Kit is a solution based on the existing façade and roof panels provided by RDR, with wooden structural frame and filled with mineral wool insulation and completed by dry wall at the external side. Three types of prefabricated timber frame panels form part of the solution for the Czech demo: a) The most complete panel will involve the typical layers of the RDR panels, windows and improved by the external Wall Heating and Cooling system (eWHC), which takes advantage of the heat capacity of the existing walls in order to transfer the heat to the interior; b) there will be other wall panels that will be self-standing, not attached to any existing wall, and therefore cannot take advantage of the eWHC technology. These panels will be located in the 1st floor level, where the roof was ending previously; c) similar to these wall panels, the roof panels will form a new volume and therefore will not integrate the eWHC system.

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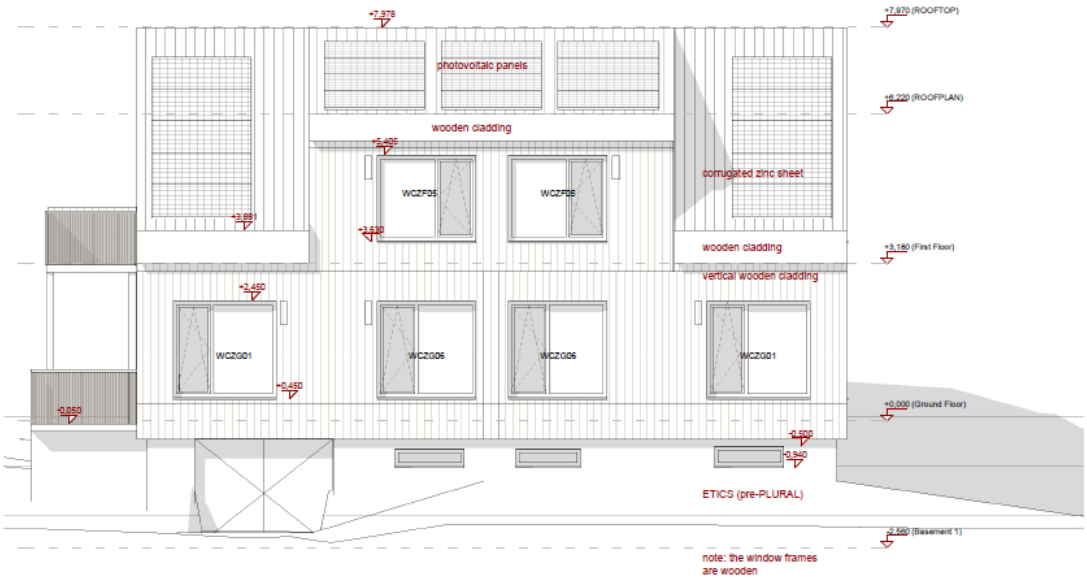

FIGURE 4.4-1: APPLICATION OF THE CONEXWALL ON THE CZECH DEMONSTRATION BUILDING

All major components of this solution are enclosed in a prefabricated timber-based module (envelope-kit), operating towards nZEB state with minimum ecological footprint and high comfort conditions for inhabitants. This multifunctional unit consists of:

- Timber frame construction with insulation of about 20-30 cm - depending on climate –
- Integrated triple-glazed windows with integrated solar shading
- Ventilation system with heat recovery
- Low temperature external wall water-based heating distribution system
- Heat pump by Daikin (not integrated in the facade)
- PV modules for renewable electricity production (roof)

Its most innovative feature is the external Wall Heating and Cooling (eWHC) module, applicable externally (either on the external wall or on the roof), as it integrates a low temperature exterior hydronic wall heating system between the existing wall layer and the new added envelope.

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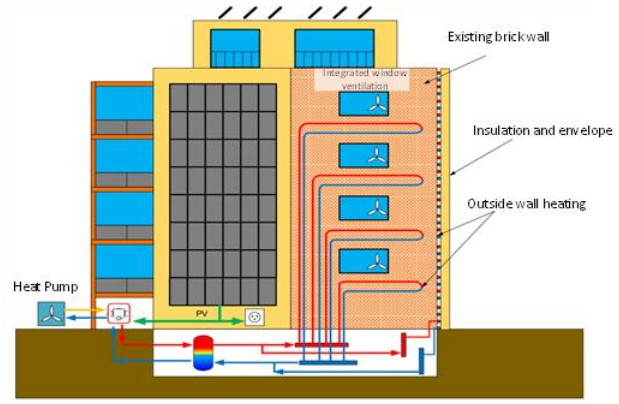

FIGURE 4.4-2: LAYOUT OF EWHC SOLUTION

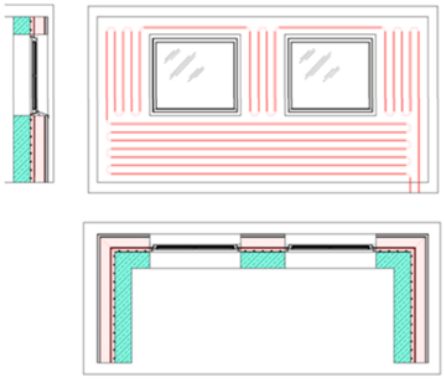

FIGURE 4.4-3: REDESIGNED CONEXWALL ENVELOPE KIT

This technology introduces the low temperature hydronic heating or cooling distribution from the outside, with minor or low disturbance on the inside of the building. This is accomplished by combining the heat distribution with the mandatory new high-performance insulation. Such solution addresses mostly buildings with high heating demand in colder climates, since it activates the thermal mass of the existing wall and shifts the heating period to day time, increasing "self-consumption" and mitigating as a result the energy demand for heating.

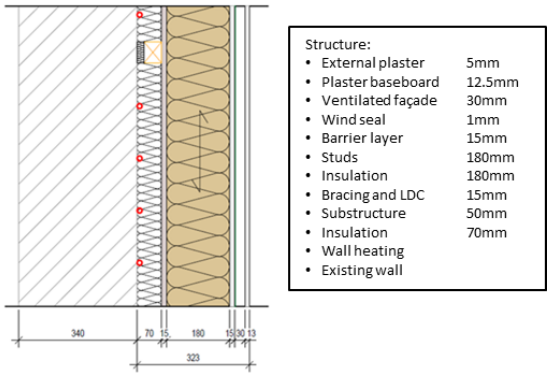

FIGURE 4.4-4: THE PRELIMINARY LAYOUT OF THE CONEXWALL WALL

The components integrated into the ConExWall PnU Kit are shown in the next table, together with an initial assessment of relevance as part of the product to be eventually certified and the viability of their standardisation, taking into account both the available references (which will be compiled and studied in the next chapters) and the need to modify/adjust/select the component according to a defined project/works (thus making more difficult their standardisation and fully certification).

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TABLE 3: COMPONENTS OF CONEXWALL PNU KIT AND PRE-ANALYSIS OF THE STANDARDISATION VIABILITY

Component	Core, essential component	Optional, ancillary component	Initial assessment of standardisation viability
eWHC heating and cooling system: heating pipes	X		Standard commercial product
eWHC heating and cooling system: support for the pipes	X		Standard commercial product, partly customised
eWHC heating and cooling system: flexible thermal insulation	X		Standard commercial product
Timber Structure	X		Customized product
Thermal insulation: wood fibre	X		Standard commercial product
Vapour barrier		X	Standard commercial product
Weathering membrane		X	Standard commercial product
Wooden cladding		X	Standard commercial product
Wooden windows	X		Standard commercial product
Stainless steel anchors	X		Standard commercial product
Ventilation unit		X	Standard commercial product
Sealants for joints		X	Standard commercial product
Reused metal cladding (roof panels)		X	Standard commercial product
PV modules (roof panels)		X	Standard commercial product

4.5 Considerations on commercial products used as components in PnU Kits

Many of the components that will be integrated into the PnU Kits are standardised commercial products. This is an adequate approach in the development of innovative solutions (use of well-known products as much as possible) so that effort can be put in the innovative goals such as integration of the different components, manufacturing processes for the industrialisation of systems, combination of new functionalities, etc.

The commercial products will therefore need to comply with the applicable European legislation when put on the market, regardless of their use as integrated products in a constructive system (PnU Kits). In that sense, their certification (e.g. certificate of compliance with a certain European directive, regulation or standard) previous to their integration into a constructive element will be used in the PnU Kits assessment and certification processes in two ways:

- As a part of the Factory Production Control, when establishing the requirements for the supplied components (also related to PLURAL project WP6 Manufacturing & Assembly of PnU Kits), and
- Use of those certified characteristics which can be also relevant in the PnU Kits declaration of performance (e.g. thermal resistance of insulating products according to EN 13162). To that purpose, it will always be necessary to determine if the characteristic certified for a component is appropriately expressed (assessment method, end-use conditions, performance declaration) in

relation to the component integrated into a wider constructive system in the relevant end-use conditions.

Therefore, the analysis of the European legislation other than CPR related to the separate components, together with the associated technical specifications such as the product standards, is necessary and done in the next chapter of this Deliverable.

4.6 Considerations on system definition for certification purposes

In other to be able to certify a product, it is necessary to accurately define such a product. This definition of the product scope, use conditions and limitations will involve for example the selection of materials used for the different parts of the PnU Kits, the geometry of the components and system, the assembly of the parts and possible variants, or the installation means, conditions and restrictions.

The assessment and certification procedures will depend on this correct definition of the product, the range of possible variants, taking into account the PnU Kits end-use configurations.

The definition of the product must not only take into account design criteria, but also the perspective of the final product performances that need be expressed in the assessment and certification, differentiating and analysing all involved parameters for each Basic Work Requirement and essential characteristics. As an example, if reaction to fire is required, the materials of the cladding element or external element will need to be fully defined and the range of variants limited in order to establish the pertinent assessment methods.

Therefore, after having analysed in this Deliverable the references and basis for the certifications procedures of the PnU Kits, a more detailed and closed definition of the systems and integrated components will be necessary at the beginning of Task 8.2.

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5. Certification of components in PLURAL PnU Kits

5.1 General

In the next subchapters information is provided on the European legislation, as well as on the reference product standards, applicable to the components integrated into the PLURAL PnU Kits. However, this information will need to be handled bearing in mind that the products (components integrated) must be understood in end use conditions as part of a system, a constructive kit as defined in CPR. This interpretation of the European legislation applicability to the components in their intended use as PnU Kit' components will be done in Task 8.2. For the final certification of the PnU Kits as constructive products under CPR, it is likely that not all the characteristics included in the components' reference specifications given in the next subchapters are necessary, as said. However, the purpose of Task 1.3 is to have the widest approach possible, to later in T8.1 analyse the requirements for the intended use and function of the components in the PnU Kit and, therefore, select the relevant essential characteristics and assessment procedures for the certification of the kits. Additionally, the assessment methods provided in the technical specifications might need to be adjusted in some cases to cover representative end use conditions of components integrated in the PnU Kits.

Components that are commercial products must comply with the European legislation, meaning that they must be supplied to the PnU Kit manufacturer providing all necessary documentation to demonstrate compliance with the relevant legislation (e.g. declaration of conformity, declaration of performance…). The information contained in such certificates will then need to be incorporated into the certification process of the PnU Kits in different manners, as described in subchapter 4.5.

The components that integrate the PnU Kits are by themselves mostly commercial products and, therefore, they will be required to comply with all applicable European legislation when supplied for assembly into PnU Kits. The product's harmonised technical specification referred to in the tables of the next subchapters, falling under the scope of the identified European legislation, that are applicable to the components integrating the different PLURAL PnU Kits are also detailed in this chapter.

5.2 SmartWall PnU Kit

In the next table, the components integrating the SmartWall PnU Kit are listed together with the European legislation of application and a brief description of the requirements or reference standard for its compliance.

TABLE 4: EUROPEAN LEGISLATION APPLICABLE TO THE SMARTWALL COMPONENTS

Component	European legislation	Requirement for compliance / reference standards
Fan coil		CE marking (declaration of conformity) according to:
	LVD 2014/35/EU	EN 60335-1 and EN 60335-2-40
	EMC 2014/30/EU	EN 55014-1, EN 55014-2 and EN 61000-3-2 and EN 61000-3-3
	Ecodesign Directive 2009/125/EC and Regulation 206/2012	CE marking (declaration of conformity) according to Directive 2009/125/EU EN 1397 as reference standard for performance assessment
	RoHS 2011/65/EU	EN 50581
Steel frame (RHS)	CPR (EU) 305/2011	CE marking (DoP) according to EN 14195 (profiles), or equivalent, and EN 10025-1 (material)
Air filter	Ecodesign Directives 2009/125/EC and 1253/2014	CE marking (declaration of conformity) according to EN ISO 16890
Integrated energy storage (batteries)	Battery Directive 2006/66/CE	CE marking (declaration of conformity) according to EN IEC 60086-1
PV modules[1]		CE marking (declaration of conformity) according to:
	LVD 2014/35/EC	EN IEC 61215 and EN IEC 61730
	EMC Directive 2014/30/EU	EN 61000-3-2 and EN 61000-3-3
	RoHS 2011/65/EU	EN 50581
Toolbox	Not applicable	---
Multisensor	Not applicable	---
Active fire suppression system		CE marking (declaration of conformity) according to:
	PE Directive 2014/68/UE	Directive 2014/68/UE
	RoHS 2011/65/EU	EN 50581
Insulation	CPR (EU) 305/2011	CE marking (DoP) according to EN 13162
Windows	CPR (EU) 305/2011	CE marking (DoP)according to EN 14351-1
Windows's blinds	MD 2006/42/EC (for motorized devices)	CE marking (declaration of conformity) according to EN 13659. EN 13659 also a reference standard under CPR.
Cement board	CPR (EU) 305/2011	CE marking (DoP) according to EN 12467
Gypsum board	CPR (EU) 305/2011	CE marking (DoP) according to EN 520
3D printed elements	Not applicable	---
Multifunctional coatings	RoHS 2011/65/EU	CE marking (declaration of conformity) according to EN 50581
Mechanical fasteners (nails, screws and staples)	CPR (EU) 305/2011	CE marking according to EN 14566 or equivalent
Inlet and outlet air grilles	Not applicable	No requirement
Antivibration mounts	Not applicable	No requirement

[1] More details on the regulatory framework of Photovoltaic panels can be found at www.pvsites.eu. And was used as reference for this document.

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5.3 eAHC PnU Kit- HybridWall

In the next table, the components integrating the HybridWall PnU Kit are listed together with the European legislation of application and a brief description of the requirements or reference standard for its compliance.

TABLE 5: EUROPEAN LEGISLATION APPLICABLE TO THE HYBRIDWALL PNU KIT- HYBRIDWALL COMPONENTS

Component	European legislation	Requirement for compliance
Ventilation system		
Ventilation Unit		CE marking (declaration of conformity) according to:
	EMC Directive 2014/30/EU	EN 55014-1, EN 55014-2 and EN 61000-3-2, EN 61000-3-3
	Ecodesign Directive 2009/125/EC	Directive 2009/125/EU EN 308 and EN 13141-8 as reference standards for performance assessment
Pipes and connections	Ecodesign Directives 2009/125/EC and 1253/2014	CE marking (declaration of conformity) according to EN 13142
Fire penetration seal	CPR (EU) 305/2011	CE marking according to EAD 350454-00-1104
PV modules		CE marking (declaration of conformity) according to:
	LVD 2014/35/EC	EN IEC 61215 and EN IEC 61730
	EMC Directive 2014/30/EU	EN 61000
	RoHS 2011/65/EU	EN 50581
SEM	Not applicable	---
Insulation	CPR (EU) 305/2011	CE marking (DoP) according to EN 13162
Windows	CPR (EU) 305/2011	CE marking (DoP) according to EN 14351-1
DENVELOPS technology		
Profiles	CPR (EU) 305/2011	CE marking (DoP) according to EN 14195 (profiles) or equivalent
Fixings/connectors/anchors	CPR (EU) 305/2011	CE marking (DoP) according to EN 14566 or equivalent, depending on the component
Cladding elements	CPR (EU) 305/2011	CE marking (DoP) according to EN 14782 or equivalent, depending on the final component
Coatings	RoHS 2011/65/EU	CE marking (declaration of conformity) according to EN 50581

5.4 eWHC PnU Kit- ConExWall

In the next table, the components integrating the ConExWall PnU Kit are listed together with the European legislation of application and a brief description of the requirements or reference standard for its compliance.

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TABLE 6: EUROPEAN LEGISLATION APPLICABLE TO THE EWHC PNU KIT- CONEXWALL COMPONENTS

Component	European legislation	Requirement for compliance
eWHC heating and cooling system: heating pipes	CPR (EU) 305/2011	EN ISO 21003 as reference standad
eWHC heating and cooling system: support for the pipes	CPR (EU) 305/2011	CE marking according to EN 13171
eWHC heating and cooling system: flexible thermal insulation	CPR (EU) 305/2011	CE marking according to EN 13162
Timber Structure	CPR (EU) 305/2011	CE marking according to EN 14080 or EN 14250
Thermal insulation: wood fibre	CPR (EU) 305/2011	CE marking according to EN 13171
Vapour barrier	CPR (EU) 305/2011	CE marking according to EN 13984
Weathering membrane	CPR (EU) 305/2011	CE marking according to EN 13859-2
Reused metal cladding	CPR (EU) 305/2011	CE marking according to EN 14782
Wooden windows	CPR (EU) 305/2011	CE marking according to EN 14351-1
Stainless steel anchors	CPR (EU) 305/2011	CE marking according to EN 14592
Ventilation unit		
Sealants for joints	CPR (EU) 305/2011	CE marking according to EN 15651-1
Metal cladding (roof panels)	CPR (EU) 305/2011	CE marking according to EN 14782
PV modules (roof panels)		CE marking (declaration of conformity) according to:
	LVD 2014/35/EC	EN IEC 61215 and EN IEC 61730
	EMC Directive 2014/30/EU	EN 61000
	RoHS 2011/65/EU	EN 50581

5.5 Construction Products Regulation 305/2011 (CPR)

5.5.1 General

Regulation No 305/2011 (Construction Products Regulation, or CPR) of the EU came into force on 1 July 2013. The regulation lays down conditions for the placing or making available on the market of construction products by establishing harmonised rules on how to express the performance of construction products in relation to their essential characteristics and on the use of CE marking on those products.

The aim of Regulation (EU) No 305/2011 is to ensure the accuracy of information on the performance of construction products. This Regulation aims to remove the technical barriers to trade in construction products within the countries of the European Union.

Therefore, CPR sets the ground for a European market of construction products free of constraints (technical barriers) and based on common harmonised methods to determine and declare the performance of such products (common “information system” for construction products that must be understood and accepted in any EU Member State).

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This is the basis that a designer (or any other agent on the market) needs to analyse and decide on the compliance of such product with a certain regulation in force in the place of use. It is thus important to stress that such compliance is not intrinsic to the declaration of performance done by the manufacturer of the product (this compliance verification is not within the scope of CPR), but it is an analysis to be done by the user of such product (being the user typically the designer of the works).

Regarding the main contents of CPR, the regulation sets out requirements for the construction products, which are described in the following chapters:

- General Provisions (Subject matter, Definitions, Basic requirements)
- Declaration of performance and CE marking
- Obligations of economic operators (manufacturers, authorised representatives, importers, distributors)
- Harmonised technical specifications
- Technical assessment bodies
- Notifying authorities and notified bodies
- Market surveillance and safeguard procedures

The technical assessment of construction products, as well as the declaration of their performances, is split in seven Basic work requirements (BWRs):

1. Mechanical resistance and stability
2. Safety in case of fire
3. Hygiene, health and the environment
4. Safety and accessibility in use
5. Protection against noise
6. Energy economy and heat retention
7. Sustainable use of natural resources

The process for a manufacturer of a construction product to CE mark their product is:

- Initial assessment of the product according to its applicable harmonised technical specification (hTS)
- Tasks of AVCP (Assessment and Verification of Constancy of Performance) according to AVCP system laid down in its hTS.

There are 5 AVCP systems (4, 3, 2+, 1 and 1+), cited here from least to most severe. AVCP system for a certain product is set by the European Commission through EC Decisions based on the level of involvement of the product with safety requirements (mainly structural and fire safety requirements); such products

with no involvement with safety will tend to AVCP system 4 whereas products with a strong involvement with safety and complex manufacturing processes will tend to AVCP system 1+.

Once these tasks are done the manufacturer may finally:

- Affix the CE-marking label on their product.
- Issue a Declaration of Performance, which becomes an official document that binds the manufacturer in front of the market as regards the technical performance of their product.

5.5.2 Harmonised technical specifications applicable to components under CPR

EN 520 - Gypsum plasterboards - Definitions, requirements and test methods

This document specifies the characteristics and performance of gypsum plasterboards intended to be used in building construction works including those intended for secondary manufacturing operations. It includes boards designed to receive either direct surface decoration or gypsum plaster. This document covers the following product performance characteristics: reaction to fire, water vapour permeability, flexural strength (breaking load), impact resistance and thermal resistance. The following performance characteristics are linked to systems assembled with plasterboards: shear strength, fire resistance, impact resistance direct airborne sound insulation and acoustic absorption to be measured according to the corresponding European test methods. If required, tests should be done on assembled systems simulating the end use conditions. This document covers also additional technical characteristics that are of importance for the use and acceptance of the product by the Construction Industry and the reference tests for these characteristics. It provides for the evaluation of conformity of the product to this document.

TABLE 7: ESSENTIAL CHARACTERISTICS AND ASSESSMENT METHODS IN EN 520

Essential characteristic	Assessment method
Shear strength (for stiffening timber framed external walls and timber roof truss structures)	EN 520
Reaction to fire (for exposed situations)	EN 520 or EN 13501-1
Water vapour permeability (for moisture diffusion control)	EN ISO 12572
Flexural strength	EN 520
Impact resistance (in end use conditions)	ISO 7892
Direct airborne sound insulation (in end use conditions)	EN ISO 140-3 and EN ISO 717-1
Acoustic absorption (in end use conditions)	EN ISO 354
Thermal resistance	EN 12664
Shear strength (for stiffening timber framed external walls and timber roof truss structures)	EN 520

EN 10025-1 - Hot rolled products of structural steels - Part 1: General technical delivery conditions

This document specifies requirements for flat and long products (see Clause 3) of hot rolled structural steels excluding structural hollow sections and tubes. Part 1 of this document specifies the general delivery conditions. The specific requirements for structural steels are given in the following. Parts: Part 2: Technical delivery conditions for non-alloy structural steels. Part 3: Technical delivery conditions for normalized/normalized rolled weldable fine grain structural steels. Part 4: Technical delivery conditions for thermomechanical rolled weldable fine grain structural steels. Part 5: Technical delivery conditions for structural steels with improved atmospheric corrosion resistance. Part 6: Technical delivery conditions for flat products of high yield strength structural steels in the quenched and tempered condition The steels specified in this document are intended for use in welded, bolted and riveted structures.

TABLE 8: ESSENTIAL CHARACTERISTICS AND ASSESSMENT METHODS IN EN 10025-1

Essential characteristic	Assessment method
Tolerances on dimensions and shape	EN 10025-1
Elongation	EN 10025-2 to EN 10025-6
Tensile strength	EN 10025-2 to EN 10025-6
Yield strength	EN 10025-2 to EN 10025-6
Impact strength	EN 10025-2 to EN 10025-6
Weldability (chemical composition)	EN 10025-2 to EN 10025-6
Durability (chemical composition)	EN 10025-2 to EN 10025-6

EN 12467 - Fibre-cement flat sheets - Product specifications and test methods

The European standard specifies the technical requirements and establishes methods of inspection and test as well as acceptance conditions for fibre-cement flat sheets, siding shingles and planks (later referred to as sheets) having an apparent density greater than 1,0 kg/dm3 for one or more of the following uses: - internal wall and ceiling finishes; - external wall and ceiling finishes; - roofing underlayers. This standard covers sheets reinforced with fibres of different types as specified in 5.1.1.

TABLE 9: ESSENTIAL CHARACTERISTICS AND ASSESSMENT METHODS IN EN 12467

Essential characteristic	Assessment method
Mechanical resistance	EN 12467, clause 7.3.2
Reaction to fire	EN 12467, clause 7.5
Water permeability	EN 12467, clause 7.3.3
Durability against warm water	EN 12467, clause 7.3.5
Durability against soak/dry	EN 12467, clause 7.3.6
Durability against freeze-thaw	EN 12467, clause 7.4.1
Durability against heat-rain	EN 12467, clause 7.4.2

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EN 13162 - Thermal insulation products for buildings - Factory made mineral wool (MW) products - Specification

This European Standard specifies the requirements for factory made mineral wool products, with or without facings or coatings, which are used for the thermal insulation of buildings. The products are manufactured in the mat blankets, boards or slabs. Products covered by this standard are also used in prefabricated thermal insulation systems and composite panels; the performance of systems incorporating these products is not covered. This standard describes product characteristics and includes procedures for testing, evaluation of conformity, marking and labelling. This standard does not specify the required level of a given property to be achieved by a product to demonstrate fitness for purpose in a particular application. The levels required for a given application are to be found in regulations or non-conflicting standards. Products with a declared thermal resistance lower than 0,25 m^2·K/W or a declared thermal conductivity greater than 0,060 W/(m·K) at 10 °C are not covered by this standard. This standard does not cover in situ insulation products (covered by EN 14064 parts 1 and 2) and products intended to be used for the insulation of building equipment and industrial installations (covered by EN 14303).

TABLE 10: ESSENTIAL CHARACTERISTICS AND ASSESSMENT METHODS IN EN 13162

Essential characteristic	Assessment method
Thermal resistance	EN 12667 or EN 12939
Reaction to fire	EN 13501-1 and EN 15715
Durability	EN 13162, clause 4.2.7
Compressive strength	EN 826
Tensile/flexural strength	EN 1607 / EN 12089
Water permeability	EN 1609 and EN 12087
Water vapour permeability	EN 12086
Airborne sound insulation	EN ISO 10140-1
Sound absorption	EN ISO 354
Propensity to undergo continuous smouldering	EN 16733

EN 13171 - Thermal insulation products for buildings - Factory made wood fibre (WF) products - Specification

This European Standard specifies the requirements for factory made wood fibre (WF) products, with or without facings or coatings, which are used for the thermal insulation of buildings). The products are manufactured in the form of rolls, batts, felts, boards or slabs. Products covered by this standard are also used in prefabricated thermal insulation systems and composite panels; the performance of systems incorporating these products is not covered. This standard describes product characteristics and includes procedures for testing, evaluation of conformity, marking and labelling. This standard does not specify the required level of a given property to be achieved by a product to demonstrate fitness for purpose in a particular application. The classes and levels required for a given application are to be found in regulations or non-conflicting standards. Products with a declared thermal resistance lower than 0,20 m2·K/W or a

declared thermal conductivity greater than 0,070 W/(m·K) at 10 °C are not covered by this standard. This standard does not cover in situ insulation products and products intended to be used for the insulation of building equipment and industrial installations.

TABLE 11: ESSENTIAL CHARACTERISTICS AND ASSESSMENT METHODS IN EN 13171

Essential characteristic	Assessment method
Thermal resistance	EN 12667 or EN 12939
Reaction to fire	EN 13501-1
Durability of reaction to fire against heat, weathering, ageing/degradation	EN 13171, clause 4.2.7
Durability of thermal resistance against heat, weathering, ageing/degradation	EN 13171, clause 4.2.7
Compressive strength	EN 826
Tensile/Flexural strength	EN 1607
Durability of compressive strength against ageing/degradation	EN 1606
Water permeability	EN 1609
Water vapour permeability	EN 12086
Acoustic absorption index	EN ISO 354 or EN ISO 11654
Direct airbone sound insulation index	EN 29053

EN 13659 - Shutters - Performance requirements including safety

This European Standard specifies the performance requirements which shutters shall fulfil when fitted within a building. It deals also with the significant hazards for construction, transport, installation, operation and maintenance of the shutters (see list of significant machine hazards in annex C). It applies to all shutters as well as similar products whatever their use and nature of the materials used, as follows: - external Venetian blind, roller shutter, wing shutter, Venetian shutter, flat-closing concertina shutter, concertina shutter or sliding panel shutter, with or without a system of projection. These products can be operated manually with or without compensating spring, or by means of electric motors (power operated products).

This standard is not cited in OJEU and, therefore, compliance with it does not confer the affixing of CE mark under the Regulation (EU) No. 305/2011. It was analysed to identify possible characteristics relevant to the PnU Kits.

TABLE 12: ESSENTIAL CHARACTERISTICS AND ASSESSMENT METHODS IN EN 13659

Essential characteristic	Assessment method
Resistance to wind loads	EN 1932
Additional thermal resistance	EN ISO 10077-1
Total solar energy transmittance g_{tot}	EN 13363-1

EN 13859-2 - Flexible sheets for waterproofing - Definitions and characteristics of underlays - Part 2: Underlays for walls

This European standard specifies the characteristics of flexible sheets for underlays for walls which are to be used in walls behind outside wall coverings in order to avoid penetration of wind and water from outside. It specifies the requirements and test methods and provides for the evaluation of conformity of the products with the requirements of this document.

TABLE 13: ESSENTIAL CHARACTERISTICS AND ASSESSMENT METHODS IN EN 13859-2

Essential characteristic	Assessment method
Reaction to fire	EN ISO 11925-2 or EN 13501-1
Water tightness	EN 1928 or EN 13111
Water vapour resistance	EN 1931 or EN ISO 12572
Tensile properties	EN 12311-1
Resistance to tearing	EN 12310-1 and modifications Annex B of EN 13859-2
Flexibility at low temperature (pliability)	EN 1109
Durability: Artificial behaviour, concerning - resistance to water penetration - tensile properties	EN 13859-2

EN 13984 - Flexible sheets for waterproofing - Plastic and rubber vapour control layers - Definitions and characteristics

This European Standard specifies the characteristics of flexible sheets of plastic or rubber intended for use as water vapour control layers for buildings and applies to both reinforced and unreinforced products. It specifies requirements and test methods and provides for the evaluation of conformity of the products with the requirements of this European Standard.

TABLE 14: ESSENTIAL CHARACTERISTICS AND ASSESSMENT METHODS IN EN 13984

Essential characteristic	Assessment method
Water tightness	EN 1928
Resistance to impact	EN 12691
Durability (water vapour resistance after artificial ageing)	Ageing: EN 1296 Test method: EN 1931
Durability (chemical resistance)	EN 1847 and EN 123211-2
Resistance to tearing	EN 12310-1 or EN 13859-1
Joint strength	EN 12317-2
Tensile properties	EN 12311-2 or EN 13859-1
Reaction to fire	EN 13501-1

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EN 14080 - Timber structures - Glued laminated timber and glued solid timber - Requirements

This European Standard sets the performance requirements of the following glued laminated products: - Glued laminated timber (glulam); - Glued solid timber; - Glulam with large finger joints; - Block glued glulam for use in buildings and bridges. It also lays down minimum production requirements, provisions for evaluation and attestation of conformity and marking of glued laminated products. This European Standard is applicable for glued laminated timber made of coniferous species listed in this standard or poplar consisting of two or more laminations having a thickness from 6 mm up to 45 mm (inclusive). It may be possible to produce glulam made from specific hardwood species based on some provisions of this European Standard. In this case, Annex ZA does not apply. This European Standard is applicable for glued solid timber made of coniferous species listed in this standard or poplar consisting of two to five laminations having a thickness greater than 45 mm and less than or equal to 85 mm. This European Standard is applicable for large finger joints in glued laminated timber with a finger length of at least 45 mm. This European Standard is applicable for block glued glulam having solid rectangular cross sections. This European Standard also gives the requirements for glued laminated products treated against biological attack. Glued laminated products treated with fire retardants are not covered.

TABLE 15: ESSENTIAL CHARACTERISTICS AND ASSESSMENT METHODS IN EN 14080

Essential characteristic	Assessment method
Mechanical resistance of glued laminated products covering Modulus of elasticity, Bending strength, Compressive strength, Tensile strength and Shear strength as:	
Properties of timber	EN 14081-1
Strength of finger joints	EN 14080, clause 5.1.4.2
Geometrical data	EN 14080, clause 5.11
Resistance to fire	EN 14080, clause 5.7
Reaction to fire	EN 13501-1
Release of formaldehyde	EN 14080 Annex A
Durability of bonding strength	
Species	EN 14080, clause 5.5.2
Adhesives	EN 14080, clause 5.5.3
Durability of other characteristics (i.e. resistance to biological organisms)	
Laminations without preservative treatment	EN 350-2
Laminations with preservative treatment	EN 15228, clause 6

EN 14195 - Metal framing components for gypsum board systems - Definitions, requirements and test methods

This European Standard specifies the characteristics of metal framing components (e.g. profiles, hangers and connectors) intended to be used in building construction works in conjunction with gypsum boards manufactured according to EN 520, EN 15283 1 and EN 15283 2 and gypsum board products from reprocessing conforming to EN 14190 where the assembly is non-loadbearing. Such assemblies include, for example, partitions, wall and ceiling linings, ceilings with mechanically fixed boards and the cladding of

beams, columns, ducts and shafts. It covers the following performance characteristics: reaction to fire, flexural (yield) strength and loadbearing capacity of suspension components to be measured according to the relevant test methods as specified or cited in this European Standard.

TABLE 16: ESSENTIAL CHARACTERISTICS AND ASSESSMENT METHODS IN EN 14195

Essential characteristic	Assessment method
Reaction to fire	EN 13501-1
Flexural tensile strength	EN ISO 6892-1
Load-bearing capacity of suspension devices	EN 14195

EN 14250 - Timber structures - Product requirements for prefabricated structural members assembled with punched metal plate fasteners

This European Standard specifies material, product and documentation requirements for prefabricated structural members (e.g. trusses for roofs, walls and floors, frames, composite beams and girders) for use in buildings made from solid structural timber according to EN 14081-1 with or without finger joints assembled with punched metal plate fasteners. The standard also covers tests and/or calculation methods to carry out the evaluation of conformity and requirements for the marking of these members. As regards resistance to biological organisms, this standard covers prefabricated structural members manufactured from either untreated timber or timber treated to improve its natural durability. This standard does not cover prefabricated timber structural members intended to be used in constructions under predominantly dynamic loads (e.g. bridges) or for use in unprotected external conditions (i.e. use class 3 in accordance with EN 335-1). Furthermore, it does not cover members treated to improve their fire performance.

TABLE 17: ESSENTIAL CHARACTERISTICS AND ASSESSMENT METHODS IN EN 14250

Essential characteristic	Assessment method
Mechanical resistance as load bearing capacity and stiffness or declaration and covered under the following method by:	
Method 3b -Load-bearing capacity and deflection	EN 1990, EN 1991 and EN 1995-1-1
Dimensional stability, as shrinkage and swelling	EN 1995-1-1
Reaction to fire	EN 13501-1
Fire resistance, where required	EN 13501-2 or EN 1995-1-1 and EN 1995-1-2

EN 14351-1 - Windows and doors - Product standard, performance characteristics - Part 1: Windows and external pedestrian doorsets without resistance to fire and/or smoke leakage characteristics

This European Standard identifies material independent performance characteristics that are applicable to windows (including roof windows, roof windows with external fire resistance and French windows), external pedestrian door-sets (including unframed glass door-sets, escape route door-sets) and screens. This European Standard applies to: - Manually or power operated windows, French windows and screens

for installation in vertical wall aper-tures and roof windows for installation in inclined roofs, complete with: - related hardware, if any; - weather stripping, if any; - glazed apertures when intended to have glazed apertures; - with or without incorporated shutters and/or shutterboxes and/or blinds; and manually or power operated windows, roof windows, French windows and screens that are - fully or partially glazed including any non-transparent infill; - fixed or partly fixed or openable with one or more casements/sashes (e.g. hinged, projecting, pivoted, sliding). - Manually operated external pedestrian doorsets with flush or panelled leaves, complete with: - integral fanlights, if any; - adjacent parts that are contained within a single frame for inclusion in a single aperture, if any. The products covered by this European Standard are not assessed for structural applications

TABLE 18: ESSENTIAL CHARACTERISTICS AND ASSESSMENT METHODS IN EN 14351-1

Essential characteristic	Assessment method
Watertightness	EN 1027
Resistance to wind loads	EN 12211
Load-bearing capacity of safety devices	EN 14609 or EN 948
Acoustic performance (when required)	EN ISO 140-3 or EN ISO 717-1 or Annex B of EN 14351-1
Thermal transmittance (when required)	EN ISO 10077-1 or EN ISO 10077-2 or EN ISO 12567
Radiation properties	EN 410 or EN 13363-1 or EN 13363-2
Air permeability (when required)	Assessment method: EN 1026

EN 14566 - Mechanical fasteners for gypsum plasterboard systems - Definitions, requirements and test methods

This European Standard specifies the characteristics and performance of mechanical fasteners, including nails, screws and staples, intended to be used for the fixing of gypsum plasterboard, gypsum boards with fibrous reinforcement, products from secondary processing and suitable ancillary products as shown in Figure 2, to timber and metal, as appropriate, in building construction works. The fasteners secure the board to the framing enabling its surface to be finished by jointing or plastering to receive decoration. They can also be used for the construction of the framing and for the connection between substructure and load bearing components and for fixing boards together. Mechanical fasteners contribute to the stability of the assembly. This European Standard covers the following product performance characteristics: reaction to fire and flexural strength to be measured according to the corresponding European test methods. It provides for the evaluation of conformity of the product to this European Standard. This European Standard also covers the additional technical characteristics that are of importance for the use and acceptance of the products by the construction industry and the reference tests for these characteristics.

TABLE 19: ESSENTIAL CHARACTERISTICS AND ASSESSMENT METHODS IN EN 14566

Essential characteristic	Assessment method
Reaction to fire	EN 13501-1
Flexural strength	EN 14566

EN 14592 - Timber structures - Dowel-type fasteners – Requirements

This document specifies the characteristics of the following types of dowel-type fasteners: - nails; - staples; - screws; - dowels; - bolts with nuts. This document covers dowel-type fasteners for structural use in load bearing timber structures only. This document covers also the following additional intended uses of the screws: - to fix roof or cladding elements to the timber structure, with or without insulation layers; and - as reinforcement inserted in timber or in a glue laminated timber element to improve its resistance to compression perpendicular to the grain. This document covers types of dowel-type fasteners, which are manufactured of either carbon steel or stainless steel and which may be coated for the following purposes: - corrosion protection (as Type 1 coating); - lubrication, to facilitate insertion (as Type 2 coating); - withdrawal enhancement and/or collation for nails and staples (adhesive and/or resin coatings) (as Type 3 coating). This document covers types of dowel-type fasteners, which are manufactured from materials and within the specifications for their geometry related properties, only as they are specified for: - nails (see G.1); - staples (see G.2); - screws (see G.3); - dowels (see G.4); and - bolts with nuts (see G.5). This document specifies also the assessment and verification of constancy of performance (AVCP) procedures of these characteristics and includes provisions for marking of dowel-type fasteners. This document does not cover dowel-type fasteners treated with fire retardants to improve their fire performance, nor does it cover glued-in rods.

TABLE 20: ESSENTIAL CHARACTERISTICS AND ASSESSMENT METHODS IN EN 14592

Essential characteristic	Assessment method
Yield moment	EN 409 or EN 1995-1-1
Withdrawal	EN 1382 or EN 1995-1-1
Head pull-through	EN 1383 or EN 1995-1-1
Tensile capacity	EN 1383
Torsional ratio (for screws only)	EN ISO 10666 and EN 14592 Annex B
Durability	EN 14592 Annex A and EN 1995-1-1

EN 14782 - Self-supporting metal sheet for roofing, external cladding and internal lining - Product specification and requirements

This European Standard specifies the terminology, requirements and test methods for factory made self-supporting metal sheets and tiles (for non-structural applications) delivered in the form of manufactured pieces for roofing and wall cladding and lining. This standard also covers ceiling (including internal metal sheet) and soffit applications and cassettes (see Figure 1). This standard covers self-supporting copper, zinc, steel, aluminium and stainless steel sheet with or without coatings, e.g. metallic, organic, inorganic or multi-layer (see Annex A). A moisture retaining layer may be present on the reverse side of the product. This standard also includes rules for marking, labelling and evaluation of conformity. This standard does not cover products for structural purposes, i.e. it does not cover products intended to contribute to the global

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or partial stability of the building structure by providing racking resistance or resistance to permanent static loads (excluding self-weight of the metal sheet). Requirements concerning acoustical and thermal insulation properties are not considered in this standard. This standard does not include calculation or design requirements with regards to the works, installation techniques or the performance of the installed products.

TABLE 21: ESSENTIAL CHARACTERISTICS AND ASSESSMENT METHODS IN EN 14782

Essential characteristic	Assessment method
Mechanical resistance	EN 14782, Annex B
Water permeability	EN 14782, clause 4.4
Dimensional Change	EN 14782, clause 4.6
Reaction to fire	EN 14782 5.2 or EN 13501-1
External fire performance	EN 14782, clause 5.1 or ENV 1187
Durability	EN 14782, clause 4.8

EN 15651-1 - Sealants for non-structural use in joints in buildings and pedestrian walkways - Part 1: Sealants for facade elements

This European Standard specifies definitions and requirements for non-structural facade sealants intended for sealing exterior wall joints, window and door perimeter joints in building construction, including the interior face. NOTE Provisions on assessment and verification of constancy of performance - AVCP (i.e. Product type determination and Factory Production Control) and marking of these products are given in EN 15651-5. This European Standard does not apply to non-structural sealants in any of non-paste form, to those used in interior walls and/or partitions and to oil-based mastics.

TABLE 22: ESSENTIAL CHARACTERISTICS AND ASSESSMENT METHODS IN EN 15651-1

Essential characteristic	Assessment method
Reaction to fire	EN 13501-1
Water tightness and Air tightness	
Resistance to flow	EN ISO 7390
Loss of volume	EN ISO 10563
Tensile properties (i.e. elongation)	EN ISO 10591 and EN ISO 10590
Tensile properties (i.e. secant modulus)	EN ISO 8339
Tensile properties (i.e. at maintained extension)	EN ISO 8340
Durability	EN ISO 9046 or EN ISO 10591 and EN ISO 9047 or EN ISO 10590

EAD 350454-00-1104 - Fire stopping and fire sealing products - Penetration seals

Penetration seal products are intended to maintain the fire resistance of a separating element at the position where services pass through (e.g., ventilation pipes in HybridWall PnU Kit).

The essential characteristics considered in the EAD are shown in the next table together with the relevant assessment methods.

TABLE 23: ESSENTIAL CHARACTERISTICS AND ASSESSMENT METHODS IN EAD 350454-00-1104

Essential characteristic	Assessment method
Reaction to fire	EN 13501-1
Resistance to fire	EN 13501-2 and EN 1366-3
Air permeability	EN 1026
Water permeability	Annex C of EAD 350454-00-1104
Resistance to impact/movement	EOTA Technical Report 001
Durability	Depending on the material, according to the relevant harmonised product standard or to EOTA Technical Report 024
Airborne sound insulation	EN ISO 10140-1
Thermal conductivity	EN 12664, EN 12667 or EN 12939
Water vapour permeability	EN ISO 10456, EN ISO 12572 or EN 12086

5.5.3 Summary of harmonised specifications in relation to Pnu Kits

Below are listed the summary of harmonised technical specifications in relation to PnU Kits

TABLE 24: HARMONISED TECHNICAL SPECIFICATIONS IN RELATION TO COMPONENTS IN PNU KITS

hEN	SmartWall	eAHC - HYBRIDWALL	eWHC - CONEXWALL
EN 520	X		
EN 10025-1	X	X	X
EN 12467	X		
EN 13162	X	X	X
EN 13171			X
EN 13659	X		
EN 13859-2			X
EN 13984			X
EN 14080			X
EN 14195	X	X	
EN 14250			X
EN 14351-1	X	X	X
EN 14566	X	X	
EN 14782		X	X
EN 15651-1			X
EAD 350454-00-1104	X	X	X

5.6 Low Voltage Directive EU 2014/35 (LVD)

5.6.1 General

The purpose of this Directive is to ensure that electrical equipment on the market fulfils the requirements providing for a high level of protection of health and safety of persons, and of domestic animals and property, while guaranteeing the functioning of the internal market. This Directive shall apply to electrical equipment designed for use with a voltage rating of between 50 and 1000 V for alternating current and between 75 and 1500 V for direct current.

This Directive should be limited to the expression of the safety objectives. To facilitate conformity assessment with the Directive objectives, it is necessary to provide for a presumption of conformity for electrical equipment which is in conformity with harmonised standards that are adopted in accordance with Regulation (EU) No 1025/2012 of the European Parliament and of the Council of 25 October 2012 on European Standardisation for the purpose of expressing detailed technical specifications of those objectives.

The Directive specifies the requirements with respect to health and safety for all types of electrical equipment falling under its purview, ensuring the equipment is safe for use as intended and are listed below:

1. General conditions

a. the essential characteristics, the recognition and observance of which will ensure that electrical equipment will be used safely and in applications for which it was made, shall be marked on the electrical equipment, or, if this is not possible, on an accompanying document;
b. the electrical equipment, together with its component parts, shall be made in such a way as to ensure that it can be safely and properly assembled and connected;
c. the electrical equipment shall be so designed and manufactured as to ensure that protection against the hazards set out in points 2 and 3 is assured, providing that the equipment is used in applications for which it was made and is adequately maintained.

2. Protection against hazards arising from the electrical equipment

Measures of a technical nature shall be laid down in accordance with point 1, in order to ensure that:

a. persons and domestic animals are adequately protected against the danger of physical injury or other harm which might be caused by direct or indirect contact;
b. temperatures, arcs or radiation which would cause a danger, are not produced;
c. persons, domestic animals and property are adequately protected against non-electrical dangers caused by the electrical equipment which are revealed by experience;
d. the insulation is suitable for foreseeable conditions.

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3. Protection against hazards which may be caused by external influences on the electrical equipment

Technical measures shall be laid down in accordance with point 1, in order to ensure that the electrical equipment:

a. meets the expected mechanical requirements in such a way that persons, domestic animals and property are not endangered;
b. is resistant to non-mechanical influences in expected environmental conditions, in such a way that persons, domestic animals and property are not endangered;
c. does not endanger persons, domestic animals, and property in foreseeable conditions of overload.

5.6.2 Reference standards applicable to components under LVD

EN 60335-1 - Household and similar electrical appliances - Safety - Part 1: General requirements

This European Standard deals with the safety of electrical appliances for household environment and commercial purposes, their rated voltage being not more than 250 V for single-phase and 480 V for others.

EN 60335-2-40 - Household and similar electrical appliances - Safety - Part 2-40: Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers

Deals with the safety of electric heat pumps, including sanitary hot water heat pumps, air-conditioners, and dehumidifiers incorporating sealed motor-compressors. The maximum rated voltage being not more than 250 V for single phase and 600 V for all other appliances. The referenced appliances may consist of one or more assemblies. If provided in more than one assembly, the assemblies are to used together, and the requirements are based on the use of matched assemblies. Supplementary heaters, or a provision for their separate installation, are within the scope of this standard, but only heaters which are designed as a part of the appliance package, the controls being incorporated in the appliance.

EN IEC 61215-1 - Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1: Test requirements

This document lays down requirements for the design qualification of terrestrial photovoltaic modules suitable for long-term operation in open-air climates. The useful service life of modules so qualified will depend on their design, their environment and the conditions under which they are operated. Test results are not construed as a quantitative prediction of module lifetime. In climates where 98th percentile operating temperatures exceed 70 °C, users are recommended to consider testing to higher temperature test conditions as described in IEC TS 63126. Users desiring qualification of PV products with lesser lifetime expectations are recommended to consider testing designed for PV in consumer electronics, as described in

IEC 63163 (under development). Users wishing to gain confidence that the characteristics tested in IEC 61215 appear consistently in a manufactured product may wish to utilize IEC TS 62941 regarding quality systems in PV manufacturing. This document is intended to apply to all terrestrial flat plate module materials such as crystalline silicon module types as well as thin-film modules. It does not apply to systems that are not long-term applications, such as flexible modules installed in awnings or tenting. This document does not apply to modules used with concentrated sunlight although it may be utilized for low concentrator modules (1 to 3 suns). For low concentration modules, all tests are performed using the irradiance, current, voltage and power levels expected at the design concentration. This document does not address the particularities of PV modules with integrated electronics. It may however be used as a basis for testing such PV modules. The objective of this test sequence is to determine the electrical characteristics of the module and to show, as far as possible within reasonable constraints of cost and time, that the module is capable of withstanding prolonged exposure outdoors. Accelerated test conditions are empirically based on those necessary to reproduce selected observed field failures and are applied equally across module types. Acceleration factors may vary with product design, and thus not all degradation mechanisms may manifest. Further general information on accelerated test methods including definitions of terms may be found in IEC 62506. Some long-term degradation mechanisms can only reasonably be detected via component testing, due to long times required to produce the failure and necessity of stress conditions that are expensive to produce over large areas. Component tests that have reached a sufficient level of maturity to set pass/fail criteria with high confidence are incorporated into the IEC 61215 series via addition to Table 1. In contrast, the tests procedures described in this series, in IEC 61215-2, are performed on modules.

EN IEC 61730 - Photovoltaic (PV) module safety qualification - Part 1: Requirements for construction

EN IEC 61730-1 specifies and describes the fundamental construction requirements for photovoltaic (PV) modules in order to provide safe electrical and mechanical operation. Specific topics are provided to assess the prevention of electrical shock, fire hazards, and personal injury due to mechanical and environmental stresses. This part of IEC 61730 pertains to the particular requirements of construction. IEC 61730-2 defines the requirements of testing. This International Standard series lays down IEC requirements of terrestrial photovoltaic modules suitable for long-term operation in open-air climates. This standard is intended to apply to all terrestrial flat plate module materials such as crystalline silicon module types as well as thin-film modules. This new edition includes the following significant technical changes with respect to the previous edition: - adaption of horizontal standards and inclusion of IEC 60664 and IEC 61140; - implementation of insulation coordination, overvoltage category, classes, pollution degree and material groups definition of creepage, clearance and distance through insulation.

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5.7 Electromagnetic Compatibility Directive 2014/30/EU (EMCD)

5.7.1 General

This Directive regulates the electromagnetic compatibility of equipment. It aims to ensure the functioning of the internal market by requiring equipment to comply with an adequate level of electromagnetic compatibility.

The main objective of the EMCD is to guarantee the free movement of equipment and to create an acceptable electromagnetic environment whilst ensuring that equipment will function as intended in that environment. In order to achieve it, a harmonised and acceptable level of protection is required by the Directive, based on Article 114 of the TFEU, leading to full harmonisation in the Union.

Relevant definitions:

- *Equipment:* it means any apparatus or fixed installation.
- *Apparatus:* it means any finished appliance or combination thereof made available on the market as a single functional unit, intended for the end-user and liable to generate electromagnetic disturbance, or the performance of which is liable to be affected by such disturbance.
- *Fixed installation:* it means a particular combination of several types of apparatus and, where applicable, other devices, which are assembled, installed and intended to be used permanently at a predefined location.
- *Electromagnetic compatibility:* it means the ability of equipment to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to other equipment in that environment.

The Directive sets out mandatory “essential requirements” formulated in a general manner for all equipment within scope. Those essential requirements are listed below:

1. General requirements

Equipment shall be so designed and manufactured, having regard to the state of the art, as to ensure that:

a. the electromagnetic disturbance generated does not exceed the level above which radio and telecommunications equipment or other equipment cannot operate as intended;
b. it has a level of immunity to the electromagnetic disturbance to be expected in its intended use which allows it to operate without unacceptable degradation of its intended use.

2. Specific requirements for fixed installations

A fixed installation shall be installed applying good engineering practices and respecting the information on the intended use of its components, with a view to meeting the essential requirements set out in point 1.

5.7.2 Reference standards applicable to components under EMCD

EN 55014-1 - Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus - Part 1: Emission

It specifies the requirements that apply to the emission of radio-frequency disturbances in the frequency range 9 kHz to 400 GHz from appliances, electric tools and similar apparatus, whether powered by AC or DC (including a battery). Also included in the scope of this standard are separate parts of the above mentioned equipment such as motors and switching devices (e.g. power or protective relays); however, no emission requirements apply to such separate parts, unless otherwise stated in this standard.

EN 55014-2 - Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus - Part 2: Immunity - Product family standard

It deals with the electromagnetic immunity of appliances and similar apparatus for household and similar purposes that use electricity, as well as electric toys and electric tools, the rated voltage of the apparatus being not more than 250 V for single-phase apparatus to be connected to phase and neutral, and 480 V for other apparatus. Apparatus may incorporate motors, heating elements or their combination, may contain electric or electronic circuitry, and may be powered by the mains, by transformer, by batteries, or by any other electrical power source. Apparatus not intended for household use, but which nevertheless may require the immunity level, such as apparatus intended to be used by laymen in shops, in light industry and on farms, are within the scope of this standard, as far as they are included in CISPR 14-1.

EN IEC 61000-3-2 - Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤16 A per phase)

This standard deals with the limitation of harmonic currents injected into the public supply system. It specifies limits of harmonic components of the input current which can be produced by equipment tested under specified conditions. It is applicable to electrical and electronic equipment having a rated input current up to and including 16 A per phase, and intended to be connected to public low-voltage distribution systems. Arc welding equipment which is not professional equipment, with a rated input current up to and including 16 A per phase, is included in this document. Arc welding equipment intended for professional use, as specified in IEC 60974-1, is excluded from this document and can be subject to installation restrictions as indicated in IEC 61000-3-12. The tests according to this document are type tests. For systems with nominal voltages less than but not equal to 220 V (line-to-neutral), the limits have not yet been considered. This fifth edition cancels and replaces the fourth edition published in 2014. This edition constitutes a technical revision. This edition includes the following significant technical changes with respect to the previous edition: a) an update of the emission limits for lighting equipment with a rated power ≤ 25 W to take into account new types of lighting equipment; b) the addition of a threshold of 5 W under which no emission limits apply to all lighting equipment; c) the modification of the requirements

applying to the dimmers when operating non-incandescent lamps; d) the addition of test conditions for digital load side transmission control devices; e) the removal of the use of reference lamps and reference ballasts for the tests of lighting equipment; f) the simplification and clarification of the terminology used for lighting equipment; g) the classification of professional luminaires for stage lighting and studios under Class A; h) a clarification about the classification of emergency lighting equipment; i) a clarification for lighting equipment including one control module with an active input power ≤ 2 W; j) an update of the test conditions for television receivers; k) an update of the test conditions for induction hobs, taking also into account the other types of cooking appliances; l) for consistency with IEC 61000-3-12, a change of the scope of IEC 61000-3-2 from equipment with an input current ≤ 16 A to equipment with a rated input current ≤ 16 A.

EN IEC 61000-3-3 - Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current <= 16 A per phase and not subject to conditional connection

This standard is concerned with the limitation of voltage fluctuations and flicker impressed on the public low-voltage system. It specifies limits of voltage changes which may be produced by an equipment tested under specified conditions and gives guidance on methods of assessment. It is applicable to electrical and electronic equipment having an input current equal to or less than 16 A per phase, intended to be connected to public low-voltage distribution systems of between 220 V and 250 V line to neutral at 50 Hz, and not subject to conditional connection. IEC 61000-3-3 has the status of a product family standard within the IEC 61000 series.

5.8 Ecodesign Directive 2009/125/EC

5.8.1 General

This Directive establishes a framework for the setting of Community ecodesign requirements for energy-related products with the aim of ensuring the free movement of such products within the internal market. This Directive provides for the setting of requirements which the energy-related products covered by implementing measures must fulfil in order to be placed on the market and/or put into service. It contributes to sustainable development by increasing energy efficiency and the level of protection of the environment, while at the same time increasing the security of the energy supply.

An *Energy-related product* is defined as follows: it means any good that has an impact on energy consumption during use which is placed on the market and/or put into service, and includes parts intended to be incorporated into energy-related products covered by this Directive which are placed on the market

and/or put into service as individual parts for end-users and of which the environmental performance can be assessed independently.

5.8.2 Reference standards applicable to components under Directive 2009/125/EC

EN 308 - Heat exchangers - Test procedures for establishing performance of air to air heat recovery components

This document specifies methods to be used for testing of air-to-air heat recovery components (HRC). The main purpose of the HRC is to exchange heat between exhaust air and supply air in order to save energy, which results in — preheat or heat, and/or — precool or cool supply air in ventilation systems or air conditioning systems. Optionally HRC can exchange air humidity between exhaust and supply air. The HRC contains the heat exchangers and all necessary features and auxiliary devices for the exchange of sensible heat and (if available) air humidity between exhaust air and supply air. The HRC will be installed in casings or ducts. If fans are part of the test unit, the effect of the fan power on the measured values will be corrected. This document specifies procedures and input criteria required for tests to determine the performance of a HRC at one or several test conditions, each of them with continuous and stationary air flows, air temperatures and humidities at both inlet sides. Three different test types are covered: — Test type A, Laboratory testing of HRC installed in test casings (A1) or a HRC sections (A2); — Test type B, Laboratory testing of HRC installed in non-residential ventilation units in design configuration; — Test type C, on-site (field) testing of HRC in non-residential ventilation units (C1) or a HRC sections (C2) in operation configuration. This document is applicable to recuperators, regenerators, and HRC with intermediary heat transfer medium. This document prescribes test methods for determining: 1) the temperature and humidity efficiency, 2) the pressure drop of exhaust air and supply air sides, 3) possible internal leakages; exhaust air transfer ratio (EATR) and outdoor air correction factor (OACF), 4) external leakages and 5) auxiliary energy used for the operation of the HRC.

The general requirements considered in EN 308 are as follows:

- Heat recovery device
- External leakage
- Internal exhaust leakage
- Carry-over
- Temperature and humidity ratios
- Pressure drop

EN 1397 - Heat exchangers - Hydronic room fan coil units - Test procedures for establishing the performance

This European Standard applies to room fan-coil units using hot or chilled water or water mixtures. It applies to units designed for an air flow of not more than 0,7 m^3/s and an external static pressure due to duct resistance of 65 Pa max. Air heating may be achieved by means of electrical resistance heaters.

The main characteristics considered in EN 1397 are as follows:

- Air flow rate test for ducted unites
- Capacity rating (cooling, heating, moisture, condensate flow)
- Sweat test

EN 13141-8 - Ventilation for buildings - Performance testing of components/products for residential ventilation - Part 8: Performance testing of non-ducted mechanical supply and exhaust ventilation units (including heat recovery)

This document specifies the laboratory test methods and test requirements for the testing of aerodynamic, thermal, acoustic and the electrical performance characteristics of non-ducted mechanical supply and exhaust residential ventilation units used in single dwellings. The purpose of this document is not to consider the quality of ventilation but to test the performance of the equipment. In general, a ventilation unit contains: - fans for mechanical supply and exhaust; - air filters; - air-to-air heat exchanger for heat and possibly humidity recovery; - control system; - inlet and outlet grilles. Such equipment can be provided in more than one assembly, the separate assemblies of which are designed to be used together. Such equipment can contain alternating heat exchangers which provide separate supply and exhaust air flows. In certain cases, i.e. alternating ventilation unit, it may be declared that the equipment can be installed in such a way that it serves more than one room. For the purpose of this document, these products are assessed in a single room.

The main characteristics considered in EN 13141-8 are as follows:

- External leakage
- Internal leakage
- Internal mixing
- External mixing
- Air flow
- Filter bypass leakage
- Temperature ratio
- Functioning at low outdoor temperature

- Sound power level radiated in the indoor space
- Sound power level radiated in the outdoor space
- Effective power input

EN 13142 - Ventilation for buildings - Components/products for residential ventilation - Required and optional performance characteristics

This document specifies and classifies the component/product performance characteristics, which may be necessary for the design, rating and dimensioning, placing on the market of residential ventilation products and systems to provide the predetermined performance, comfort conditions of temperature, air velocity, humidity, hygiene and sound in the occupied zone.

It defines those performance characteristics (mandatory or optional) which shall be determined, measured and presented according to relevant test methods. It provides a classification scheme, which leads to a full definition of product properties based on test methods described in various EN Standards, and gives an overview of the test standards. Distinction between mandatory and optional requirement is left to each European and national regulations.

This document does not apply to other products such as filters, fire dampers, ducts, control devices and sound attenuators, which may also be incorporated in residential ventilation. This European Standard specifies in Annex ZA and Annex ZB the requirements of EU 1253/2014 and EU 1254/2014 for residential ventilation units below 1 000 m3/h air volume flow. This European Standard does not cover requirements raised by European Directives (e.g. low voltage directive, EMC directive) and other requirements such as corrosion, reaction to fire and snow penetration.

The main characteristics considered in EN 13142 are as follows:

- Air flow rate/ pressure performance
- Acoustic performance
- Mechanical external and internal supply

EN ISO 16890-1 - Air filters for general ventilation - Part 1: Technical specifications, requirements and classification system based upon particulate matter efficiency (ePM)

It establishes an efficiency classification system of air filters for general ventilation based upon particulate matter (PM). It also provides an overview of the test procedures, and specifies general requirements for assessing and marking the filters, as well as for documenting the test results. It is intended for use in conjunction with ISO 16890-2, ISO 16890-3 and ISO 16890-4. The test method described in this part of ISO

16890 is applicable for air flow rates between 0,25 m3/s (900 m3/h, 530 ft3/min) and 1,5 m3/s (5 400 m3/h, 3 178 ft3/min), referring to a test rig with a nominal face area of 610 mm × 610 mm (24 inch × 24 inch). ISO 16890 (all parts) refers to particulate air filter elements for general ventilation having an ePM1 efficiency less than or equal to 99 % when tested according to the procedures defined within ISO 16890-1, ISO 16890-2, ISO 16890-3 and ISO 16890-4. Air filter elements with a higher initial efficiency are evaluated by other applicable test methods (see ISO 29463-1, ISO 29463-2, ISO 29463-3, ISO 29463-4 and ISO 29463-5). Filter elements used in portable room-air cleaners are excluded from the scope of this part of ISO 16890. The performance results obtained in accordance with ISO 16890 (all parts) cannot by themselves be quantitatively applied to predict performance in service with regard to efficiency and lifetime. Other factors influencing performance to be taken into account are described in Annex A of this Standard.

The main characteristics considered in EN ISO 16890-1 are as follows:

- Material (suitable material to withstand normal usage and exposures to those temperatures, humidities and corrosive environments that are likely to be encountered.)
- Nominal air flow rate
- Resistance to air flow
- Fractional efficiency curves (particle size efficiency spectrum)
- Arrestance

5.9 Batteries and accumulators Directive 2006/66/EC

5.9.1 General

This Directive establishes rules regarding the placing on the market of batteries and accumulators and, in particular, a prohibition on the placing on the market of batteries and accumulators containing hazardous substances; and specific rules for the collection, treatment, recycling and disposal of waste batteries and accumulators to supplement relevant Community legislation on waste and to promote a high level of collection and recycling of waste batteries and accumulators.

It seeks to improve the environmental performance of batteries and accumulators and of the activities of all economic operators involved in the life cycle of batteries and accumulators, e.g. producers, distributors and end-users and, in particular, those operators directly involved in the treatment and recycling of waste batteries and accumulators

This Directive shall apply to all types of batteries and accumulators, regardless of their shape, volume, weight, material composition or use. It shall apply without prejudice to Directives 2000/53/EC and 2002/96/EC.

A *Battery or accumulator* is defined as follows: means any source of electrical energy generated by direct conversion of chemical energy and consisting of one or more primary battery cells (non-rechargeable) or consisting of one or more secondary battery cells (rechargeable).

The prohibitions mentioned before are listed below. Without prejudice to Directive 2000/53/EC, Member States shall prohibit the placing on the market of:

a. all batteries or accumulators, whether or not incorporated into appliances, that contain more than 0,0005 % of mercury by weight; and
b. portable batteries or accumulators, including those incorporated into appliances, that contain more than 0,002 % of cadmium by weight.

5.9.2 Reference standards applicable to components under Directive 2006/66/EC

EN IEC 60086-1 - Primary batteries - Part 1: General

It is intended to standardize primary batteries with respect to dimensions, nomenclature, terminal configurations, markings, test methods, typical performance, safety and environmental aspects. This document on one side specifies requirements for primary cells and batteries. On the other side, this document also specifies procedures of how requirements for these batteries are to be standardised. As a classification tool for primary batteries, this document specifies system letters, electrodes, electrolytes, and nominal as well as maximum open circuit voltage of electrochemical systems. The object of this part of IEC 60086 is to benefit primary battery users, device designers and battery manufacturers by ensuring that batteries from different manufacturers are interchangeable according to standard form, fit and function. Furthermore, to ensure compliance with the above, this part specifies standard test methods for testing primary cells and batteries.

5.10 Pressure equipment Directive 2014/68/EU

5.10.1 General

This Directive shall apply to the design, manufacture and conformity assessment of pressure equipment and assemblies with a maximum allowable pressure PS greater than 0,5 bar. Pressure equipment means any vessels, piping, safety accessories and pressure accessories, including, where applicable, elements attached to pressurized parts, such as flanges, nozzles, couplings, supports, lifting lugs.

5.10.2 Reference standards applicable to components under Directive 2014/68/EU

No reference standard exists for the products considered in PLURAL PnU Kits.

5.11 Hazardous substances Directive 2011/65/EU (RoHS)

5.11.1 General

Amended by Directive (EU) 2015/863. This Directive lays down rules on the restriction of the use of hazardous substances in electrical and electronic equipment (EEE) with a view to contributing to the protection of human health and the environment, including the environmentally sound recovery and disposal of waste EEE. This Directive shall apply to EEE falling within the categories:

- Large household appliances.
- Small household appliances.
- IT and telecommunications equipment.
- Consumer equipment.
- Lighting equipment.
- Electrical and electronic tools.
- Toys, leisure and sports equipment.
- Medical devices.
- Monitoring and control instruments including industrial monitoring and control instruments.
- Automatic dispensers.
- Other EEE not covered by any of the categories above.

Electrical and electronic equipment (EEE) means equipment which is dependent on electric currents or electromagnetic fields in order to work properly and equipment for the generation, transfer and measurement of such currents and fields and designed for use with a voltage rating not exceeding 1000 volts for alternating current and 1500 volts for direct current.

Homogeneous material means one material of uniform composition throughout or a material, consisting of a combination of materials, that cannot be disjointed or separated into different materials by mechanical actions such as unscrewing

The restricted substances referred to in the directive and maximum concentration values tolerated by weight in homogeneous materials are listed below:

- Lead (0,1 %)
- Mercury (0,1 %)
- Cadmium (0,01 %)
- Hexavalent chromium (0,1 %)
- Polybrominated biphenyls (PBB) (0,1 %)
- Polybrominated diphenyl ethers (PBDE) (0,1 %)

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5.11.2 Reference standards applicable to components under RoHS

EN 50581 - Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

This European Standard specifies the technical documentation that the manufacturer needs to compile in order to declare compliance with the applicable substance restrictions. The documentation of the manufacturer's management system is outside the scope of this European Standard.

5.12 Machinery Directive 2006/42/EC (MD)

5.12.1 General

This Directive defines only the essential health and safety requirements of general application, supplemented by a number of more specific requirements for certain categories of machinery.

The essential health and safety requirements should be satisfied in order to ensure that machinery is safe; these requirements should be applied with discernment to take account of the state of the art at the time of construction and of technical and economic requirements.

This Directive has the dual aim of harmonising the health and safety requirements applicable to machinery on the basis of a high level of protection of health and safety, while ensuring the free circulation of machinery on the EU market.

The directive promotes the free movement of machinery within the single market and guarantees a high level of protection for EU workers and citizens.

5.12.2 Reference standards applicable to components under Directive 2006/42/EC

EN 13659 - Shutters - Performance requirements including safety

This European Standard specifies the performance requirements which shutters shall fulfil when fitted within a building. It deals also with the significant hazards for construction, transport, installation, operation and maintenance of the shutters (see list of significant machine hazards in annex C). It applies to all shutters as well as similar products whatever their use and nature of the materials used, as follows: - external Venetian blind, roller shutter, wing shutter, Venetian shutter, flat-closing concertina shutter, concertina shutter or sliding panel shutter, with or without a system of projection. These products can be operated manually with or without compensating spring, or by means of electric motors (power operated products).

6. Certification of PLURAL PnU Kits as innovative constructive systems

6.1 General

Innovative construction products and construction systems lack reference product standards against which to characterise and demonstrate their technical performance on the market.

In this context, the construction regulations and building codes in Europe establish mechanisms aimed at enabling the entry into the market of these products in conditions of safety and certainty regarding the technical performance they offer, through technical evaluations of their fitness for use of the innovative product or construction system (for example, Article 5.2 (5), part I of the CTE in Spain).

These evaluations are issued by technical assessment bodies -TAB- designated by the public administration based on their knowledge and experience in assessment of innovative products, independence, work procedures, etc. Frequently there is more than one TAB per country in Europe and in some cases their scope of expertise and designation is limited to certain product scopes. For instance, in Spain there are three TABs: Instituto Eduardo Torroja (IETcc), Institut de Tecnologia de la Construcció (ITeC) and Tecnalia, that offer their technical assessment services both at European level and at Spanish level (commonly known as National Approvals).

There are two main routes that respond to this need of a manufacturer to demonstrate the technical performance of their innovative construction product:

a. ETA + CE marking: European technical assessment and subsequent CE certification to achieve the CE marking of the product.
b. National Approval: technical evaluation of the suitability of the innovative product for the intended uses, in compliance with relevant National construction regulations.

These two options have a common technical evaluation base, while they show some differences in scope. The following table briefly defines the scope of each of these options, and the main benefits it brings to the manufacturer.

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TABLE 25: OVERVIEW OF THE CERTIFICATIONS SCHEMES FOR INNOVATIVE CONSTRUCTION SYSTEMS

Scope	Symbols	Documents	Description
European		ETA European Technical Assessment + Verification of manufacturing (AVCP): CE-marking	It is a: – Passport for free circulation in the European market. – Help to access to other international markets outside EU. – Differentiation of the product against the competition. It does NOT: – Imply compliance with any building regulation of any country in Europe. Include additional technical information, such as installation criteria or construction details.
National	Depending on the TAB	Evaluation document of fitness for use (e.g. in Spain DAU)	It is a: • Compliance with the National Building codes or other mandatory regulations. • Integral evaluation of the product (including project and execution criteria, constructive solutions). • Facilitates the prescription of the product in front of control bureaus, designers, installers. It does NOT: • Lead to the CE-marking of the product. Consider requirements other than those in Spanish regulations.

In a very synthetic way, the European route of the ETA + CE marking offers the manufacturer, as the main advantage over the National Approvals, a certification valid in the European Union and EFTA countries (and technical-commercial acceptance in many other countries outside of it), while the National Approval, being a specific instrument for the National regulatory context, provides more technical content than the ETA+CE marking, since it addresses technical aspects of the product that are complementary to the features offered by the product, such as:

- The project criteria for a correct use of the product in the project phase.
- The execution criteria for a correct installation of the product in the execution phase on site.
- Analysis of compliance with construction regulations in the country.

In summary, both options are useful to the designer or user of the innovative product or system to know with certainty the certified technical performance offered by said product. In addition to that, the National

Approval also offers -unlike the ETA- the analysis of the fitness for use of the product and the compliance of the National construction regulations.

Additional information on National Approvals is given in subchapter 8.2.

Regarding the European route of the ETA + CE marking for the certification of an innovative construction product, the main aspects to be considered are described in the next figures.

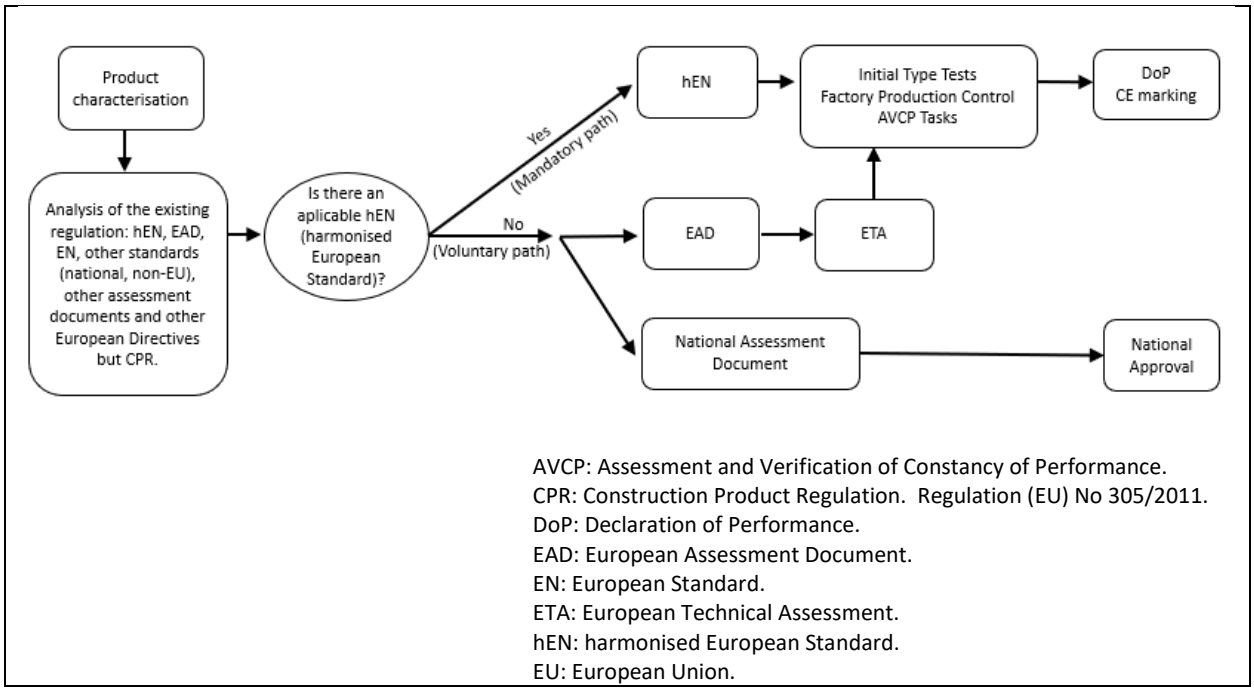

FIGURE 6.1-1: ROUTES FOR TECHNICAL ASSESSMENT OF CONSTRUCTION PRODUCTS

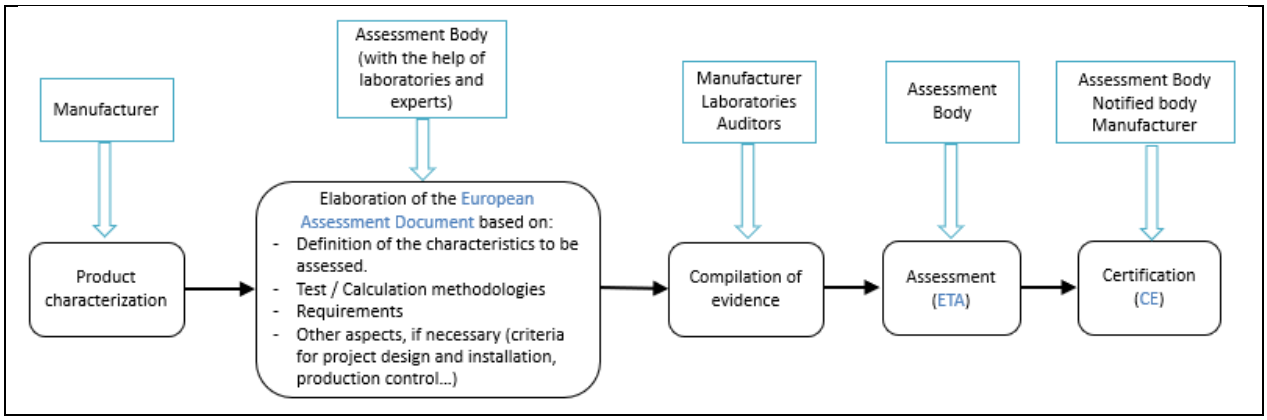

FIGURE 6.1-2: CE MARKING OF AN INNOVATIVE CONSTRUCTION PRODUCT VIA ETA

Regarding PnU Kits as whole constructive systems, no harmonised technical specification (European standard or EAD) is currently available for the technical assessment and certification of the PnU Kits. Therefore, the first step for the CE marking of the PnU Kits will be the elaboration of an EAD (European Assessment Document, hTS under CPR) by a member of EOTA[2].

In the next subchapter 6.2.2, the available harmonised technical specification (hTS) in the field of façade or external wall constructive systems are analysed, with respect to the essential characteristics and assessment methods considered, as a reference for the development of an EAD for the assessment and subsequent certification of the PnU Kits. This compilation and analysis will serve as a basis for selecting the required characteristics and assessment methods appropriate to PnU Kits, with the necessary adaptations and complementary actions, to be carried out in Task 8.2. The scope of such technical specifications does not cover the PLURAL PnU Kits, but the technical requirements, the selection of essential characteristics, and even some of the assessment methods and certification procedures, can partly be deemed as a start point.

Finally, in subchapter 6.2.3, an initial evaluation of the essential characteristics from façade-related hTS and their potential applicability to PnU Kits is shown.

Chapter 3 of EADs also contains all necessary provisions for the assessment and verification of constancy of performance within the CE marking process. This information will also be helpful to establish the cornerstones of the actions to be undertaken by the manufacturer of the product in the procedure of assessment and verification of constancy of performance, but it is not included in this deliverable since the final certification scheme strongly depends on the essential characteristics of eventually considered in the new EADs for PnU Kits. At the time of writing this deliverable, all these requirements and provisions in EADs related to factory production control are being considered in PLURAL WP6 Manufacturing & Assembly of PnU Kits.

6.2 Harmonised technical specifications (hTS) under CPR

6.2.1 General

The list of EADs, published by EOTA, related to façade constructive elements or to products installed in the field of façade or external wall constructive systems is shown in the next table. Following, in subchapter 6.2.2, an analysis has been performed of the most relevant harmonised technical specifications covering façade systems, to identify the essential characteristics considered in such technical specifications, as well

[2] EOTA: European Organisation for Technical Assessment – eota.eu.

as the associated assessment methods. It is important to mention again that in general the scope of the analysed hTS strongly deviates from the concepts of the PLURAL PnU Kits and, therefore, they are not directly applicable for their assessment and certification. However, the selection of characteristics done in the past in the development of such EADs, particularly those related to constructive systems, will be useful as reference when establishing the essential characteristics and methods of the harmonised technical specification for PLURAL PnU Kits assessment and certification.

TABLE 26: EADS RELATED TO FAÇADE CONSTRUCTIVE ELEMENTS

EAD	Title	Date
Curtain walling, cladding, structural sealant glazing		
090001-00-0404	Pre-fabricated compressed mineral wool boards with organic or inorganic finish and with specified fastening system	May 2015
090017-00-0404	Point supported vertical glazing	October 2015
090019-00-0404	Kits for ventilated external wall claddings of lightweight boards on subframe with rendering applied in situ with or without thermal insulation	December 2016
090020-00-0404	Kits for external wall claddings made of agglomerated stone	October 2016
090034-00-0404	Kit composed by subframe and fixings for fastening cladding and external wall elements	June 2016
090035-00-0404	Insulated glass unit with structural sealant punctually anchored	April 2017
090040-00-0404	Cantilevered structural glass railing/balustrade	March 2016
090058-00-0404	Ventilated external wall cladding kit comprising a metallic honeycomb panel and its associated fixings	November 2016
090062-00-0404	Kits for external wall claddings mechanically fixed	July 2018
090101-00-0404	Cruciform glazing support to be used in curtain walls	April 2018
090119-00-0404	Kits for external wall cladding of mineral boards with rendering applied in situ	July 2018
090120-00-0404	Kits for non-load bearing mineral board external wall systems	July 2018
Thermal insulation products, composite insulation kits/systems		
040005-00-1201	Factory-made thermal and/or acoustic insulation products made of vegetable or animal fibres	June 2015
040007-00-1201	Thermal insulation products for buildings with radiant heat reflective component	December 2015
040010-00-1201	Insulation product made of expanded perlite (EPB)	February 2018
040011-00-1201	Vacuum insulation panels (VIP) with factory applied protection layers	December 2017
040012-00-1201	Thermal insulation board made of mineral material	February 2018
040016-01-0404	Glass fibre mesh for reinforcement of cementitious or cement-based renderings	December 2019
040037-00-1201	Low lambda composite boards made of mineral wool fibres and aerogel additives	December 2014
040057-00-1201	Thermal insulation board made of microporous silica	May 2018

EAD	Title	Date
040065-00-1201	Thermal insulation an/or sound absorbing boards based on expanded polystyrene and cement	July 2016
040083-00-0404	External thermal insulation composite systems (ETICS) with renderings	January 2019
040089-00-0404	ETICS with renderings for the use on timber frame buildings	June 2016
040090-00-1201	Factory-made boards and products formed by moulding of an expanded polylactic acid (EPLA) for thermal and/ or acoustical insulation	November 2015
040138-01-1201	In-situ formed loose fill thermal and/or acoustic insulation products made of vegetable fibres.	May 2018
040287-00-0404	Kits for external thermal insulation composite system (ETICS) with panels as thermal insulation product and discontinuous claddings as exterior skin	June 2017
040288-00-1201	Factory-made thermal and acoustic insulation made of polyester fibres	April 2016
040369-00-1201	Insulation made of loose-fill or compound granulated expanded cork	September 2016
040419-00-1201	Thermal insulation board made of pressed rigid polyurethane foam	November 2019
040427-00-0404	Kits for external thermal insulation composite system (ETICS) with mortar as thermal insulation product and renderings or discontinuous claddings as exterior skin	July 2018
040461-00-1201	Thermal insulation product made of loose fill expanded perlite (EP)	March 2017
040465-00-0404	ETICS with renderings on mono-layer or multi-layer wall made of timber	December 2017
040643-00-1201	Fiber reinforced silica aerogel thermal insulation	May 2017
040729-00-1201	Thermal insulation made of loose mineral wool	September 2017
040759-00-0404	External thermal insulation composite system (ETICS) with rendering on boards based on polystyrene and cement	May 2018
040773-00-1201	Expanded polystyrene foam boards as load bearing layer and thermal insulation outside the waterproofing	August 2018
40914-00-0404	Veture kits – prefabricated units for external wall insulation and their fixing devices	November 2018
041389-00-1201	Boards made of agglomerated natural cork for thermal and acoustic insulation	February 2019
041561-00-1201	In-situ formed thermal insulation made of mineral-based foam	July 2020
Wall and ceiling finishes (external and internal), Internal partition kits		
210020-00-0402	Factory made self-supporting composite PUR/PIR foam insulated metal sheet for roofing, external cladding and internal lining	August 2018
210024-00-0504	Cement-bonded board	January 2018
210046-00-1201	Thin metal composite sheet	February 2018
Fixings		
330030-00-0601	Fastener of external wall claddings	August 2018

EAD	Title	Date
330046-01-0602	Fastening screws for metal members and sheeting	January 2016
330047-01-0602	Fastening Screws for Sandwich Panels	January 2016
330196-00-0604	Plastic anchors for fixing of ETICS with rendering	June 2016
330196-01-0604	Plastic anchors made of virgin or non-virgin material for fixing of ETICS with rendering	June 2017
330389-00-0601	Point connector made of glass fibre reinforced polymer for sandwich walls	May 2017
330965-00-0601	Powder actuated fastener for the fixing of ETICS in concrete	March 2017
331433-00-0601	Injected anchor for thermal insulation boards	August 2018
332229-00-0602	Stainless steel point fastener for glass claddings	August 2019
333220-00-0601	Pre-installed anchor for fastening concrete façade elements	January 2021

6.2.2 Analysis of harmonised technical specification related to façade constructive elements

The following harmonised technical specifications (5 EADs and 1 hEN) are analysed below:

- EAD 090062-01-0404 - KITS FOR EXTERNAL WALL CLADDINGS MECHANICALLY FIXED
- EAD 090285-00-0404 - KITS FOR MODULAR INDUSTRIALIZED FAÇADE SKIN SYSTEMS
- EAD 090034-00-0404 - KIT COMPOSED BY SUBFRAME AND FIXINGS FOR FASTENING CLADDING AND EXTERNAL WALL ELEMENTS
- EAD 040083-00-0404 - EXTERNAL THERMAL INSULATION COMPOSITE SYSTEMS (ETICS) WITH RENDERINGS
- EAD 040914-00-0404 - VETURE KITS – PREFABRICATED UNITS FOR EXTERNAL WALL INSULATION AND THEIR FIXING DEVICES
- EN 13830 - CURTAIN WALLING - PRODUCT STANDARD

EAD 090062-01-0404 - KITS FOR EXTERNAL WALL CLADDINGS MECHANICALLY FIXED

The EAD covers the assessment of kits for external wall claddings mechanically fixed, consisting of the following components:

- Cladding elements.
- Cladding fixings made of metal materials (steel or aluminium alloys).
- Subframe (optional) such as profiles, brackets, screws, rivets, or metal anchors.
- Thermal insulation layer (optional).
- Other ancillary components (optional) such as breather membrane, cavity barriers, joint sealants, or strips.

The EAD covers the intended use of external wall claddings (rainscreens) as external finishes of walls:

- in ventilated façades, and/or
- in non-ventilated façades.

Cladding kits are fixed to external vertical walls made of masonry (clay, concrete or stone), concrete (cast on site or as prefabricated panels), timber or metal frame in new or existing buildings (retrofit).

TABLE 27: ESSENTIAL CHARACTERISTICS AND ASSESSMENT METHODS IN EAD 090062-01-0404

BWR	Essential characteristic	Assessment method
BWR 1	Not relevant	---
BWR 2	Reaction to fire	EN 13501-1 and EAD 090062-01-0404
	Façade fire performance	EAD 090062-01-0404, Annex Q
	Propensity to undergo continuous smouldering	EN 16733
BWR 3	Watertightness of joints (protection against driving rain)	EN 12865 Procedure A and Annex D of EAD 090062-01-0404
	Water absorption	EAD 090062-01-0404, cl. 2.2.5. Thermal insulation: EN ISO 29767, EN ISO 16535 and EN ISO 16536
	Water vapour permeability (for non-ventilated façades)	EAD 090062-01-0404, cl. 2.2.6. Cladding element: EN ISO 12572 Thermal insulation: EN 12086 Breather membrane: EN ISO 12572
	Drainability	EAD 090062-01-0404, cl. 2.2.7
	Content, emission and/or release of dangerous substances (Leachable substances)	CEN/TS 16637-2
BWR 4	Wind load resistance	EAD 090062-01-0404, Annex E
	Resistance to horizontal point loads	EAD 090062-01-0404, Annex F
	Impact resistance	EAD 090062-01-0404, Annex G
	Mechanical resistance of the cladding element	EAD 090062-01-0404, cl. 2.2.12.1 to 2.2.12.4
	Mechanical resistance of the connection between cladding and its fixing	EAD 090062-01-0404, cl. 2.2.12.5 to 2.2.12.10
	Mechanical resistance of the cladding fixing	EAD 090062-01-0404, cl. 2.2.12.11 to 2.2.12.13
	Resistance of profiles	EAD 090062-01-0404, cl. 2.2.12.14
	Tension/pull-out resistance of subframe fixings	EAD 090062-01-0404, cl. 2.2.12.15
	Shear load resistance of subframe fixings	EAD 090062-01-0404, cl. 2.2.12.16
	Bracket resistance (horizontal and vertical load)	EAD 090062-01-0404, cl. 2.2.12.17
	Resistance to seismic loads. Out-of-plane fundamental vibration period	EAD 090062-01-0404, Annex R
	Resistance to seismic loads. Out-of-plane acceleration	EAD 090062-01-0404, Annex R
	Resistance to seismic loads. In-plane displacement	EAD 090062-01-0404, Annex R
BWR 5	Airborne sound insulation	EN ISO 10140-1 Annex G
BWR 6	Thermal resistance	Kit (calculation): EN ISO 6946 Components: EN ISO 10456 or EN 12667, EN 12939, EN 12664, EN ISO 8990 Thermal bridges: EN ISO 10211
Durability	Hygrothermal behaviour	EAD 090062-01-0404, cl. 2.2.16.1
	Behaviour after pulsating load	EAD 090062-01-0404, cl. 2.2.16.2
	Freeze-thaw resistance	EAD 090062-01-0404, cl. 2.2.16.3

BWR	Essential characteristic	Assessment method
	Behaviour after immersion in water	EAD 090062-01-0404, cl. 2.2.16.4
	Dimensional stability (humidity/temperature)	EAD 090062-01-0404, cl. 2.2.16.5
	Chemical and biological resistance	Depending on the component material: EN 335, EN 350, EN ISO 6988, EN 12326-1, EN ISO 10545-13, EN 15534-1
	UV radiation resistance	Depending on the component material: EN 16153, EN 1013, EN 13245-1, EN 15534-1
	Corrosion	EAD 090062-01-0404, cl. 2.2.16.8
	Ageing behaviour of kits with thin metallic composite panels	EAD 090062-01-0404, cl. 2.2.16.9

EAD 090285-00-0404 - KITS FOR MODULAR INDUSTRIALIZED FAÇADE SKIN SYSTEMS

The EAD is not yet published and is being developed in EOTA for DENVELOPS (who as a partner of PLURAL has given his permission for disclosing the following information). The core system covered by the EAD is similar to the system being developed as PLURAL PnU Kit and, therefore, this EAD will be a very appropriate basis for the development of an assessment document for HybridWall PnU Kit.

The EAD covers the assessment of kits for modular industrialized façade skin systems (from now on MIFSS) which consist of the following components:

- Modular industrialized fabric: vertical profiles made of steel or aluminium alloy, connectors made of steel or aluminium alloy, hinges (optional) made of steel or aluminium alloy, fixing devices (screws, rivets, nuts, etc.), skin elements (optional) and skin element mechanical fixings (optional), integrated thermal insulation panels (optional), integrated metal banister.
- Supporting device made of steel or aluminium alloy: load-guide, load-point (optional) and fixing devices to connect the modular fabric with the building supporting structure.
- Retaining device made of steel or aluminium alloy.
- Anchors (optional).

MIFSS kits are mechanically fixed to supporting building structure or external vertical walls made of masonry (clay, concrete or stone), concrete (cast on site or as prefabricated panels), timber or metal frame in new or existing buildings (retrofit).

TABLE 28: ESSENTIAL CHARACTERISTICS AND ASSESSMENT METHODS IN EAD 090285-00-0404

BWR	Essential characteristic	Assessment method
BWR 1	Not relevant	---
BWR 2	Reaction to fire	EN 13501-1 and EAD 090062-01-0404
	Façade fire performance	EAD 090062-01-0404, Annex Q
	Propensity to undergo continuous smouldering	EN 16733
BWR 3	Watertightness of joints (protection against driving rain)	EN 12865 Procedure A and Annex D of EAD 090062-01-0404

BWR	Essential characteristic	Assessment method
	Water absorption	EAD 090062-01-0404, cl. 2.2.5. Thermal insulation: EN ISO 29767, EN ISO 16535 and EN ISO 16536
	Drainability	EAD 090062-01-0404, cl. 2.2.7
	Content, emission and/or release of dangerous substances (Leachable substances)	CEN/TS 16637-2
BWR 4	Wind load resistance	EAD 090062-01-0404, Annex E, and EAD 090285-00-0404, cl. 2.2.1
	Resistance to external horizontal point loads	EAD 090062-01-0404, Annex F
	Resistance to internal horizontal point loads	EAD 210005-00-0505, cl. 2.2.8
	External impact resistance	EAD 090285-00-0404, cl. 2.2.2
	Internal impact resistance	EAD 090285-00-0404, cl. 2.2.3
	Mechanical resistance of the skin element	EAD 090285-00-0404, cl. 2.2.4
	Mechanical resistance of the modular fabric	EAD 090285-00-0404, cl. 2.2.5
	Mechanical resistance of the supporting device	EAD 090285-00-0404, cl. 2.2.6
	Mechanical resistance of the retaining device	EAD 090285-00-0404, cl. 2.2.7
	Mechanical resistance of the integrated banister	EAD 090285-00-0404, cl. 2.2.8
	Safety against personal injuries by contact	EAD 210005-00-0505, cl. 2.2.11
	Resistance to seismic loads	EAD 090062-01-0404, cl. 2.2.13
BWR 5	Airborne sound insulation	EN ISO 10140-1 Annex G
BWR 6	Thermal resistance	Kit (calculation): EN ISO 6946 Components: EN ISO 10456 or EN 12667, EN 12939, EN 12664, EN ISO 8990 Thermal bridges: EN ISO 10211
Durability	Hygrothermal behaviour	EAD 090062-01-0404, cl. 2.2.16.1
	Behaviour after pulsating load	EAD 090062-01-0404, cl. 2.2.16.2
	Freeze-thaw resistance	EAD 090062-01-0404, cl. 2.2.16.3
	Behaviour after immersion in water	EAD 090062-01-0404, cl. 2.2.16.4
	Dimensional stability (humidity/temperature)	EAD 090062-01-0404, cl. 2.2.16.5
	Chemical and biological resistance	Depending on the component material: EN 335, EN 350, EN ISO 6988, EN 12326-1, EN ISO 10545-13, EN 15534-1
	UV radiation resistance	Depending on the component material: EN 16153, EN 1013, EN 13245-1, EN 15534-1
	Corrosion	EAD 090062-01-0404, cl. 2.2.16.8
	Ageing behaviour of kits with thin metallic composite panels	EAD 090062-01-0404, cl. 2.2.16.9

EAD 090034-00-0404 - KIT COMPOSED BY SUBFRAME AND FIXINGS FOR FASTENING CLADDING AND EXTERNAL WALL ELEMENTS

This EAD is applicable to a kit composed of subframe and fixings for fastening skin elements (cladding elements and external wall elements) which consists of the following components:

- Skin element fixing for fastening the skin elements.
- Subframe metallic vertical profiles.
- Subframe metallic brackets.

- Subframe metallic skin element fixings.
- Ancillary components.

This EAD covers the intended use of subframe and fixing kits for the mechanical fastening of skin elements (cladding elements or external wall elements) in façades with air space, ventilated or not, and intended to be fixed to the supporting structures in new or existing buildings (retrofit).

TABLE 29: ESSENTIAL CHARACTERISTICS AND ASSESSMENT METHODS IN EAD 090034-00-0404

BWR	Essential characteristic	Assessment method
BWR 1	Not relevant	---
BWR 2	Reaction to fire	EAD 090034-00-0404, cl. 2.2.1
BWR 3	Not relevant	---
BWR 4	Wind load resistance	EAD 090034-00-0404, Annex B
	Resistance to vertical load of the whole assembled system	EAD 090034-00-0404, Annex C
	Resistance to vertical load of skin element fixings	EAD 090034-00-0404, Annex D
	Resistance to horizontal load of skin element fixings	EAD 090034-00-0404, Annex D
	Resistance to pulsating load of skin element fixings	EAD 090034-00-0404, Annex E
	Resistance of skin element fixings in case of inaccuracies of installation	EAD 090034-00-0404, Annex F
	Pull-through resistance of fixings (from profiles)	EAD 090034-00-0404, Annex G
	Inertia and resistance of profiles	EAD 090034-00-0404, cl. 2.2.10
	Resistance to vertical load of brackets	EAD 090034-00-0404, Annex H
	Resistance to horizontal load of brackets	EAD 090034-00-0404, Annex H
	Mechanical characteristics of subframe fixings	EAD 090034-00-0404, cl. 2.2.13
	Corrosion	EAD 090034-00-0404, cl. 2.2.14
BWR 5	Not relevant	---
BWR 6	Not relevant	---

EAD 040083-00-0404 - EXTERNAL THERMAL INSULATION COMPOSITE SYSTEMS (ETICS) WITH RENDERINGS

This EAD applies for External Thermal Insulation Composite Systems (ETICS) with renderings (rendering system) to be applied as external thermal insulation on the walls of buildings. The walls are made of masonry (bricks, blocks, stones...) or concrete (cast on site or as prefabricated panels) with or without rendering systems. Depending on fixing method of thermal insulation the EAD covers the ETICS as follows:

- Purely bonded ETICS with 20 % as minimum bonded area,
- Bonded ETICS with supplementary mechanical fixings with 20 % as minimum bonded area,
- Mechanically fixed ETICS with supplementary adhesive with 20 % as minimum bonded area,
- Purely mechanically fixed ETICS with bonded area less than 20 %.

The ETICS may be used on new or existing (retrofit) vertical building walls. They may also be used on horizontal or inclined surfaces which are not exposed to precipitation. The ETICS gives the building wall to which it is applied additional thermal insulation and protection from effects of weathering. ETICS are non-

load-bearing construction elements. They do not contribute directly to the stability of the building wall on which they are installed. ETICS are not intended to ensure the air tightness of the building structure.

TABLE 30: ESSENTIAL CHARACTERISTICS AND ASSESSMENT METHODS IN EAD 040083-00-0404

BWR	Essential characteristic			Assessment method
BWR 1	Not relevant			---
BWR 2	Reaction to fire	ETICS		EN 13501-1 / EN 15715 / EAD 040083-00-0404, cl. 2.2.1
		Thermal insulation		
		Adhesive		
	Façade fire performance			EAD 040083-00-0404, Annex C
	Propensity to undergo continuous smouldering			EN 16733
BWR 3	Content, emission and/or release of dangerous substances (Leachable substances)			CEN/TS 16637-2
	Water absorption	Base coat and rendering system		EAD 040083-00-0404, cl. 2.2.5.1
		Thermal insulation		According to harmonised technical specification or EN 1609/Method A
	Watertightness of the ETICS: Hygrothermal behaviour			EAD 040083-00-0404, cl. 2.2.6
	Watertightness: Freeze thaw performance			EAD 040083-00-0404, cl. 2.2.7
	Impact resistance			EAD 040083-00-0404, cl. 2.2.8 EN ISO 7892
	Water vapour permeability	Rendering system (equivalent air thickness s_d)		EAD 040083-00-0404, cl. 2.2.9.1 EN ISO 7783
		Thermal insulation (water-vapour resistance factor)		EN 12086
BWR 4	Bond strength	Between base coat and thermal insulation		EAD 040083-00-0404, cl. 2.2.11.1
		Between adhesive and substrate		EAD 040083-00-0404, cl. 2.2.11.2
		Between adhesive and thermal insulation		EAD 040083-00-0404, cl. 2.2.11.3
		Foam adhesives		EAD 040083-00-0404, Annex F
	Fixing strength (transverse displacement test)			EAD 040083-00-0404, cl. 2.2.12
	Wind load resistance	Pull-through tests of fixings		EAD 040083-00-0404, cl. 2.2.13.1
		Static foam block test		EAD 040083-00-0404, cl. 2.2.13.2
		Dynamic wind uplift test		EAD 040083-00-0404, cl. 2.2.13.3
	Tensile test perpendicular to the faces of the thermal insulation		Dry conditions	According to harmonised technical specification or EN 1607
			Wet conditions	According to harmonised technical specification or EAD 040083-00-0404, cl. 2.2.14.2
	Shear strength and shear modulus of elasticity test of ETICS			According to harmonised technical specification or EN 12090
	Pull-through resistance of fixings from profiles			EAD 040083-00-0404, cl. 2.2.16
	Render strip tensile test			EAD 040083-00-0404, cl. 2.2.17
	Shear strength and shear modulus of foam adhesive			EAD 040083-00-0404, Annex F
	Post expansion behaviour of foam adhesives			EAD 040083-00-0404, Annex F
	Bond strength after ageing	Finishing coat tested on the rig		EAD 040083-00-0404, cl. 2.2.20.1
		Finishing coat not tested on the rig		EAD 040083-00-0404, cl. 2.2.20.2
	Mechanical and physical characteristics of the mesh			EAD 040016-00-0404
	Tensile strength of the glass fibre mesh			EAD 040016-00-0404
	Protection of metal mesh			EN ISO 1460 / EN ISO 1461 / EN 10244-2
BWR 5	Airborne sound insulation			EN ISO 10140-1 / EN ISO 10140-2 /

BWR	Essential characteristic	Assessment method
		ISO 10140-5
	Dynamic stiffness of the thermal insulation	According to harmonised technical specification or EN 29052-1
	Air flow resistance of the thermal insulation	According to harmonised technical specification or EN 29053, method A
BWR 6	Thermal resistance and thermal transmittance of ETICS	EAD 040083-00-0404, cl. 2.2.23 EN 12667 / EN 12664 / EN 12939

EAD 040914-00-0404 - VETURE KITS – PREFABRICATED UNITS FOR EXTERNAL WALL INSULATION AND THEIR FIXING DEVICES

This EAD covers the assessment of VETURE kits for the thermal insulation of external walls. They consist of the following components:

- VENTURE unit. Prefabricated component to be delivered on site as a factory made unit composed of:
    1. Factory made thermal insulation products.
    2. Skin. Factory applied coverings such as claddings (tiles, boards…) or renders.
    3. Skin-attachment. Factory applied mode to attach the skin to the thermal insulation product.
- VETURE fixing devices such as rails, profiles or punctual fixings.
- Anchors between the VETURE fixing device and the substrate (optional).
- Other ancillary components (optional) such as grout or sealant material for the joints, supplementary thermal insulation products, etc.

The VETURE kits are non-load bearing construction elements. They do not contribute to the stability of the wall on which they are installed. The VETURE kits can contribute to durability of the works by providing enhanced protection from the effect of weathering. They are not intended to ensure airtightness of the building.

VETURE kits are intended to be mechanically fixed on external vertical walls made of masonry (clay, concrete or stone), concrete (cast on site or as prefabricated panels) in new or existing buildings (retrofit).

TABLE 31: ESSENTIAL CHARACTERISTICS AND ASSESSMENT METHODS IN EAD 040914-00-0404

BWR	Essential characteristic	Assessment method
BWR 1	Not relevant	---
BWR 2	Reaction to fire	EN 13501-1 and EAD 040914-00-0404
	Façade fire performance	EAD 040914-00-0404, Annex O
	Propensity to undergo continuous smouldering	EN 16733
BWR 3	Watertightness (resistance to driving rain)	EN 12865 Procedure A and EAD 040914-00-0404, cl. 2.2.4

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BWR	Essential characteristic		Assessment method
	Water absorption by capillarity		EAD 040914-00-0404, Annex B
	Water vapour permeability		EAD 040914-00-0404, cl. 2.2.6, EN ISO 12572
	Accelerated ageing behaviour (Moisture behaviour)		EAD 040914-00-0404, cl. 2.2.7
	Content, emission and/or release of dangerous substances		CEN/TS 16637-2
BWR 4	Wind load resistance		EAD 040914-00-0404, Annex E
	Bond strength (only for skin adhesively attached)		EAD 040914-00-0404, Annex F
	Tensile strength		EN 1607 and EAD 040914-00-0404, cl. 2.2.11
	Pull-through resistance	Through the insulation product	EAD 040914-00-0404, Annex G
		Through the skin	EAD 040914-00-0404, Annex G
		Through the fixing device	EAD 040914-00-0404, Annex G
	Resistance of the grooves	Grooved insulation product	EAD 040914-00-0404, Annex H
		Grooved skin	EAD 040914-00-0404, Annex H
	Dead load resistance		EAD 040914-00-0404, Annex I
	Displacement behaviour		EAD 040914-00-0404, Annex J
	Resistance to horizontal point loads		EAD 040914-00-0404, Annex K
	Impact resistance		EAD 040914-00-0404, Annex L
BWR 5	Airborne sound insulation		EN ISO 10140-1 Annex G.
BWR 6	Thermal resistance		Kit (calculation): EN ISO 6946 Components: EN ISO 10456 or EN 12667, EN 12939, EN 12664, EN ISO 8990 Thermal bridges: EN ISO 10211
Durability	Dimensional stability: by humidity		According to harmonised technical specification or EN 318 or EN 1170-7.
	Dimensional stability: by temperature		According to harmonised technical specification or cl. 3.2.6 of EN 1993-1-1, cl. 3.2.5 of EN 1999-1-1 or EN 14617-11.
	Thermal shock		EAD 040914-00-0404, cl. 2.2.7 or Annex M
	Chemicals and biological resistance		According to harmonised technical specification
	Corrosion		EAD 040914-00-0404, cl. 2.2.20.5
	UV radiation resistance		According to harmonised technical specifications or depending on the component material: EN ISO 877-1, EN ISO 877-3, EN ISO 4892-1, EN ISO 4892-2, EN ISO 4892-3, EN 927-2, EN 13245-2, EN 10169.

EN 13830 - CURTAIN WALLING - PRODUCT STANDARD

This European Standard specifies requirements of curtain walling kit intended to be used as a building envelope to provide weather resistance, safety in use and energy economy and heat retention and provides test/assessments/calculation methods and compliance criteria of the related performances. The curtain walling kit covered by this standard should fulfil its own integrity and mechanical stability but does not contribute to the load bearing or stability of the main building structure, and could be replaced

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independently of it. This standard applies to curtain walling kit ranging from a vertical position to ± 15° from the vertical. Any sloping parts should be contained within the curtain walling kit. This standard is applicable to the whole of the curtain walling kits, including the fixings. Curtain walling according to this standard is intended to be used as part of the building envelope.

TABLE 32: ESSENTIAL CHARACTERISTICS AND ASSESSMENT METHODS IN EN 13830

Essential characteristic		Assessment method
Reaction to fire		EN 13501-1
Resistance to fire		EN 13501-2 (EN 1364-3, EN 1364-4)
Façade fire performance		According to National regulations
Watertightness		EN 12155 / EN 12154 / EN 13050
Resistance to dead weight		EN 1991-1-1
Resistance to wind load		EN 12179 / EN 13116 / EN 1991-1-4
Resistance to snow load		EN 1991-1-3
Impact resistance		EN 14019
Resistance to horizontal point loads		EN 1991-1-1
Resistance to seismic loads		EN 1998-1 / EN 13830, Annex B
Resistance to thermal shock		EN 13830
Airborne sound insulation		EN ISO 10140-2 / EN ISO 717-1
Flanking sound transmission		EN ISO 10848-1 / EN ISO 10848-2 / EN ISO 717-1
Thermal transmittance		EN ISO 12631 / EN ISO 12567-1 / EN 12412-2
Air permeability		EN 12153 / EN 12152
Radiation		EN 410
Durability	Watertightness	EN 13830, cl. 5.17.2
	Thermal transmittance	EN 13830, cl. 5.17.3
	Air permeability	EN 13830, cl. 5.17.4

6.2.3 Initial evaluation of the essential characteristics from façade-related hTS

In the next table, the essential characteristics considered in the above analysed EADs related to façade constructive elements, as well as in EN 13830, are given in relation to their potential applicability to PnU Kits. As described in the previous pages, the systems covered by the technical specifications significantly deviate from the PnU Kits (except in the case of EAD 090285-00-0404 and HybridWall PnU Kit, as explained). However, the main purpose of this subchapter, summarised in the next table, is to have identified the nature of the characteristics required on a constructive system installed in a building façade, to later (Task 8.2) adapt such characteristics and the associated assessment methods to the particularities of the PnU Kits, when relevant. This initial cross-analysis is a first approach to the potential selection of characteristics for the assessment and certification process, but it can change during the development of Task 8.2. The selection will strongly depend on the final design of the PnU Kits to be certified, as well as the main target markets and the manufacturer interests.

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TABLE 33: ESSENTIAL CHARACTERISTICS FROM FAÇADE-RELATED THS AND APPLICABILITY TO PNU KITS

BWR	Essential characteristic	SmartWall	HybridWall	ConExWall
1	-	PnU Kits do not have a loadbearing function. Mechanical resistance against actions (e.g. wind or seismic loads) are dealt under BWR 4 through the technical characterisation of the mechanical resistance of the Kits/components.		
2	Reaction to fire	Yes	Yes	Yes
	Resistance to fire	Yes. Requirement applicable to the whole external wall element.		
	Façade fire performance	Yes. Required only in some Member States. No European harmonised test method is available.		
	Propensity to undergo continuous smouldering	Yes: assessment by components where relevant (e.g. mineral wool insulation)		
3	Watertightness of joints (protection against driving rain)	No	Yes	No
	Watertightness of the system	Yes	No	Yes
	Water absorption	Yes. In relation to the insulation characteristics.		
	Water vapour permeability	Yes	No	Yes
	Drainability	No	Yes	No
	Content, emission and/or release of dangerous substances (	Yes	Yes	Yes
4	Wind load resistance	Yes	Yes	Yes
	Resistance to horizontal point loads	Yes	Yes	Yes
	Impact resistance	Yes	Yes	Yes
	Mechanical resistance of cladding elements	Yes. Final definition of the appropriate characteristics is necessary (T8.1).		
	Mechanical resistance of subframe	Yes. Final definition of the appropriate characteristics is necessary (T8.1).		
	Mechanical resistance of fixings	Yes. It concerns all fixings, both within the own PnU system and also to the existing building structure. Final definition of the appropriate characteristics is necessary (T8.1).		
	Mechanical resistance (banister)	Yes, if relevant due to final PnU Kits design		
	Safety against personal injuries by contact	Depending on the final PnU Kit design	Yes	Depending on the final PnU Kit design
	Resistance to seismic loads	Yes. Final definition of the appropriate characteristics is necessary (T8.1).		
5	Airborne sound insulation	Yes	Yes	Yes
6	Thermal resistance	Yes	Yes	Yes
Durability	Hygrothermal behaviour	Yes	Yes	Yes
	Behaviour after pulsating load	No	Yes	No
	Freeze-thaw resistance	Yes	Yes	Yes
	Behaviour after water immersion	Yes	Yes	Yes
	Dimensional stability (humidity/temperature)	Yes	Yes	Yes
	Chemical and biological resistance	Yes	Yes	Yes
	UV radiation resistance	Yes	Yes	Yes
	Corrosion	Yes	Yes	Yes
	Ageing behaviour of kits with thin metallic composite panels	No	Yes	No

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7. Certification of sustainability performance of PLURAL PnU Kits

7.1 General – European framework

Regarding the product environmental requirements and characterisation, there are many regulations but few mandatory standards. One of the most important regulations, although not yet mandatory, is the LEVEL(s) Project. An environmental indicators project, promoted by the European Commission through the Joint Research Centre (JRC). The LEVEL(s) project determines the need to calculate the environmental impact (carbon footprint included) at the product and building model through calculating the life cycle analysis of the total construction work. The idea is that it will be mandatory in 2030 and for this reason it is convenient to consider the LEVEL(s) project.

It must also be noticed that the Construction Products Regulation (CPR) is now under revision. The following information and figures are extracted from an Online Q&A session on New Construction Products Regulation, held on 14 June 2022 by European Commission Unit GROW H.1 – Construction[3], and it shows information about changes envisaged by the Commission proposal for the CPR.

One of the main purposes is to finally address the sustainability performance of construction products. The vision of the new CPR about environmental sustainability involves:

- green transition of the manufacturing processes
- overall sustainability of the built environment
- efficient use of natural resources by facilitating reuse and recycling

The new regulation on Ecodesign for Sustainable Products Regulation (ESPR, built on the current Ecodesign Directive 2009/125/EC) will improve EU products' circularity, energy performance and other environmental sustainability aspects. The principles and goals into which the new ESPR is integrated are shown in the next figure.

[3] https://ec.europa.eu/docsroom/documents/50640.

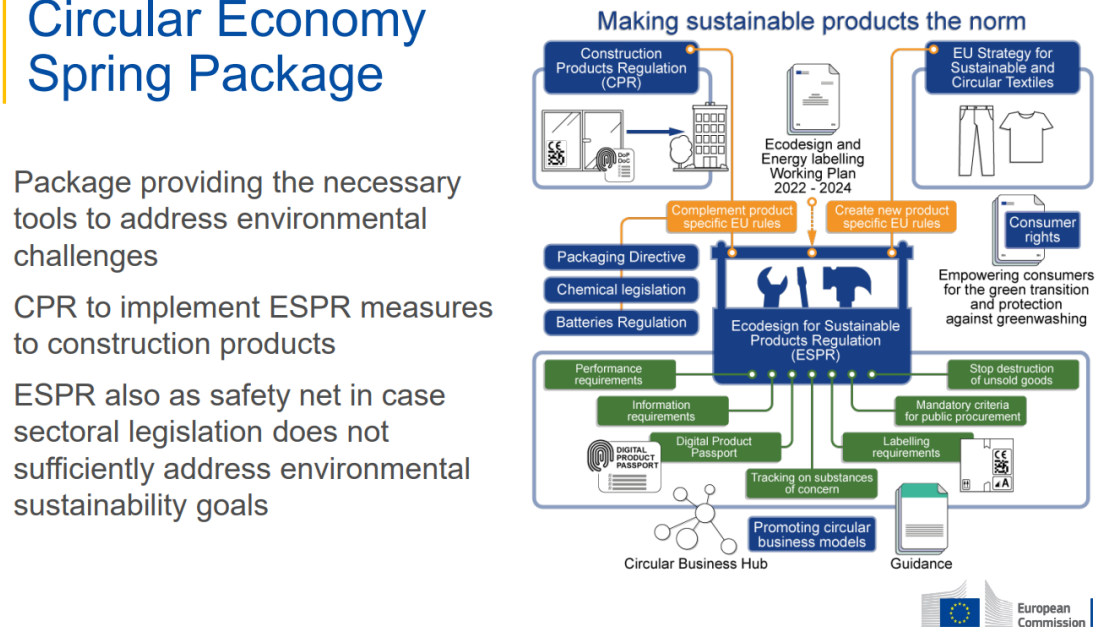

FIGURE 7.1-1: ONLINE Q&A SESSION ON NEW CPR (14.06.2022, EC UNIT GROW H.1) – EU LEGISLATION ON ENVIRONMENTAL CHALLENGES

In this context, it can be assumed that the LEVEL(s) methodology will be the tool for the assessment of sustainability of buildings. In the next figure, the connection between European regulations, as well as the integration to National regulations, is shown.

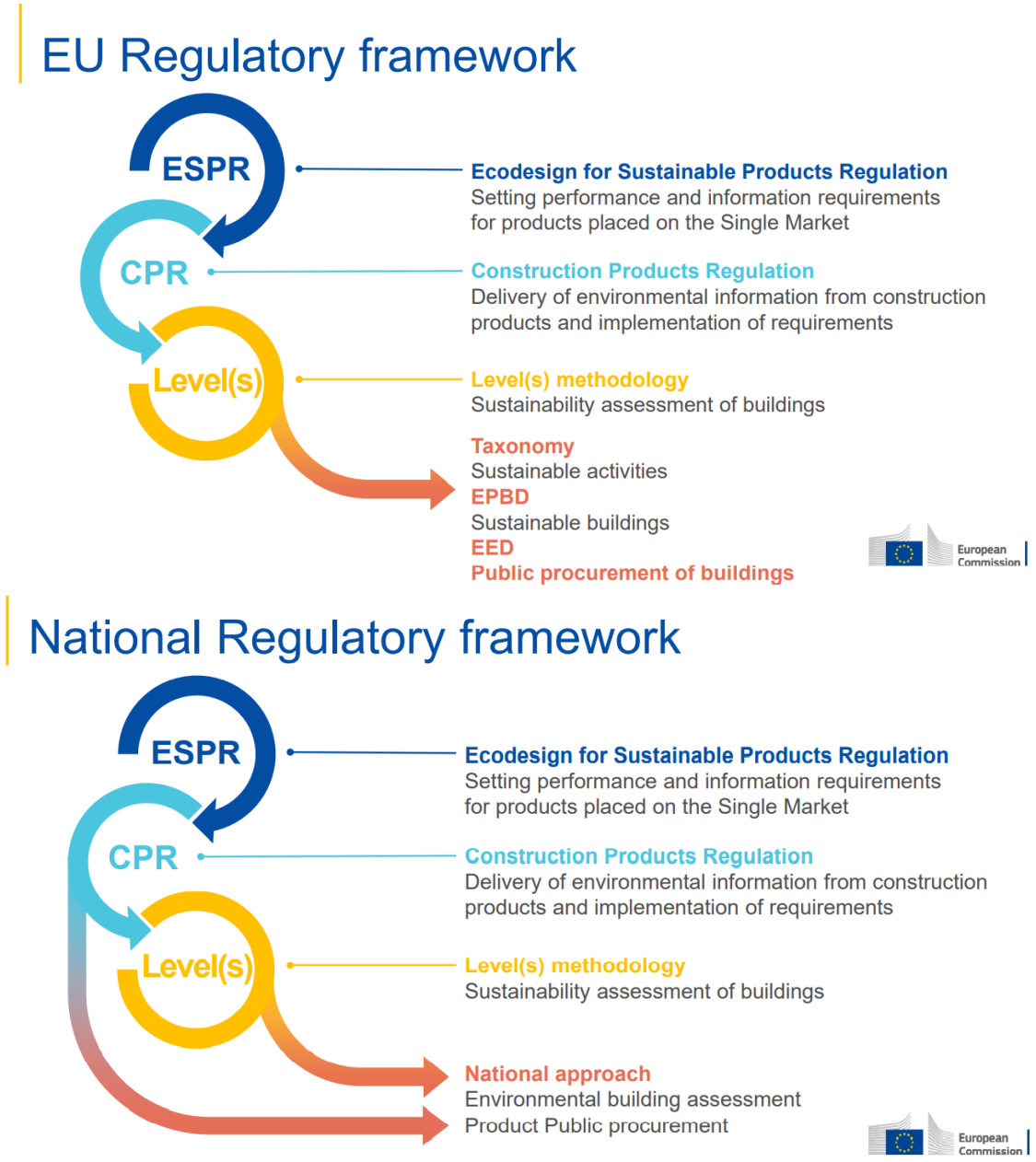

FIGURE 7.1-2: ONLINE Q&A SESSION ON NEW CPR (14.06.2022, EC UNIT GROW H.1) – FRAMEWORK OF EUROPEAN/NATIONAL REGULATIONS

A brief description of the ESPR framework is shown in the next figure.

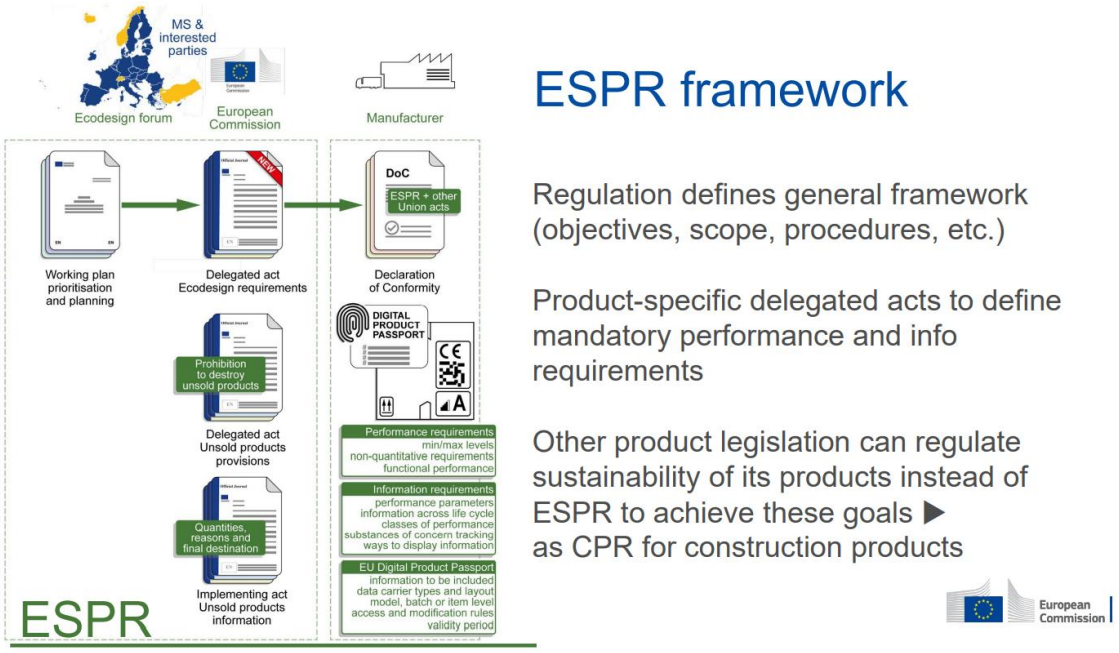

FIGURE 7.1-3: ONLINE Q&A SESSION ON NEW CPR (14.06.2022, EC UNIT GROW H.1) – ESPR FRAMEWORK

At National level, or even local level, there is a range of regulations –with different scope and status– on carbon emission targets or the information on the carbon emissions that a construction product must have, for example, various climate change laws have been published in the member states, some of them mentioning the need to incorporate the calculation of the carbon footprint in the products.

In public bidding, in recent years, there is an increasing obligation to declare environmental impacts at building level. Some of the clearest examples are:

- In France, when a construction product is marketed and its environmental characteristics are highlighted, the regulation, since July 2017, oblige the person responsible for placing it on the market to make the environmental declaration of their product and to deposit it in the place chosen by the verification program for its storage. Which is www.inies.fr.
- In Catalonia there is a Climate change law 16/2017, that requires construction products to have information on their carbon emissions.
- In Italy exists the Minimum Environmental Criteria (CAM in Italian). These criteria are established by the Plan for the environmental sustainability of consumption in the public administration sector and are adopted by Decree of the Minister of the Environment for the Protection of Land and Sea (IT).

CAMs are mandatory for all contracting stations pursuant to art. 18 of Law 221/2015, of art. 34 on "Energy and environmental sustainability criteria" of Legislative Decree no. 50/2016 "Procurement Code" (as amended by Legislative Decree 56/2017): to this day, CAM's have been adopted for 17 categories of supplies and assignments, while others are being defined.

- In Germany, the ÖKOBAUDAT is the mandatory database for the Assessment System for Sustainable Construction (Bewertungssystem Nachhaltiges Bauen, BNB). Data sets are provided for the relevant construction products, in accordance with DIN EN 15804.
- In Europe, under new CPR, it is foreseen that the sustainability performance of construction products will be assessed, regarding BWR 7 (Sustainable use of natural resources), by means of expressing the CO_2 emissions associated with the product life cycle.

In that sense, the Ecolabels (environmental labels) are a voluntary system for the environmental assessment of products that identify and certify those products with environmental impact data by means of a series of sustainability criteria.

In the case of PnU Kits, as well as regarding their integrated components, Environmental labels Type I or Type III (EPD – Environmental Product Declaration) can be appropriate tools to provide the relevant information on sustainability performance, considering that the environmental information incorporated cannot be a sum of EPDs but must be given at the PnU Kits level. The products incorporated in a PnU Kit are installed, transferred, or even modified, and all these impacts must be incorporated at the PnU Kit. Information related to the Environmental labels and associated standards and procedures is given in Chapter 7.3.

7.2 LEVEL(s)

LEVEL(s) is a European initiative to incorporate environmental indicators at the building level. LEVEL(s) provides a common language to assess and report on the Sustainability of buildings. It is a system developed by the European Commission through the JRC (Joint Research Centre) to apply the principles of the circular economy, Climate Change and Life Cycle Analysis in our built environment.

LEVEL(s) offers a well-proven system for measuring and supporting desired Sustainability improvements from design to end of life of a building. It can be applied to residential buildings or offices.

This framework provides a clear set of priorities for the environmental performance of a building and a standardized basis for establishing requirements for new and renovated buildings.

Before its official launch in October 2020, LEVEL(s) was extensively tested by projects across the EU, ITeC was one of those early beta testers, and we now offer it in our management systems. The final framework is now available and is already influencing authorities, policy makers and public buyers across the EU.

The application of LEVEL(s) allows:

- Meet the climate and recovery goals by incorporating circularity and life cycle thinking into the national, regional, or local policies, which will help the technician effectively reduce the cost of carbon throughout the life cycle through public procurement, building standards and sustainable finance.
- Measure the environmental and financial impact of sustainable construction projects on resource use and environmental performance, health and comfort, and their cost, value, and risk
- Integrate sustainability into urban planning, including the construction and renovation of public buildings and the monitoring and regulation of the sustainability and environmental performance of buildings managed by the private sector.
- Harmonize the evaluation and certification systems with the common language of LEVEL(s).

At design phase using LEVEL(s) allows:

- Quantify, analyse, and better understand the entire life cycle of a project, which includes aspects such as resource use and environmental performance, health and comfort, and cost, value, and risk.
- Future-proof the building projects by ensuring that they take these aspects of sustainability into account at the design stage, which will help the technician to increase the useful life, long-term value, and potential of the building in terms of sustainability, reuse, and recycling.
- introduce simple construction to the clients, using LEVEL(s) common language, to help them to prioritize sustainability in their construction projects.
- use cumulative information to create a feedback loop that will help the technician to compare actual and designed performance, identify lessons learned, and thereby optimize your future designs.

The European Commission started developing the LEVEL(s) framework in 2015. Subsequently, it collected extensive feedback from more than 80 projects across 21 Member States, which tested the indicators between 2017 and 2019. Authorities and decision-makers were among those involved in this process.

Compliance LEVEL(s)

The assessment of the LEVEL(s) indicators is based on the following Macro objectives:

1. Carbon Emissions for the entire Life Cycle of the Building
2. Efficient Resources and Life Cycle of Materials
3. Efficient use of water resources

4. Health and comfortable spaces
5. Adaptation and resilience to climate change
6. Value and Optimized Life Cycle Cost

Various indicators emerge from these Macro objectives as shown in the next figure.

Thematic areas	Macro objectives	Indicators			
Resource use and environmental performance	1. Greenhouse gas emissions along a buildings life cycle	1.1 Use stage energy performance (kWh/m2/yr)	1.2 Life cycle Global Warming Potential (CO2 eq./m2/yr)		
	2. Resource efficient and circular material life cycles	2.1 Bill of quantities, materials and lifespans	2.2 Construction and Demolition waste	2.3 Design for adaptability and renovation	2.4 Design for deconstruction
	3. Efficient use of water resources	3.1 Use stage water consumption (m3/occupant/yr)			
Health and comfort	4. Healthy and comfortable spaces	4.1 Indoor air quality	4.2 Time out of thermal comfort range	4.3 Lighting	4.4 Acoustics
Cost, value and risk	5. Adaption and resilience to climate change	5.1 Life cycle tools: scenarios for projected future climatic conditions	5.2 Increased risk of extreme weather	5.3 Increased risk of flooding	
	6. Optimised life cycle cost and value	6.1 Life cycle costs (€/m²/yr)	6.2 Value creation and risk factors		

FIGURE 7.2-1: LEVEL(S) MACRO OBJECTIVES AND INDICATORS

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7.3 Ecolabels

7.3.1 General

Ecolabels, also called ecological labels, are a voluntary system for the evaluation of products, materials or services that identify and certify those with less environmental impact through a series of ecological criteria.

Ecolabels allow products, materials, or services to be identified that meet criteria of "environmental goodness" in the process of manufacturing, use or at the end of life. Its purpose, therefore, is that, through the transfer of information to the user, the use of those products and services that contribute to the care and conservation of the environment is promoted.

The EN ISO 14020 standard establishes the general principles of labels:

- Reduce the environmental impact of products and services.
- Inform and encourage consumers to choose through ecological awareness.
- Encourage manufacturers to use it.
- Promote eco-design in product development.
- Motivate sales through environmental marketing.

The overall goal of eco-labelling is to use market mechanisms to stimulate continuous improvement of the environment. Through the communication of verifiable, exact, and non-based data related to the environmental aspects of products and services, it promotes the demand for those that are preferable from the environmental point of view.

Ecolabels are currently classified into three types, regulated by the EN ISO 14021, EN ISO 14024 and EN ISO 14025 standards, as shown in the next table.

TABLE 34: ECOLABELS DESCRIPTION

	Type I: Ecolabels	Type II: Environmental self-declarations	Type III. Environmental Product Declarations (EPD)
Standard	ISO 14024	ISO 14021	ISO 14025
Reason	The product meets specific environmental criteria (created by the system owner)	Indicators provided by the manufacturer itself. Own criterion	Report with a quantitative statement of environmental impact indicators
Certification	Mandatory by independent third party	Voluntary, self-certified	Mandatory by independent third party
Is the LCA contemplated?	Yes (sometimes)	No	Yes
It is necessary to calculate the LCA?	No	No	Yes

	Type I: Ecolabels	Type II: Environmental self-declarations	Type III. Environmental Product Declarations (EPD)
Communication to the final consumer	Yes	Yes	No
Examples			

The choice between one Ecolabel or another brings different environmental advantages, from complying with public regulations to carrying out private certifications at the building level that exist in the market. The way in which these certifications consider all ecolabels' changes depending on their content and the type of ecolabel.

The use of ecological labels contributes to the improvement of the environment and greatly benefits the companies that use them, since they help to make a difference and make them more competitive. There are different types of ecolabels which are generally classified into type I, II and III.

The type II eco-labels are environmental self-declarations, without the obligation to be reviewed by an independent third party, therefore, they are considered not suitable for assessing the sustainability of the Pnu Kits.

7.3.2 Type I Ecolabels

Voluntary environmental qualification system that officially identifies and certifies that certain products or services have a minor impact on the environment, considering various aspects related to sustainability.

- Different ecological labelling programs coexist.
- Each program has its specific distinctive.
- Each program defines specific product categories
- Each program defines specific environmental improvement criteria.
- Environmental data may not be quantified but qualified.
- Complies with the specific requirements of ISO 14024.
- They are granted by an independent third party, which acts as a certifying entity.
- They allow the identification of environmentally compatible products and services in a simple way.
- Aimed at B2C business models.

The main programs of type 1 Ecolabels of public initiative are shown in the following table.

TABLE 35: MAIN PROGRAMS OF TYPE 1 ECOLABELS

Name	Region	Badge
GLOBAL ECOLABELLING NETWORK	Global	
ECOLABEL	Europe	
Distintiu de Garantia de Qualitat Ambiental de la Generalitat de Catalunya	Catalonia	
BLAUER ENGEL	Germany	
NORDIC SWAN	Scandinavian countries	
UMWELTZEICHEN BAUME	Austria	
STICHTING MILIEUKEUR	Holland	
NF-ENVIRONNEMENT	France	

On the other hand, some type 1 Ecolabel programs of private initiative are shown in the next figure.

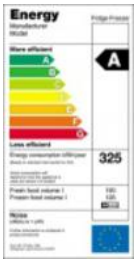
FIGURE 7.3-1: TYPE 1 ECOLABEL PRIVATE PROGRAMS

Within the framework of the PLURAL project, the type 1 Ecolabels that could be of interest for the PnU systems are summarised in the next table.

TABLE 36: TYPE 1 ECOLABELS RELEVANT FOR PLURAL PNU KITS

Name	Region	Badge	Description	Categories related to PnU Kits
ECOLABEL	Europe		European Union voluntary label for environmental excellence. Established in 1992 and recognised across Europe and worldwide, the EU Ecolabel certifies products with a guaranteed, independently-verified low environmental impact.	- Coatings - Paints and varnishes
Distintiu de Garantia de Qualitat Ambiental de la Generalitat de Catalunya	Catalonia		Catalan ecological labelling system that recognizes products and services that exceed certain environmental quality requirements beyond those established as mandatory by current regulations.	- Wooden Products - Acoustic and thermal insulation products with recycled material
AENOR Medio Ambiente	Spain		Type I ecolabel system aimed at recognizing environmentally friendly products or services. Certification procedure based on auditing and labs test. The program will mark those products with less environmental impacts. It is mainly oriented to consumer products.	- Building products - Energy - Machinery & Equipment
BASF Eco-Efficiency	Global		BASF SE has developed a label for products that have been evaluated by an Eco-Efficiency Analysis. The awarding of the label is dependent on demanding requirements: After conclusion of the analysis a third party evaluation (peer review) is requested	- Building products - Energy - Machinery & Equipment

Name	Region	Badge	Description	Categories related to PnU Kits
BLAUER ENGEL	Global		The Blue Angel was initiated by the German government and awarded by an independent Jury to products that are environmentally friendlier than others serving the same use. Each label specifies that the product or service focuses on one of four different protection goals: health, climate, water, and resources.	- Construction Products - Heating / Power
Carbon Reduction Label	Global		The Carbon Reduction Label is a public commitment that the carbon footprint of a product or service has been measured and certified and the owner of the product or service has committed to reduce that footprint over the following two years. The footprint that has been calculated will have been rigorously measured and be comparable based on the PAS2050 standard and Footprint Expert™. This will have a been full life cycle assessment including production, use and disposal.	- Building products - Energy - Machinery & Equipment
Cradle to Cradle Certified (CM) Products Program	Global		The Cradle to Cradle Certified (CM) Products Program provides a company with a means to demonstrate efforts in eco-intelligent design. Cradle to Cradle Certification is a third-party sustainability label that requires achievement across multiple attributes: - Use materials that are safe for human health and the environment through all use phases. - Product and system design for material reutilization, such as recycling or composting. - Use of renewable energy. - Efficient use of water, and maximum water quality associated with production. - Company strategies for social responsibility.	- Building products - Machinery & Equipment
Danish Indoor Climate Label	Global		The Danish Indoor Climate label is a tool for development and selection of indoor air quality friendly products and better understanding of the impact of products and materials on the indoor air quality in buildings.	- Building products
DECLARE	Global		The goal of Declare is to position the building product sector within a transparent materials economy. Declare is an ingredients label for building products, paired with an online database. It allows manufacturers to demonstrate their leadership in the marketplace and it provides consumers with honest information for product selection.	- Building products

Name	Region	Badge	Description	Categories related to PnU Kits
ECOLOGO	Global		The ECOLOGO Certification Program was acquired by UL Environment, a division of UL (Underwriters Laboratories) in 2010. ECOLOGO Certification is based on multi attribute, life cycle–based standards. All products certified to an ECOLOGO standard must meet or exceed each of the listed criteria before receiving the mark.	- Building products - Energy
EU Energy Label	Europe		By law, the European Community Energy Label must be displayed on all new household products displayed for sale, hire or hire-purchase. The Directive applies to the following types of household appliances, even where these are sold for non-household uses: refrigerators, freezers and their combinations; washing machines, dryers and their combinations; dishwashers; ovens; water heaters and hot-water storage appliances; lighting sources; air-conditioning appliances.	- Building products - Energy
Environmentally Friendly Product	Europe		The ecolabel "Ekologicky setrny vyrobek" is the official registered label of The Czech ecolabelling programme (National Programme for Labelling Environmentally Friendly Products). It was launched on 14. April 1994. The programme is administered by CENIA, Czech Environmental Information Agency. The guarantor of the programme is the Ministry of the Environment.	- Building products - Machinery & Equipment
Environmentally Friendly Label: Croatia	Croatia		The main objective of awarding the Environmental Label is the promotion of products with a reduced adverse environmental impact as compared to other equivalent products. Awarding of the Environmental Label was established to promote development of new (e.g. low-waste) technologies, production and consumption of products less adverse to the environment, pollution reduction and a more economical management of raw materials and energy. It promotes concern for environmental and consumer protection.	- Building products
GREENGUARD	Global		GREENGUARD Certification helps manufacturers create -- and helps buyers identify -- interior products and materials that have low chemical emissions into indoor air during product usage. All certified products must meet stringent emissions standards based on established chemical exposure criteria.	- Building products - Machinery & Equipment

Name	Region	Badge	Description	Categories related to PnU Kits
Green Crane: Ukraine	Ukraine		Green Crane is a voluntary, multiple specifications based environmental labelling program that operates to international standards and principles. It is awarded to products with relatively less environmental impact compared to similar products, during their entire life cycle, from extracting and collecting the product materials, to the manufacturing, distribution, use and consumption, disposal, and recycling.	- Building products
Hungarian Ecolabel	Hungary & Romania		Hungarian national ecolabel developed by the Ministry of Environment in 1994. Goals and procedures meet the requirements of ISO 14024 standard.	- Building products
EUROFINS Indoor Air Comfort	Europe		Eurofins certification considers the most stringent requirements for emissions from products across Europe in their Indoor Air Comfort 'Gold' certification scheme.	- Coatings
M1 Emission Classification of Building Materials	Global		The aim of the classification is to enhance the development and use of low-emitting building materials so that material emissions do not increase the requirement for ventilation. The classification presents requirements for the materials used in ordinary workspaces and residences. For air-handling components there is a separate Cleanliness Classification of Air-handling Components.	- Building products
Minergie-ECO	Europe		MINERGIE ECO is a label for new and refurbished low-energy-consumption buildings that addresses ecological and social requirements. It can be combined with MINERGIE, MINERGIE-P, and MINERGIE-A, which are standards that focus more on energy consumption.	- Building products - Buildings
National Programme of Environmental Assessment and Ecolabelling in the Slovak Republik (NPEHOV)	Europe		Its aim is to promote development of production and consumption of products that have impact on lowering of negative impacts on environment, energy consumption and consumption of raw material and hazardous substances, to improve among public, producers, suppliers, sellers' better knowledge about environmental performance of products, to lower pollution of environment	- Building products
Nordic Ecolabel or "Swan"	Scandinavian countries		Demonstrates that a product is a good environmental choice. The "Swan" symbol, as it is known in Nordic countries, is available for 65 product groups. The Swan checks that products fulfil certain criteria using methods such as samples from independent laboratories, certificates and control visits.	- Building products

Name	Region	Badge	Description	Categories related to PnU Kits
OK biobased	Belgium		OK biobased label offers a comprehensive guarantee about the origin of your products. On a basis of the determined percentage of renewable raw materials (% Bio-based carbon), your product can be certified as one-star-bio-based, two-star-bio-based, three-star-bio-based or four-star-bio-based.	- Building products - Machinery & Equipment
Passivhaus	Global		PassivHaus is a certification for super-energy efficient buildings meeting the code developed by the PassivHaus Institute in Germany, and administered in Canada, Germany, UK and US. A Passive House is a very well-insulated, virtually air-tight building that is primarily heated by passive solar gain and by internal gains from people, electrical equipment, etc. Energy losses are minimized. Any remaining heat demand is provided by an extremely small source. Avoidance of heat gain through shading and window orientation also helps to limit any cooling load, which is similarly minimized. An energy recovery ventilator provides a constant, balanced fresh air supply. The result is an impressive system that not only saves up to 90% of space heating costs, but also provides a uniquely terrific indoor air quality.	- Building products - Buildings
SMaRT Consensus Sustainable Product Standards	Global		Sustainable Materials Rating Technology or SMaRT, is the consensus sustainable products standard and label for building products, fabric, apparel, textile & flooring, covering over 80% of the world's products with environmental, social, & economic criteria.	- Building products - Energy - Machinery & Equipment - Buildings
eco-INSTITUT-Label	Global		With substantial emission and toxicological testing living up to more than just the legal specifications, eco-Institut supplies clients a reliable and significant label for building products and textiles without any health hazards.	- Building products
natureplus	Europe		Natureplus is an international label of quality for sustainable building and accommodation products, tested for health, environmental-friendliness and functionality. The label's primary aim is to provide consumers as well as architects, tradesmen, building companies and all those involved in construction, with a reliable orientation aid towards sustainable products i.e. environmentally-friendly and not posing any health risks.	- Building products

Name	Region	Badge	Description	Categories related to PnU Kits
PEFC/FSC	Global	PEFC FSC	PEFC / FSC certification guarantees that wood is sourced from a forest and supply chain that is managed responsibly. It shows we care for the origins of our products, for high environmental standards and that we maintain a commitment to corporate social responsibility.	- Wooden products

7.3.3 Type III Ecolabels – Environmental Product Declaration (EPD)

An Environmental Product Declaration (EPD) is an independently verified and registered document that communicates reliable, relevant, and transparent information about the environmental profile of a product or service based on a Life-cycle assessment (LCA) of the Product or component. Its objective is to present environmental information objectively to allow comparison between products, services, or activities of the same category, but it is advisable that the comparison is always done at the project level, at building level.

EN ISO 14025 is the standard that defines the requirements that these environmental declarations must meet and that classifies them as a type III Ecological Label. For construction products and services, the European Standard EN 15804 (under CPR) is used, which facilitates the recognition of environmental information on construction products in Europe, as it constitutes a harmonized and recognized reference.

Content of an EPD

The Environmental Product Declarations (EPDs) provide a series of environmental indicators obtained from a life cycle analysis (LCA), other information derived from the LCA and the inventory, and additional environmental information.

The LCA must be developed in accordance with EN ISO 14040 and EN ISO 14044 standards, as well as with the Product Category Rules (PCR) that apply to the relevant product family. These RCPs are documents that provide the rules, requirements, and guidelines to develop an EPD for a specific product category and are published as a technical standard or by a recognized Program, such as DAPcons or Environdec. These PCRs ensure consistent criteria for a family of products with equivalent functions. In the case of construction products and services, EN 15804 standard establishes basic CPR. According to the EN ISO 14025 standard, an EPD must include, at least, the following information:

- Identification of the organization that prepares the EPD
- Product description and identification

- Identification of the Program in which the EPDs have been verified.
- Program registration code, publication date and validity period
- Identification of PCRs
- Identification of stages covered
- Data from the LCA or information modules
- Data from the analysis of the life cycle inventory (LCI) according to the PCR
- Consumption of resources, including energy, water, and renewable resources
- Emissions into the air and discharges into water and soil
- Results of the indicators of the analysis of the impact of the life cycle (LCI)
- Other data such as the amounts and types of waste (waste) produced (hazardous and non-hazardous waste)

*The corresponding PCRs may include additional requirements.

Program administrators and agents involved

Program managers are agencies that manage environmental product declaration programs. They are responsible for the publication and management of the documents and the verifiers who must have competences in environmental verification, in the specific product and in the specific sector, as well as in the applicable norms and regulations, depend on them.

The main European Program Administrators have formed the ECO Platform Association, for EPD in the construction sector. This Association seeks to promote and contribute to sustainable development, including a low-carbon economy and resource efficiency in the construction sector, by coordinating the development and provision of credible and scientifically correct product data. All EPDs recognized by this Association must comply with the EN 15804 standard. The EPDs have a defined validity period of 5 years.

Certification procedure

The EPD certification procedure is as follows:

1. Contact the Program administrator to obtain the EPD development procedure and the Product Category Rules (PCR) applicable to the product. If the PCR document for the product has not yet been developed, it will be necessary to start the procedure for its creation, or use the generic PCR, prior approval of the program administrator.
2. Develop a Life Cycle Analysis (LCA) study in accordance with the corresponding Product Category Rules (RCP).
3. Write a draft of the EPD.
4. Carry out data verification by an accredited independent verifier.
5. If the verification by an independent third party is positive, the organization must present to the system administrator all the necessary documentation in accordance with the established models.

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6. Registration of the EPD in the official registry of the Program.

Benefits of a verified Environmental Product Declaration

The main benefits of a verified Environmental Product Declaration are:

- Be able to offer credible and truthful environmental information related to the life cycle of the products or services supplied, since said information is audited and validated by an independent accredited body.
- Its classification in groups allows making comparisons between functionally equivalent products, at building level.
- The LCA serves to detect improvement points in the entire product production process, such as the reduction of consumption of raw materials, energy, water, and waste generation. The stages that an LCA considers are the extraction of raw materials and their manufacture, the product distribution and use stage, and finally the end-of-life stage of the product.
- The DAPs award points to the buildings that want to obtain an environmental certificate such as BREEAM, LEED, GREEN..., thus improving their final classification.

7.3.4 Reference ecolabels standards

EN 15804 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products

This European standard provides core product category rules (PCR) for type III environmental declarations for any construction product and construction services.

The core PCR:

- Defines the indicators to be declared, information to be provided and the way in which they are collated and reported,
- Describes which stages of a product's life cycle are considered in the EPD and which processes are to be included in the life cycle stages,
- Defines rules for the development of scenarios,
- Includes the rules for calculating the Life Cycle Inventory and the Life Cycle Impact Assessment underlying the EPD, including the specification of the data quality to be applied,
- Includes the rules for reporting predetermined, environmental and health information, that is not covered by LCA for a product, construction process and construction service where necessary,
- Defines the conditions under which constructions products can be compared based on the information provided by EPD.

For the EPD of construction services the same rules and requirements apply as for the EPD of construction products.

EN ISO 14020 Environmental labels and declarations - General principles

This international standard establishes the guidelines for the development and use of environmental labels and declarations. This International Standard is intended to be used in conjunction with other relevant standards in the ISO 14020 series.

This standard is not intended to be used as a specification for certification and registration.

EN ISO 14021 Environmental labels and declarations - Self-declared environmental claims (Type II environmental labelling)

This International Standard specifies the requirements for environmental self-declarations, including statements, symbols and graphics relating to products. Likewise, a selection of terms commonly used in environmental declarations are described and the conditions for their use are established. A general evaluation and verification methodology for the selected self-declarations is also described.

EN ISO 14024 Environmental labels and declarations - Type I environmental labelling - Principles and procedures

This International Standard contains the principles and procedures for the development of Type 1 eco-label programs, including the selection of product categories, product criteria, and product functional characteristics: and for the evaluation and demonstration of conformity. This standard also establishes certification procedures to meet the ecological label.

EN ISO 14025 Environmental labels and declarations - Type III environmental declarations - Principles and procedures

This International Standard establishes the principles and specifies the procedures for developing Type III environmental declaration programs and Type III environmental declarations. It specifically establishes the use of the ISO 14040 series of Standards in the development of type III environmental declaration programs and type III environmental declarations.

This international standard establishes the principles for the use of environmental information, in addition to those provided in ISO 14020.

Type III environmental declarations as described in this International Standard are primarily intended for business-to-business communication, but their use in business-to-consumer communication is not ruled out, under certain conditions.

7.4 Conclusion on sustainability assessment and certification

There are numerous certifications that can help us identify the environmental impact of products.

There is a consensus that self-declarations (type II ecolabel) should not be of application in a European regulatory framework, but instead, type I and type III ecolabels must be incorporated naturally in the environmental assessment of products. Specifically, the type III ecolabel, based on the calculation of life cycle analysis, should begin to be used systematically in assessing the sustainability performance of products. It must be admitted, however, that type III ecolabels still need to improve with respect to the uniformity of their data structure of the product category rules, but there is no doubt that they should have a significant importance in assessing sustainability.

Type I ecolabels must complement the environmental information that is not derived directly from the EPDs, but it is crucial to harmonise the calculation methodologies in the assessment of the different sustainability parameters. For this reason, type I ecolabels must be regulated in their calculation methodology before imposing their applicability. They also provide impact qualification values that are not easy to apply in a regulatory framework. The impact methodology assessed in the type I ecolabels is specific to each system, which makes it difficult to determine the obligation to comply with it. These ecolabels qualify the sustainability of the product, therefore there are rules that determine the qualification criteria, and they are not always objective. For this reason, the application of type I ecolabels must value the objectivity of the qualification.

The sustainability assessment in the PnU Kits or products is not mandatory in the currently existing regulations. Only in very specific countries, as in France, the incorporation of environmental information on products may become mandatory.

For the PnU Kits defined in PLURAL, it should be avoided that the environmental information is just the sum of the EPD's products that make up the PnU Kits, and work should be done at the component level. It is therefore necessary to carry out an LCA (Life Cycle Assessment) at the PnU Kit level, to know the real impact associated at the component level (foreseen within WP8 of the project).

The PnU Kit manufacturers must manage the environmental information of the integrated products, through the EPDs that incorporate such products, but it is mandatory and extremely important that the information on the total impact of the PnU Kits includes the information on the processes and impacts necessary to build the PnU Kits, either at the factory or on the construction site.

Currently there is a lot of environmental information related to products. Environmental information to be applied in the project begins to be made available. However, it is necessary to work at the construction section level. At the level of the products placed at works, there is not enough information, almost none to assess it at that level. For this reason, it is necessary to calculate the LCA of each PnU Kit, even if the corresponding EPD is not generated afterwards.

As for PnU Kits, the LCA is especially important. The impacts of their assembly do not happen on the construction site but before at the manufacturing and transport stages, and they must be properly identified to take the environmental impact of the PnU Kits at building level. This is an important point to be considered for the validation of the PnU Kits systems, analyse them at the building level.

This makes the analysis of the environmental impacts of the PnU Kits very much in line with the LEVEL(s) project. Compliance with all the LEVEL(s) requirements is done at the building level, and it is necessary to have the environmental information of the PnU Kits placed on site, therefore all associated information the PnU kit should include information on the phases of factory assembly, transport and installation on site.

This environmental calculation is not a sum of products, not even a sum of components. It is a calculation of the system placed in a building. It should therefore be understood that the PnU kits must have environmental information on the constructive system installed and their impact must be associated as part of the life cycle analysis of the building.

If the calculation criteria are applied to the system placed in a building, as LEVEL(s) does, the regulatory application increases exponentially, and all the energy analysis regulations should be added, such as 2018/84/EU, 2012/27/ EU, or 2010/31/EU among many others.

In the PLURAL project, hypotheses of use have been determined in the kits when calculating their environmental impact to avoid simulating the entire building.

Finally, the sustainability assessment based on the Life Cycle Analysis can incorporate many sustainability indicators, e.g. acidification or eutrophication (according to type III ecolabels). However, it is considered that the Project must initially focus on the impact at the level of carbon emissions and non-renewable primary energy. In the future, other indicators could be considered.

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8. National regulations

8.1 General

As detailed in subchapter 6.1, CE marking certification deals with the expression of characteristics and performances in accordance with harmonised assessment procedures, as well as with the maintenance of such product performance. It provides reliable information on the product behaviour. But it is not by itself a justification of regulatory compliance at National or local level. This is to be done at the project stage, using the information provided in the product certification and necessarily taking into account the particularities of the existing building and the PnU Kits adjustments to the real project. Additionally, the required levels of performance for a certain essential characteristic can vary from one country to another since Member States have the sovereign right to establish their own safety levels. Therefore, the performances expressed in the PnU Kits' certification will need to be incorporated into the project design and real installation conditions, to eventually verify the fulfilment of the regulatory requirements. As explained below in subchapter 8.2, National Approvals are more specifically intended for proving product fitness for use in compliance with National regulations.

Building National Codes mainly establish the requirements upon the constructive elements, parts of the building or even the whole construction, not directly on separate products. Therefore, it is necessary to build a bridge between the regulatory requirements as established in the codes and the products characteristics to be considered, in order to develop the appropriate assessment methods so that the performances declared in the certification documents are adequately expressed to be used in the technical justification of regulations compliance. In that sense, analysis of the National regulations to identify which characteristics are regulated and in which conditions is necessary to establish the basis for the assessment and certification process.

D1.2 *Technical and market codes, national and European certification frameworks* provides a detailed analysis and an extensive report on National regulations, that can be consulted as needed. In the present Task 1.3, a further analysis and distillation has been made to synthetise the relevant requirements and characteristics that directly apply to the PnU Kits from the perspective of a certification under CPR, and a summary is given in subchapter 8.3. The outcome of this analysis of the regulatory requirements potentially applicable to PnU Kits must be read in conjunction with the information on essential characteristics identified in the façade-related harmonised technical specifications under CPR, as shown in subchapter 6.2.3.

Additionally, as found in D1.2, in general National codes lack detailed regulatory framework and associated requirements for prefabricated "add-on" façade systems intended for renovation of existing buildings. This concerns all Basic work requirements. Therefore, the technical characterization of the product to be assessed and certified must provide the adequate performances to fill this gap.

Design requirements (e.g. minimum natural light surface in a room, position of PV panels…), legal acts (e.g. to foster the RES in buildings, urban planning regulations…) or provisions on building energy consumption do not directly belong to a construction product certification scheme. Therefore, although part of the National regulations, all these provisions were considered at the stage of the PnU Kits design but cannot be handled in terms of essential characteristics, assessment methods or declaration of performance.

Finally, another factor that must be highlighted and cannot be known at the construction product certification stage is the degree of application of the National regulation in the case of a building renovation. This regulatory applicability when renovating a building, or a part such as a façade, varies from one country to another, and even from one project to another, depending on the depth of the renovation. Wider information on the scope and applicability of the regulations (also in case of renovation) is given in D1.2.

The outcome of the summarised analysis given in subchapter 8.3 of the regulatory requirements potentially applicable to PnU Kits must be read in conjunction with the information on essential characteristics identified in the façade-related harmonised technical specifications under CPR, as shown in subchapter 6.2.3.

8.2 National Approvals for a prefabricated façade module

Prefabricated façade modules are large-scale façade panels aimed at offering to the building market a quick and safe solution of closing the building:

- They often include the insulation and air/watertightness features with high levels of quality thanks to its prefabricated origin.
- They may include even the finishes, if needed in the project (external or internal finishes). They may even include additional technical features or elements such as windows, ventilation units or any other equipment beyond the façade construction module itself.
- They allow for a quick closing of the building, sparing the need of external scaffolding, thus enhancing economy and safety of the works.

While these solutions offer a high number of benefits, they need to face also a great number of requirements, because a façade must respond to all of them. In fact, all basic requirements considered in construction regulations are to be found in a façade prefabricated module:

- Mechanical resistance and stability: large façade panels require strong fixing systems on the structure of the building which must also offer geometric regulation capabilities
- Safety in case of fire: both reaction and resistance to fire requirements are relevant and, in some countries, also façade fire performance must be addressed.
- Health requirements related with watertightness, air tightness and hygrothermal behaviour.

- Safety in use requirements, often involving impact resistance, etc.
- Protection against noise
- Energy economy and heat retention
- Durability and sustainable use of natural resources

Therefore, this type of products must answer to a complex set of requirements, both at the level of the prefabricated module itself and at the level of its installation on site, since the correct performance of the installed façade will utterly depend on the performance of the joints between modules (these joints and its correct sealing will have to carry the same requirements in terms of fire, noise, thermal and air separation than the module itself.

National Approval documents offer today the grounds for a complete and rigorous assessment of complex prefabricated façade modules by addressing all technical challenges that these large-scale façade modules face and assessing the fitness for use of the PnU Kits in relation to the regulatory requirements (as generically summarised in the next subchapter) of a particular National building code. The only drawback of National Approvals is that they are applicable in the country where have been issued. However, it could be a very useful tool to enter onto identified interesting markets.

8.3 Essential characteristics applicable to PnU Kits

In the next table, a summary is shown of the essential characteristics, derived from regulatory requirements identified in National codes, in relation to the potential applicability to PnU Kits in terms of product certification under CPR.

TABLE 37: ESSENTIAL CHARACTERISTICS CONSIDERED IN NATIONAL REGULATIONS AND APPLICABILITY TO PNU KITS

BWR	Essential characteristic	Applicability to PnU Kits
1	-	PnU Kits do not have a load-bearing function and therefore BWR 1 does not directly apply. However, the mechanical performance of the installed systems will need to be assessed against the relevant actions (e.g. wind or seismic loads). Since these mechanical verifications usually depend on input parameters related to a particular project, it is not possible to solve it at the level of product certification. Therefore, the product assessment and certification will provide the relevant information on the mechanical related characteristics of the system or its components (e.g. anchors) to allow for a final verification at the project stage. This mechanical characterisation is dealt under BWR 4. Additionally, the impact of the PnU Kits installation on the existing building structure must be verified during the project stage. The necessary data/information for such a verification must be provided by the PnU Kit supplier.
2	Reaction to fire	Yes. Consider PnU systems' end-use conditions.

BWR	Essential characteristic	Applicability to PnU Kits
	Resistance to fire	Yes. Requirement applicable to the whole external wall element. It might be required that the resistance to fire of the existing wall is maintained where PnU systems' installations penetrate.
	Façade fire performance	Potentially applicable. Required only in some Member States. No European harmonised test method is available (addressed at National level, e.g. ČSN ISO 13785-1, DIN 4102-20, SP FIRE 105)
	Propensity to undergo continuous smouldering	Potentially applicable. Required only in some Member States. Assessment by components where relevant (e.g. mineral wool insulation)
3	Water tightness	
	Water absorption	Potentially applicable. In relation to the insulation product characteristics (assessment by components where relevant, e.g. mineral wool insulation)
	Water vapour permeability	Yes. Particularly for eWHC, to prevent from condensations
	Dangerous substances	Potentially applicable. Required only in some Member States.
4	Wind load resistance	Yes. Particularly for eAHC.
	Resistance to horizontal point loads, impact	Yes
	Mechanical resistance of cladding elements, sub-frame, fixings	Yes. Mechanical characterisation of the PnU systems and components is needed for final verifications at project stage.
	Resistance to seismic loads	Potentially applicable, depending on the region. Mechanical characterisation of the PnU systems and components is needed for final verifications at project stage.
5	Airborne sound insulation	Yes. In general, requirement applicable to the whole external wall element.
6	Thermal resistance	Yes

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9. Conclusion

The PLURAL PnU industrialised Kits are innovative concepts intended for building renovation and, in general, national building codes do not explicitly consider such solutions and do not provide the relevant prescriptive rules to justify the technical compliance of the PnU Kits with the regulatory requirements.

Since the PLURAL PnU Kits are not standardised products, they will need to be assessed and certified as constructive products in the framework of the Construction Products Regulation (CPR) 305/2011, following the route of the ETA (European Technical Assessment) for CE marking of non-standardised products. CE marking based on an ETA is a voluntary route for manufacturer, but it can be of great value for innovative solutions. Alternatively, or even complementary, PLURAL PnU Kits can also be certified by means of a National Approval in these markets of special commercial interest.

The European route of the ETA + CE marking offers the manufacturer, as the main advantage over the National Approvals, a certification valid in the European Union and EFTA countries (and technical-commercial acceptance in many other countries outside of it), while the National Approval, being a specific instrument for the National regulatory context, provides more technical content than the ETA+CE marking, as well as the analysis of the fitness for use of the product and the compliance with the National construction regulations.

As for the certification schemes and requirements applicable to the components integrated into the PnU Kits, the European legislation has been mapped to identify their applicability and the requirements for compliance, together with the associated reference standards, with a double purpose: first, use the technical information in such standards to establish the criteria on manufacturing, assembling and quality control of the individual components into the PnU Kits production and, on the other hand, identify the characteristics in the components' certification that are relevant and can be used in the technical assessment of the PnU Kits.

Regarding the certification of the PnU Kits sustainability performance, the regulatory framework is not yet fully implemented at European level. The Level(s) project, which determines the need to calculate the environmental impact (carbon footprint included) at the product and building level through the life cycle analysis of the total construction work, is planned to be mandatory in 2030 and for this reason it is convenient to take it into account when assessing the PnU Kits sustainability performance. Also, at European level the Construction Products Regulation (CPR) is now under revision to finally address the sustainability performance of construction products.

In this provisional context of voluntary certification, Ecolabel Type III (EPD -Environmental Product Declaration), based on the PnU Kits Life Cycle Analysis, is deemed as the most appropriate tool to express the sustainability performance of the PnU Kits.

As for LCA, it must be highlighted that the environmental calculations shall not be a sum of components (sum of EPDs), but rather a calculation of the integral constructive system as installed in a building and,

therefore, including the relevant information on the stages of assembly at the factory, transport and execution on site. This will result in the analysis of the Pnu Kits environmental impacts according to the requirements of Level(s) project. At the moment, while the European regulatory framework is being fully designed and implemented, apart from the immediate value and use of obtaining an EPD, this sort of certification is deemed as the most likely to match the coming requirements in the different legislations (revised CPR, Ecodesign for Sustainable Products Regulation, LEVEL(s), etc.).

Based on the certification strategies defined in this Deliverable D1.3, as explained above, as well all the wide technical information gathered related to those certifications, the analysis will continue under Task 8.2 (once the PnU Kits have been fully designed and prototyped) to specifically define the relevant characteristics to be considered in the technical assessment and certification of the PnU Kits, in order to provide an adequate expression of the performances to be understood by the National building codes.

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Annex. Legal, Ethical, Privacy Monitoring and Review (T1.4)

INTRODUCTORY NOTE: Task 1.4 *Legal, Ethical, Privacy Monitoring and Review* was prepared in the framework of WP1. The report prepared under T1.4 is given as an Annex to D1.3. No further development or revision has been made under Task 1.3.

	Name	Date
Prepared by	Guzide Aslankaya (Pich Architects)	29/03/2022
Reviewed by WP leader	Giannis Atsonios (NTUA)	31/03/2022
Reviewed and approved by	Maria Founti (NTUA, Project Coordinator)	30/10/2022

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1. Introduction

This document describes the legal and privacy monitoring requirements that might be necessary to comply with, in particular at the demonstration countries (Spain, Czech Rep., Greece), during the deep renovation procedures. In particular, issues relating to occupant disturbance will be mapped and processed in accordance with the latest GDPR legislation.

This document is based on *Task 7.1 Buildings' survey and preliminary design and T7.6 Monitoring Campaign* which contains list of parameters to be monitored for each demo site (Kasava, Terrassa, Voula-Athens).

Sensor-based technologies for the monitoring of energy consumption and Indoor Environmental Quality (IEQ) are a key element for the Heating Ventilation and Air Conditioning (HVAC) systems in buildings. However, it should be prepared to deal with the social and thus ethical issues arising from the use of such technologies.

2. Objective

- To define types of data during monitoring campaign
- To define the household, zones and devices to be measured during monitoring
- To define all the measures undertaken and detailed Data Management Plan
- To investigate and study the laws about the ethical guidelines for monitoring
- To define the legal and privacy monitoring requirements
- To specify the data process (data collection, storage, protection, retention and destruction)
- To provide confidentiality and anonymity of data
- To create a consent form

3. Methodology

From the beginning of project, the Ethical Management of the project will meet all the respective ethical rules and obligations. The methodology followed towards this direction comprises of several steps, which are analyzed below:

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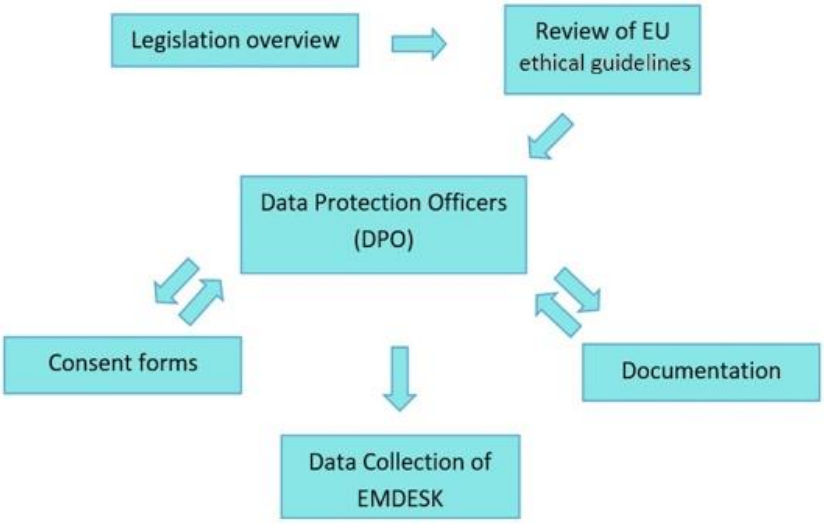

FIGURE A.1: METHODOLOGY OF PROCESSING OF PERSONAL DATA

The first step is to define the laws which are associated with the monitoring activities of the project. Beside of the directives of the EU, the legislations of the countries where the pilot projects of PLURAL have been located (Spain, Czech, Greece) are taken into consideration. Concisely, the legislations with which the PLURAL framework has to conform includes:

- Regulation (EU) 2018/1725 General Data Protection Regulation (GPDR)
- Spain, Organic Law 3/2018, of December 5, on the Protection of Personal Data and guarantee of digital rights
- Greece, Law 4624/2019 Hellenic Data Protection Authority (HDPA), measures for implementing Regulation (EU) 2016/679
- Czech, Czech Act No. 110/2019 Coll., on Personal Data Processing, being the Czech GDPR implementation law

The second step includes an investigation about the ethical guidelines for research projects in EU and an examination of the “Guidance-How to Complete your ethics self-assessment” and the “Guidelines to the Rules on Open Access to Scientific Publications and Open Access to Research Data in Horizon 2020” of the ethical and data management review in H2020.

After the overview of the relevant legislation and the EU ethical guidelines, the project Consortium established from the early phases of the project the PLURAL Data Projection Officers. Data Protection officers (Ethical Advisory Board (EAB)) have been appointed by the three beneficiaries who are responsible for the project demonstration activities and collection of personal data. These beneficiaries are: VVV-AMS,

AHC-PA, KASAVA-FENIX. The Data Protection officers consist of a centralized service that provides the necessary advice, support and supervision around ethical issues that may arise during the project lifecycle. It has a significant role in ethical management and is responsible for implementing and managing the ethical and legal issues of all procedures in the project. The representatives of the Ethical Advisory Board are Ms. Zuzana Taťáková (FENIX) for Czech pilot, Ms. Ines Fabregas Riverola (AHC), Ms. Guzide Aslankaya (PA) for Spanish pilot and Mr. Dimitris Apostolopoulos (VVV) for Greek pilot.

In order to identify all the possible ethical risks and issues that may arise during the project lifecycle, a series of internal reports will be sent to all partners in order to receive feedback and take into account all the considerations or directives. In that way all partners will be kept up to date regarding the ethics of the project and will help to create an ethical framework.

Consent forms will be handed to the building owners, building users and stakeholders (monitoring companies) in order to seek agreement or otherwise to the collection of data. To ensure transparency the consent text will specifically detail what data will be stored, who it will be transmitted to and for what purpose. The consent procedure for monitoring at each of the selected pilot sites will be obtained through a two-stage procedure:

- Initially each pilot leader will orally present the pilot to people that will be involved, carefully describing the (if any) level of privacy infringement that the execution of each of the pilot realization involves.
- Then, subjects will be required to read and sign an informed consent form (Annex 1) that will explain and it will will be translated in the national languages of the demo sites (e.g. Greek, Spanish, Czech).

4. LEGISLATIONS

The project involves the carrying out of data collection in all pilots (Kasava, Terrassa, Voula-Athens) under the leadership of each pilot site responsible during monitoring campaign. For this reason, human participants will be involved in certain aspects of the project and data will be collected and processed. This will be done in full compliance with any European and national legislation as well as directives relevant to the country. This section contains the EU and national legislations related to the project.

4.1. EU Legislation

Regarding the EU legislation, the PLURAL takes into account the following:

- Regulation (EU) 2018/1725 EU General Data Protection Regulation which is in line with the General Data Protection Regulation - GDPR (Regulation (EU) 2016/679) and Directive 2002/58/EC4 of the

European parliament and of the council regarding the processing of personal data and the protection of privacy.

- Protection of personal data which are defined by the European Charter of Fundamental Human Rights (2000/C 364/01) Art 8.

Regulation (EU) 2018/1725 Article 3 defines the personal data as: ''personal data' means any information relating to an identified or identifiable natural person ('data subject'); an identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person.''

The protection of the rights and freedoms of natural persons with regard to the processing of personal data require that appropriate technical and organizational measures be taken to ensure that the requirements of these regulations:

- No data will be collected without the explicit informed consent of the individuals under observation. This involves being open with participants about what they are involving themselves in and ensuring that they have agreed fully to the procedures/research being undertaken by giving their explicit consent.
- No data collected will be sold or used for any purposes other than the current project.
- Personal data are to be collected, processed and used, and processing systems are to be designed in accordance with the aim of collecting, processing and using as little personal data as possible. In particular, personal data are to be aliased (pseudonymized) or rendered anonymous as far as possible and will be erased at the completion of the PLURAL project (September 2024).
- The application of pseudonymisation to personal data can reduce the risks to the data subjects concerned and help controllers and processors to meet their data protection obligations. (Pseudonymization: replaces personal identifiers with nonidentifying references or keys so that anyone working with the data is unable to identify the data subject without the key).
- Any processing of personal data will be lawful and fair. It will be transparent to natural persons that personal data concerning them are collected, used, consulted or otherwise processed and to what extent the personal data are or will be processed. The principle of transparency requires that any information and communication relating to the processing of those personal data be easily accessible and easy to understand, and that clear and plain language be used.
- The processing of personal data for archiving purposes in the public interest, scientific or research purposes will be subjected to appropriate safeguards for the rights and freedoms of the data subject pursuant to this Regulation. Those safeguards will ensure that technical and organisational measures are in place in order to ensure, in particular, the principle of data minimisation.

- A data minimization policy will be adopted at all levels of the project and will be supervised by each responsible Pilot Demonstration.
- Consent of the data subject will be given by a clear affirmative act establishing a freely given, specific, informed and unambiguous indication of the data subject's agreement to the processing of personal data relating to him or her, such as by a written statement (prepared consent forms), including by electronic means, or an oral statement.
- The data subject will have the right to obtain from the controller without undue delay the rectification or erasure of inaccurate personal data concerning him or her.
- Any person who has suffered material or non-material damage as a result of an infringement of regulation will have the right to receive compensation from the Union institution or body for the damage suffered.
- Personal data won't be transferred to a country or territory outside the European Economic Area unless that country or territory ensures an adequate level of protection for the rights and freedoms of data subjects in relation to the processing of personal data.
- Personal data will be kept in a form which permits identification of data subjects for no longer than is necessary for the purposes for which the personal data are processed; personal data may be stored for longer periods insofar as the personal data will be processed solely for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes in accordance with Article 89(1) subject to implementation of the appropriate technical and organisational measures required by this Regulation in order to safeguard the rights and freedoms of the data subject ('storage limitation'), (Article 5 (e) of GDPR).

4.2. Spanish Legislation

Spanish pilot project which will be conducted in Terrassa, Spain has to comply with the Spanish legislation Organic Law 3/2018, of December 5, on the Protection of Personal Data and guarantee of digital rights.

This law develops and complement the European Union Regulation. In the first place, it is intended to achieve the adaptation of the Spanish legal system to Regulation (EU) 2016/679 of the European Parliament and the Council, of April 27, 2016 (The General Data Protection Regulation) and complete its provisions. In turn, it establishes that the fundamental right of natural persons to the protection of personal data, protected by article 18.4 of the Spanish Constitution, will be exercised in accordance with the provisions of Regulation (EU) 2016/679 and in this organic law. Secondly, it is also the object of the law to guarantee the digital rights of citizens, under the provisions of article 18.4 of the Constitution.

According to Law 3/2018: The Spanish Agency for Data Protection (AEPD) is responsible for supervising the application of this law (and the European Regulation 2016/679) and for exercising the functions established in article 57 and the powers provided for in article 58 of the law and in its development provisions. Likewise,

the Spanish Agency for Data Protection is responsible for carrying out the functions and powers attributed to it by other laws or regulations of European Union Law.

The Spanish Agency for Data Protection is an authority with its own legal personality and unlimited public and private legal capacity, which acts fully independently of the public administrations in order to comply the regulations for ensuring the privacy and data protection of citizens.

In addition, the Spanish autonomous communities have powers of regulatory development and execution of the fundamental right to the protection of personal data in their field of activity and the autonomous data protection authorities that could be created have to contribute to guarantee this fundamental right of citizenship.

In this sense, the autonomous community of Catalonia - where the Terrassa pilot is placed – it exists the Catalan Data protection authority. *The Catalan Data Protection Authority (APDCAT)* is an independent body whose mission is to safeguard, within the scope of competences held by the Catalan Government (*Generalitat de Catalunya*), the rights of protection of personal data and access to the information linked to such data. The institution provides advice about what rights exist in this area, how to exercise them and what to do if they are not respected. It also reports and advises on obligations established in the corresponding legislation and oversees entities to ensure they meet these obligations.

The scope of action of the Catalan Data Protection Authority includes the files and processing carried out by at least the following entities: Catalan public institutions, the Catalan government administration (Generalitat), Local entities, Autonomous entities, consortia and other affiliated or dependent public law organisations linked to the Administration of the Generalitat de Catalunya or Catalan local authorities. This includes the Housing Agency from Catalonia, owner and manager of the Terrassa pilot and partner number 14 in the PLURAL Consortium.

In this context, and following the Organic Law 3/2018, the pilot users, that will participate in the monitoring procedure or other strategies of data collection (such as photos or questionnaires) carried during the PLURAL project will always be informed and agree for the data that will be collected. In addition, no Personal data collected will be used outside the scope of the PLURAL project.

Further information about the Spanish and Catalan legislation can be found at the webpages of the *Spanish Data Protection Agency* (www.aepd.es) and the *Catalan Data Protection authority* (https://apdcat.gencat.cat/en/inici/index.html).

4.3. Greek Legislation

In Greece, the protection of a person's personal data against any collection, processing, and use, has been constitutionally safeguarded (see Article 9A of the Constitution of Greece, as revised in 2001). Pursuant to said provision, an independent authority shall ensure the protection of personal data.

The Greek pilot project, located in Voula-Athens, has to comply with the:

- General Data Protection Regulation (Regulation (EU) 2016/679) ('GDPR')
- Greek Law 4624/2019 “Hellenic Data Protection Authority (HDPA), measures for implementing Regulation (EU) 2016/679 on the protection of natural persons with regard to the processing of personal data, and transposition of Directive (EU) 2016/680 of the European Parliament and of the Council of 27 April 2016, and other provisions”
- Greek Law 3471/2006, (Directive 2002/58/EC and Directive 2006/136/EC), regarding the protection of personal data in the field of electronic communications

According to aforementioned legal framework:

- The regulatory authority in Greece is the Hellenic Data Protection Authority ('HDPA') that supervises the application of the provisions of the GDPR, the National Laws and other regulations relating to the protection of natural persons with regard to the processing of their personal data on the Greek territory. In addition, the HDPA also follows EU guidance (e.g. by the European Data Protection Board) when exercising its powers, while it has released guidance addressed to data controllers concerning different topics of the GDPR. Besides its powers under Article 58 of the GDPR, the HDPA has been provided with investigative and corrective powers under Article 15 of Greek Law 4624/2019
- The GDPR applies as to the personal scope
- The Greek Law 4624/2019 has a similar material scope to the GDPR but distinguishes between public bodies and private entities that process personal data (Article 2 & 3)
- The GDPR applies as to the key definitions (Article 4 of the GDPR)
- The Greek Law 4624/2019 lowers the age of child consent to 15 years (see Article 21)
- The GDPR applies as to the Contract with the data subject, Legal obligations, Interests of the data subject, public interest, Legitimate interests of the data controller
- The Greek Law 3471/2006 applies for direct marketing cases
- The Greek Law 4624/2019 sets out provisions that apply to the processing of personal data of employees in the context of employment (Article 27). However, the HDPA has considered that Article 27(1) of Greek Law 4624/2019 is not in line with the GDPR
- The Greek Law 4624/2019 sets out provisions that apply to the processing of personal data for a purpose other than that for which they were collected (Article 24 & 25). The processing of special

categories of personal data, as referred to in Article 9(1) of the GDPR, is permitted, provided that the conditions set out in the Article 24 (1) & 25 (1) are fulfilled and one of the exemptions provided for in Article 9(2) of the GDPR or Article 22 of Greek Law 4624/2019 applies

- The Greek Law 4624/2019 sets out provisions that apply to the processing of special categories of personal data for archiving purposes in the public interest, for scientific or historical research purposes or for the collection and maintenance of statistical information by way of derogation from Article 9(1), 15, 16, 18, 20 and 21 of the GDPR
- The GDPR applies as to the principles relating to processing of personal data (Article 5)
- Following the entry into force of the GDPR, there is no longer an obligation to notify the HDPA with regard to the processing of personal data, recordkeeping, or CCTV. Moreover, the granting of licenses by the HDPA for the processing of sensitive data has been also abolished
- The GDPR applies in general as to the transfer of personal data. However, under Greek Law 4624/2019 ((see Article 28(2)(d)), certain GDPR provisions, including Chapter V of the GDPR on the transfer of personal data to third countries, do not apply to the extent necessary in order to reconcile personal protection rights with the right to freedom of expression and information, including processing for journalistic purposes or academic, artistic, or literary expression
- The GDPR applies as to the Data processing records
- The GDPR applies as to the list of the kind of processing operations which are subject to the requirement for a data protection impact assessment (Article 35(4)). To this end, the HDPA has issued an extensive list
- The Greek Law 4624/2019 provides for specifications with regard to the appointment of a DPO by public entities (Article 6, 7, & 8)
- The GDPR applies as to the with regard to the notification of a personal data breach
- The GDPR applies as to data retention. As regards timeframes for retaining data, although not provided in Greek Law 4624/2019, statutory (general/ specific prescription rules), or contractual retention periods are also applied
- By way of derogation from Article 9(1) of the GDPR, the Greek Law 4624/2019 (Article 22(1) stipulates that the processing of special categories of data by public and private bodies is permitted under certain conditions. With regard to the processing of criminal conviction data, this is not addressed by the Greek Law 4624/2019
- Under Article 23 of the Greek Law 4624/2019 and according to to Article 9(4) of the GDPR, the processing of genetic data for health and life insurance purposes is expressly prohibited
- The GDPR applies as to Controller and processor contracts
- The Greek Law 4624/2019 (Article 31 & 32) sets the provisions and exemptions as to the “Information to be provided where personal data are collected from the data subject” (Article 13 and 14 of the GDPR)

- The Greek Law 4624/2019 (Article 33) sets the provisions and exemptions as to the Right of access by the data subject (Article 15 of the GDPR)
- The GDPR applies as to the data subject's right to rectification (Article 15). However, the Greek Law 4624/2019 includes limitations on the exercise of such right in the context of particular processing purposes (Article 28, 29 & 30 of the Greek Law 4624/2019)
- The Greek Law 4624/2019 (Article 34) sets the provisions and exemptions as to the Right to erasure (Article 17 of the GDPR)
- The Greek Law 4624/2019 (Article 35) sets the provisions and exemptions as to the Right to object (Article 21 of the GDPR)
- The GDPR applies as to the Right to data portability (Article 20). However, the Greek Law 4624/2019 permits data controllers to restrict data subjects' right to data portability in certain cases
- The GDPR applies as to the right for Automated individual decision-making, including profiling (Article 22).
- The GDPR applies as to the Right to restriction of processing (Article 19)
- In addition to the corrective powers provided under Article 58(2) of the GDPR, the Greek Law 4624/2019 (Article 39) specifies further those public entities will be subject to the imposition of administrative fines up to €10 million by the HDPA for the infringements included in Article 83(4), (5), and (6) of the GDPR (with a few exceptions). The GDPR applies to private entities
- The Greek Law 4624/2019 (Article 38) sets the provisions for the imposition of criminal sanctions

4.4. Czech Legislation

The Czech pilot project which will be conducted in Kasava, Czech has to comply with Czech Act No. 110/2019 Coll., on Personal Data Processing, being the Czech GDPR implementation law.

According to this law:

The Czech Republic's second data protection act - The Personal Data Processing Act 2019 (No. 110/2019 Coll.; hereinafter ZZOÚ) - is the implementation of the EU new legal framework: GDPR, Data Protection Directive 2016/680 (LED) & PNRD. Both GDPR and ZZOÚ modernise data protection to ensure they are effective in the years to come. ZZOÚ re-creates a supervisory authority (SA) for data protection - the Data Protection Authority (in Czech: Úřad pro ochranu osobních údajů; hereinafter the Czech DPA). It creates room for a new role of the Czech DPA - freedom of information.

According to this law:

This Act transposes the applicable Regulation (EU) 2016/679 of the European Parliament and of the Council); simultaneously, it follows on from directly applicable regulation of the European Union and, to

satisfy the right of every person to protection of privacy, provides for the rights and obligations in personal data processing.

Personal Data Processing for Purposes of Scientific or Historical Research or for Statistical Purposes

In processing personal data for the purpose of scientific or historical research or for statistical purposes, the controller or processor shall provide for compliance with specific measures for the protection of interests of the data subject appropriate to the state of the art, costs of implementation, nature, scope, context and purpose of processing, as well as risks to the rights and freedoms of natural persons of varying likelihood and severity.

Such measures may include, in particular

- technical and organizational measures aimed at a consistent application of the obligation pursuant to Art. 5 (1)(c) of Regulation (EU) 2016/679 of the European Parliament and of the Council;

- logging of at least all operations of collection, entering, alteration and erasure of personal data, which will make it possible to determine and verify the identity of the person performing the operation, and retaining such records for a period of at least 2 years from the operation;

- provision of information to persons who process personal data concerning obligations in the area of personal data protection;

- designation of the data protection officer;

- special limitation of access to personal data at the controller or processor,

- pseudonymisation of personal data, encryption of personal data, measures for ensuring permanent confidentiality, integrity, availability and resilience of processing systems and services;

(i) measures enabling restoration of the availability of and timely access to personal data in the event of an incident; (j) process for regularly testing, assessing and evaluating the effectiveness of technical and organisational measures for ensuring the security of the processing., (k) special limitation of transmission of personal data to a third country; or (l) special limitation of personal data processing for some other purposes.

More information can be found at: https://www.uoou.cz/en/

5. MONITORING ACTIVITIES

In order to understand the relationship of building performance, energy demand, energy generation, occupants' behaviour, thermal comfort and satisfaction, it is necessary to collect, process, and analyse a variety of data sources from smart meter reading (e.g. energy consumption, occupancy, indoor environmental conditions, etc.). In this context, data will be automatically collected by smart sensors as well as other proprietary equipment installed at the selected pilot areas in Kasava, Terrassa, Voula-Athens during monitoring campaign.

5.1. Types of Data

In-situ measurements and 3D scanning of buildings are collected during preliminary design. Moreover, different types of data will be collected during monitoring campaign, namely:

TABLE A.1: TYPES OF DATA

Pilot area	Data	Sensor related
Kasava	Renewable Electric Energy produced	from PV Inverter
	Thermal Heating Electric Consumption	Electricity meter
	Thermal Heating Gas consumption	Gas Flow-meter
	Thermal Demand	Thermal meter
	Electric consumption for ventilation	Electricity meter
	Energy to meet DHW demand	Electricity meter
	RH, Ambient light, CO_2, VOC	CVUT Multisensor
	Operative Temperature	Dry Bulb Thermometer
	Grid tarif	Access data from the company (Remote Cloud)
	SolRad, Eo - Lux outdoors, Hrout, Tout	Weather station
Terrassa	Renewable Electric Energy produced	from PV Inverter
	Thermal Heating Electric Consumption	Electricity meter
	Thermal Heating Gas consumption	Gas Flow-meter
	Thermal Demand	Thermal meter
	Electric consumption for	Electricity meter

	ventilation	
	Energy to meet DHW demand	Electricity meter
	RH, Ambient light, CO_2, VOC	CVUT Multisensor
	Air speed	Anemometer
	Operative Temperature	Radiant and Dry Bulb Thermometer
	Grid tarif	Access data from the company (Remote Cloud)
	SolRad, Eo - Lux outdoors, Hrout, Tout	Weather station
Voula-Athens	Renewable Electric Energy produced	from PV Inverter
	Thermal Heating Electric Consumption	Electricity meter
	Thermal Cooling Electric Consumption	Electricity meter
	Thermal Heat Pump Electric Consumption	GWF Heat Meter
	Thermal Heat Pump Demand	GWF Heat Meter
	Electric consumption for ventilation	Electricity meter
	Energy to meet DHW demand	Electricity meter
	RH, Ambient light, CO_2, VOC	CVUT Multisensor
	Air speed	Anemometer
	Operative Temperature	Radiant and Dry Bulb Thermometer
	Grid tarif	Access data from the company (Remote Cloud)
	SolRad, Eo - Lux outdoors, Hrout, Tout	Weather station

5.2. Processing of personal data

Personal data will be processed with some principles according to EU General Data Protection Regulation - Regulation (EU) 2018/1725 (GDPR).

Lawfulness, fairness and transparency — Processing must be lawful, fair, and transparent to the data subject.

Purpose limitation — Collected for specified, explicit and legitimate purposes and not further processed in a manner that is incompatible with those purposes.

Data minimization —Collected and processed only as much data as absolutely necessary for the purposes specified.

Accuracy — Ensuring that personal data accurate and up to date.

Storage limitation —Only stored personally identifying data for as long as necessary for the specified purpose.

Integrity and confidentiality — Processing in such a way as to ensure appropriate security, integrity, and confidentiality (e.g., by using encryption).

Accountability — The data controller is responsible for being able to demonstrate GDPR compliance with all of these principles.

5.3. Pilot participants process for the execution of the pilot use cases

The PLURAL Pilot Cases will involve existing habitants/employees/residents or visitors of selected buildings in each of the selected pilot areas along with volunteers wishing to participate in some of the envisioned Pilot Use Cases. All people that will be actively participating and/or being affected by the execution of each of the Pilot Use Case, will take part in a thorough process and informed consent procedure, that will be particularly stringent to ensure no coercion (not even soft or indirect) is exerted. The specific criteria for the selection of the volunteer participants will be determined by the pilot requirements, while there will be participants with various roles.

Furthermore, specific measures to protect the participants from a breach of privacy/confidentiality and potential discrimination will be applied, as it follows:

Confidentiality: The names of the participants in the pilots will be never revealed in any document and their participation will not be communicated to other pilot participants. As already stated above, all personal data stored during the pilot trials will completely and irreversibly anonymised and will be erased at the completion of the PLURAL project (September 2024).

As an absolute minimum anonymised process, data will not contain any of the following, or codes for the following: (if participants request)

o Participant's name, address, phone/fax. number(s), e-mail address, full postcode;

o Any identifying reference numbers, photographs, information about relatives.

Right to get more information about the pilots: The pilot participants will be able to ask any questions about the pilot trials at any time throughout the pilot realisation phase. The corresponding pilot site responsible partner will be available to answer any questions, interests or concerns about the pilot trial executions. During the pilot executions, each of the pilot participants will have the right to withdraw from the trials at any time.

Informed Consent: A detailed informed consent form is carefully prepared for each pilot site, fully outlining the scope of the trial and its purposes along with the data collected and analysed. Note that the informed consent form is provided in Section 6. This form will be shared to all the participants.

5.4. Privacy, GDPR compliancy, data security of EMDESK (the PLURAL project Management tool)

Infrastructure security: To ensure the highest infrastructure security, EMDESK is hosted with the Open Telekom Cloud (OTC) – one of the most secure and modern cloud data centres in the world. OTC infrastructure is operated in Deutsche Telekom's highly secure twin-core data centres in Magdeburg and Biere, Germany, as well as data backup. All services are strictly regulated and are regularly checked and certified by independent institutions, in order to meet the latest security and data protection requirements (TISAX, Trusted Cloud, ISO 14001, ISO 22301, ISO 9001, ISO 20000, ISO 27001, ISO 27017, ISO 27018, CSA Star Level 2, TÜV Trusted Cloud Service, TCDP version 1.0). For more information, visit: https://open-telekom-cloud.com/en/security/data-centers

OTC's data processing is strictly regulated by the German data protection act and compliant with GDPR which is certified in accordance with the Trusted Cloud Data Protection Profile (TCDP) 1.0. For more information, visit: https://open-telekom-cloud.com/en/security/data-protection-and-compliance

Data segregation & confidentiality: The production systems, the database and the network are physically and logically separated from the enterprise infrastructure. In addition, we separate customer accounts logically at the data layer. There are strict security policies for employees' access. Access to customer data is only a last resort option, strictly controlled and logged, technically and legally limited to a handful of employees to ensure appropriate customer support under strict confidentiality conditions and supervision of senior management. To connect to our production infrastructure, employees must use secure authentication that is identity-based and restricted based on employee role using a least-privilege approach. EMDESK employees are trained on data protection and legally obliged to non-disclosure. When evaluating access levels, the security workgroup takes into account employee experience levels, responsibilities, and internal risk assessments.

Software development security: The software architecture and release cycle is designed to protect against security breaches. EMDESK uses a version control system to track changes to our code base. Changes to the architecture and code must follow the internal coding principles, security policies, and industry's best practices for security. Changes are pushed to a staging server for thorough review and withstand numerous manual/automated tests before being released into production. At regular intervals EMDESK conducts source code reviews by our development advisory team. Releases are typically deployed outside typical European business hours during a planned downtime period. Urgent changes can be made available on demand (e.g. a security patch).

User authentication: Each user in EMDESK has a unique account with a verified business email address. EMDESK forces users to set account passwords validated against password policies with high security criteria, including complexity, reuse, and expiration requirements. Passwords are hashed and salted in accordance with industry best practice. 2-Factor Authentication is available as an additional security measure to protect EMDESK accounts. User sessions and IP addresses are individually tracked and can be individually audited or revoked by their user. We have a maximum session duration configured.

Data redundancy, backup, and recovery: EMDESK's data protection model provides near real-time database replication to ensure that customer data is both secure and available on redundant and geographically distributed servers in Germany. The exchange of data between them runs via their own network, separate from the internet. A full backup is performed daily, encrypted, and stored in an environment separate from the primary servers to ensure fault tolerance. In an emergency, customer data from the past can be restored. Even in the unlikely event of multiple server failures, major disruptions, or disasters, we can recover the entire production system from our disaster recovery site, which includes a live updated standby database system.

Privacy and GDPR compliant: EMDESK is committed and obligated by European and German law to protect the privacy of users and their data. The EU's General Data Protection Regulation (GDPR) and the German federal data protection act (BDSG) force organizations based in Germany and the EU, but also those outside of the EU processing the personal data of people residing in the EU, to comply with these regulations. These legislations give users greater security, transparency, and control of their personal data online – a principle we couldn't agree more with. EMDESK has certified services, for which they act as data processor, under GDPR / BDSG. They have established processes to ensure that we respect your right to erasure, rectification, data portability, information and to be forgotten or restriction. They have a personal data registry that is maintained, pursuant to Article 30 of the GDPR. This lists out the type of personal data, where the personal data is stored, maintained, and processed, any data flow, who the responsible party is, and the retention times. For more information, see our Privacy Policy.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 958218

6. Annex 1 - PLURAL informed consent form

PLUG-AND-USE RENOVATION WITH ADAPTABLE LIGHTWEIGHT SYSTEMS

TEST SITE: [Enter test site name]

SPONSOR: European Union HORIZON 2020: The EU Framework Programme for Research and Innovation

RESEARCHER: [Enter name of researcher]

CONTACT DETAILS: [Enter contact details of researcher]

DATE: [Enter date]

1. BACKGROUND PURPOSE OF THE STUDY:

The main goal of PLURAL H2020 project is to design, validate and demonstrate a palette of versatile, adaptable, scalable, off-site prefabricated "Plug and Use" (PnU) façade Kits for deep renovation of residential buildings. The PnU Kits will incorporate renewable energy technologies in prefabricated façade components with optimized performance for different building types, climates and socio-economic conditions.

The project has the following objectives: Design and manufacturing of optimized PnU Kits; Development and validation of IT tools; Pilot validation and real scale demonstration; Multi stakeholder "Go-to-Market" strategy. For more information, please visit www.plural-renovation.eu

As a building user/builing owners/test site user/ key market stakeholder [please choose] you have been selected to participate in this study to provide feedback on any related impacts during the PLURAL trial phase.

2. WHAT WILL I BE ASKED TO DO?

Feedback will be collected via the attached pro forma. The following precautions will be taken to protect your anonymity and confidentiality. You are under no pressure to provide feedback and you are free to decline to answer any questions. Any information collected will be destroyed if you do not wish of us to use the information.

3. WHAT TYPE OF INFORMATION WILL BE COLLECTED?

You will not be identified in the research findings either directly or indirectly unless we have your permission to do so. Even after receiving your permission, we will not identify or quote you in any publication (e.g. direct quote or paraphrase your comment) without allowing you to verify the accuracy of

quotes that are being used. Information collected will be restricted to questions relevant to the nature of your use of the building (number of hours per day, number of days per week, etc.; rooms occupied).

Please put a check mark on the line corresponding to your willingness to be identified:

You may quote me and use my name: Yes____ No____

4. CAN WE CONTACT YOU FOR FURTHER RESEARCH?

You may contact me in the future for further research related to the PLURAL project:

Yes____ No____

5. ARE THERE RISKS OR BENEFITS IF I PARTICIPATE?

Since confidentiality is being provided, no risks are foreseen in relation to participation. Benefits would be restricted to the contributions of the study towards understanding any impacts on the internal comfort of building users caused by PLURAL during the trial.

6. WHAT HAPPENS TO THE INFORMATION I PROVIDE?

All information collected will be stored electronically in password-protected electronic files. All personal information (e.g. name and contact details) will be destroyed after the research study is completed in September 2024. Summaries of feedback may be provided to other researchers in the team, but this will be provided in a format that will ensure that your identity cannot be ascertained.

7. WHO IS ORGANISING AND FUNDING THE RESEARCH?

PLURAL has received funding from the European Union's Horizon 2020 Research and Innovation programme EC Grant Agreement No. 958218

8. SIGNATURES (WRITTEN CONSENT)

Your signature on this form indicates that you:

1) Understand to your satisfaction the information provided to you about your participation in this research project.

2) Understand that your participation is voluntary, that you can choose not to provide feedback and that you can withdraw at any stage of the project without being penalized or disadvantaged in any way.

3) Consent to the processing of your personal information for the purposes of this research study. You understand that such information will be treated as strictly confidential and handled in accordance with the [insert data protection regulation relevant to the test site country].

Participant's Name:

_____

Participant's Signature

_____

Date:

_____

Researcher's Name:

_____

Researcher's Signature:

_____

Date:

QUESTIONS/CONCERNS

If you have any further questions or want clarification regarding this research and/or your participation, please contact the researcher (see contact details above) or PLURAL Project Coordinator: Prof. Maria Founti (mfou@central.ntua.gr).

A copy of this consent form has been given to you to keep for your records and reference.

7. Conclusion

This document has presented the ethical scope of PLURAL, as well as the procedure followed in order to identify the potential ethical risks that may occur during the development of the monitoring of pilot cases and its data collection, storage, and process phases.

With respect to the European laws for Human Rights and the National laws for Ethics, the PLURAL framework introduces innovative ideas proposing new technologies. To that direction, Data Protection Offices (Ethical Advisory Board) have been established in order to procure necessary information to any concerned party, but also to observe the compliance of the PLURAL project with the documented ethical and social policy and monitor the preparation and realization of the pilots.

Finally, the pilot ethical methodology has been described, which guarantees that all the PLURAL partners will have access to the data necessary for the completion of the research, while at the same time no sensitive data will be distributed outside project's scope. Ethical monitoring will be examined throughout the project lifetime.

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