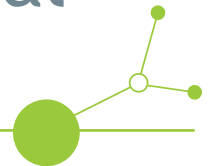




D.2.1.2 Comparative analysis of current building standards and framework for energy efficiency (EE) and sustainability in Central Europe (CE)



Version 1
27/03/2024





A.	Introduction	2
B.	Overview of existing standards and schemes in CE	3
1. General Infos	7
2. Process	8
3. Framework and Methodology.....		9
3.1. Sustainability dimension: Environmental.....		9
3.2. Sustainability dimension: Social.....		10
3.3. Sustainability dimension: Economic		11
C.	Comparative analysis	12
1. Comparison of the existing systems in CE with the indicators contained in the EU instruments ..		12
2. Contribution of analysed schemes to the MESTRI-CE objectives		13
3. Implementing efficient building data and management.....		14
4. Contribution to the building sustainability methodology		15
5. Implementing financial models		18
D.	Conclusions	20
E.	List of literature	21
F.	List of Annexes.....	22

This deliverable is edited by CASACLIMA with the contribution and support of EAST, REGEA, EAN, MAE, JSI.



A. Introduction

One of the main objectives of the MESTRI-CE project is the definition of a working methodology that will enable, also by developing specific supporting tools, the dissemination and successful application of the new European framework on energy efficiency and sustainability in buildings in the partner countries. The MESTRI-CE Sustainable Building Methodology will enhance the design of new buildings and the renovation of existing ones based on sustainability and climate-neutrality criteria aligned at CE level. Transposition of the EU climate and sustainability framework and upgrade of the actual national and regional building standards and of the methodologies applied to assess and report on the energy and sustainability performance of buildings are the focus of WP2 activities.

During the first period of the project, a status quo analysis on existing building standards and framework for energy efficiency and sustainability in Central Europe has been carried out and reported in the deliverable D.2.1.1. It allowed for a general overview of the legislative framework on energy efficiency and sustainability in buildings currently in force in the six EU countries involved in the project and provided a first analysis and comparison of the guidelines, compulsory standards or voluntary certification schemes used to assess and report on the performance of buildings.

The analysis carried out on the framework for energy efficiency and sustainability in buildings in Central Europe partner countries showed that all of them have introduced national or regional regulations on energy performance of buildings that are substantially in line with the current European energy directives. Alongside compulsory standards, which in most cases cover the requirements for the energy performance both of new buildings and of the existing ones undergoing a more or less significant renovation, in all countries there are voluntary instruments in place to support the construction of buildings with energy performances that go beyond the minimum legal requirements, and which are also increasingly focusing on the overall sustainability performance of buildings.

These instruments, whether guidelines or certification schemes, are often adopted to verify the quality of interventions in case of public incentive programmes for private investors (this is the case, for instance, of klimaaktiv in Austria or CasaClima - KlimaHaus Nature in Italy). Some others are sustainability standards that must be compulsorily applied in the case of public interventions or interventions using public funds, including EU funds (Minimum Environmental Criteria in Italy, Green Building Design Project Guidelines in Croatia, Bewertungssystem Nachhaltiges Bauen-BNB in Germany). Other times these schemes are mostly adopted on a voluntary basis by private or public investors, to ensure the quality of their investments, or by professionals as a support for the sustainable building design.



B. Overview of existing standards and schemes in CE

A total of 11 reference instruments for the promotion and verification of energy efficiency and sustainability in buildings were analysed in deliverable 2.1.1. These include examples of all types: guidelines, mandatory or voluntary standards. In general, mandatory instruments refer to the EPC standard introduced by European legislation, as is the case in Poland, Croatia and Italy. These instruments, developed by national governments, can be applied to any type of building. Exceptions are the Minimum Environmental Criteria in Italy and the BNB in Germany, which are intended for public buildings only. The voluntary instruments analysed are also generally promoted or have been promoted by public bodies (energy agencies, ministerial departments), occasionally with the participation of non-profit organisations. These schemes are often linked to a financial or volumetric incentive, as in the case of CasaClima - KlimaHaus Nature in South Tyrol or the Green Deal Building Design Project in Croatia. All voluntary instruments require higher performance than the respective national standards. Often these instruments have crossed the borders of the countries in which they were created, such as in the case of Passivhaus or DGNB, and have become well-known quality certifications in Europe and in some cases even outside Europe. Of particular interest is the tool described by the Slovenian partner, which represents a first example of the concrete application of the Level(s) framework promoted by the European Commission and is cited in the latest version of the EPBD as a reference to which the various Member States should aspire. Another peculiarity that should be highlighted concerns the instruments that can be classified as guidelines. In fact, these instruments never introduce a new calculation method. Rather, they build on the approach used in the national EPCs and sometimes introduce new indicators for those topics, such as the environmental impact of materials or indoor comfort, that are not yet part of the EPCs.

The first analysis conducted on the national and regional building standards and schemes selected by the project partners, and preparatory to the comparative analysis which will be presented in this deliverable, shows that the selected instruments can be divided into two main groups with regard to the dimensions of sustainability covered (see Figure 1).

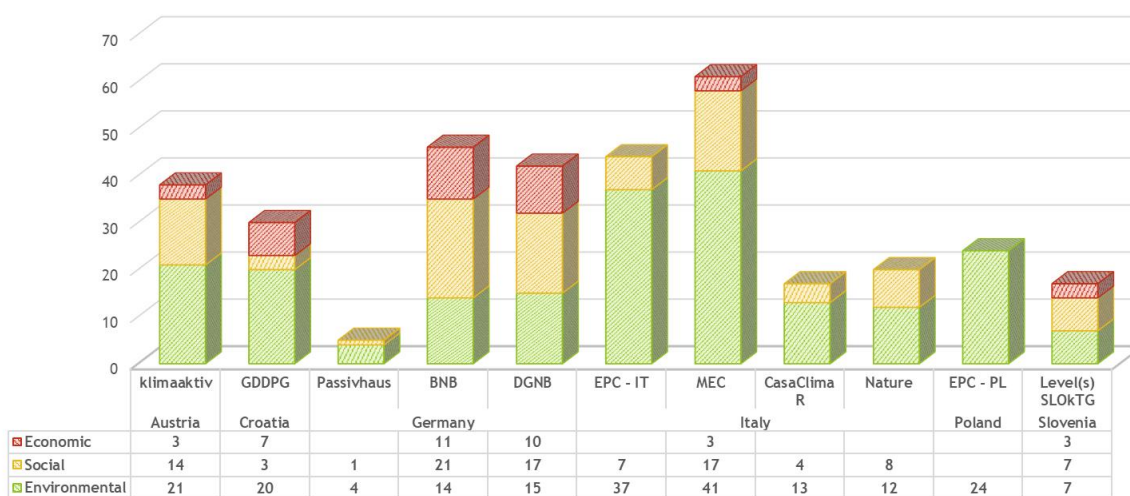


Figure 1- Dimensions of sustainability covered and number of related indicators for the most relevant national or regional building assessment schemes

The first group, consisting of the national Italian and Polish Energy Performance Certificate (EPC) standards and the Passivhaus, the CasaClima - KlimaHaus R and CasaClima - KlimaHaus Nature certification schemes,



focuses mainly on the environmental dimension of sustainability with, however, some criteria that also embrace the social dimension. All the other schemes present a more holistic approach and foresee the use of assessment criteria/indicators that cover all three dimensions of sustainability, with a prevalence of the environmental dimension, followed by the social and economic ones.

The analysis of the thematic areas covered by the criteria/indicators used in the different selected schemes allows to identify very different approaches. The strictly energy certification schemes restrict the evaluation to the building performances in the field “Energy” and in some cases in the field “Emissions” and “IEQ” (EPCs, CasaClima - KlimaHaus R, Passivhaus). The CasaClima - KlimaHaus Nature certification scheme additionally introduces indicators in the fields “Materials” and “Water”. The thematic areas evaluated are significantly broadened in the SLOk TG, klimaaktiv, Green Deal Building Design Project Guidelines, Minimum Environmental Criteria, DGNB and BNB schemes, all characterised by a greater number of indicators in use (see also D.2.1.1). However, the distribution of the criteria/indicators in the different thematic areas remains very uneven across the different schemes (see Figure 2 and Figure 3).

The comparative analysis reported in this deliverable focuses on those standards that are directly managed by the various project partners or where they have a real opportunity to act to propose or introduce changes. A multi-criteria analysis approach has been used to highlight the ability of each standard to contribute to the objectives of implementing efficient building data and management, sustainability methodology and innovative financial models.

The comparative analysis is based on the information provided by the project partners through the completion of questionnaires used to feed the status quo analysis already reported in D.2.1.1. Each project partner has been asked to analyse the main energy efficiency and sustainability standards for buildings in use in their country. The information has been collected in tables with the following structure:

General Information: this table contains all the general information relating to each standard analysed, with the aim of identifying its scope, the type of buildings to which it can be applied, and for which type of interventions, its compulsory or voluntary application, its impact in terms of assessed/certified projects as well as other general information on the governance, the update frequency and the possibility for project partners to further develop and adapt the scheme.

Process: this table collects basic information on the evaluation/certification process and the stakeholders involved.

Framework&Methodology: this table analyses the standards selected by the project partners according to the 3 dimensions of sustainability covered: environmental, social and economic. For each of the three sustainability dimensions, thematic areas have been identified for which the relevant indicators used by the standards have been collected.

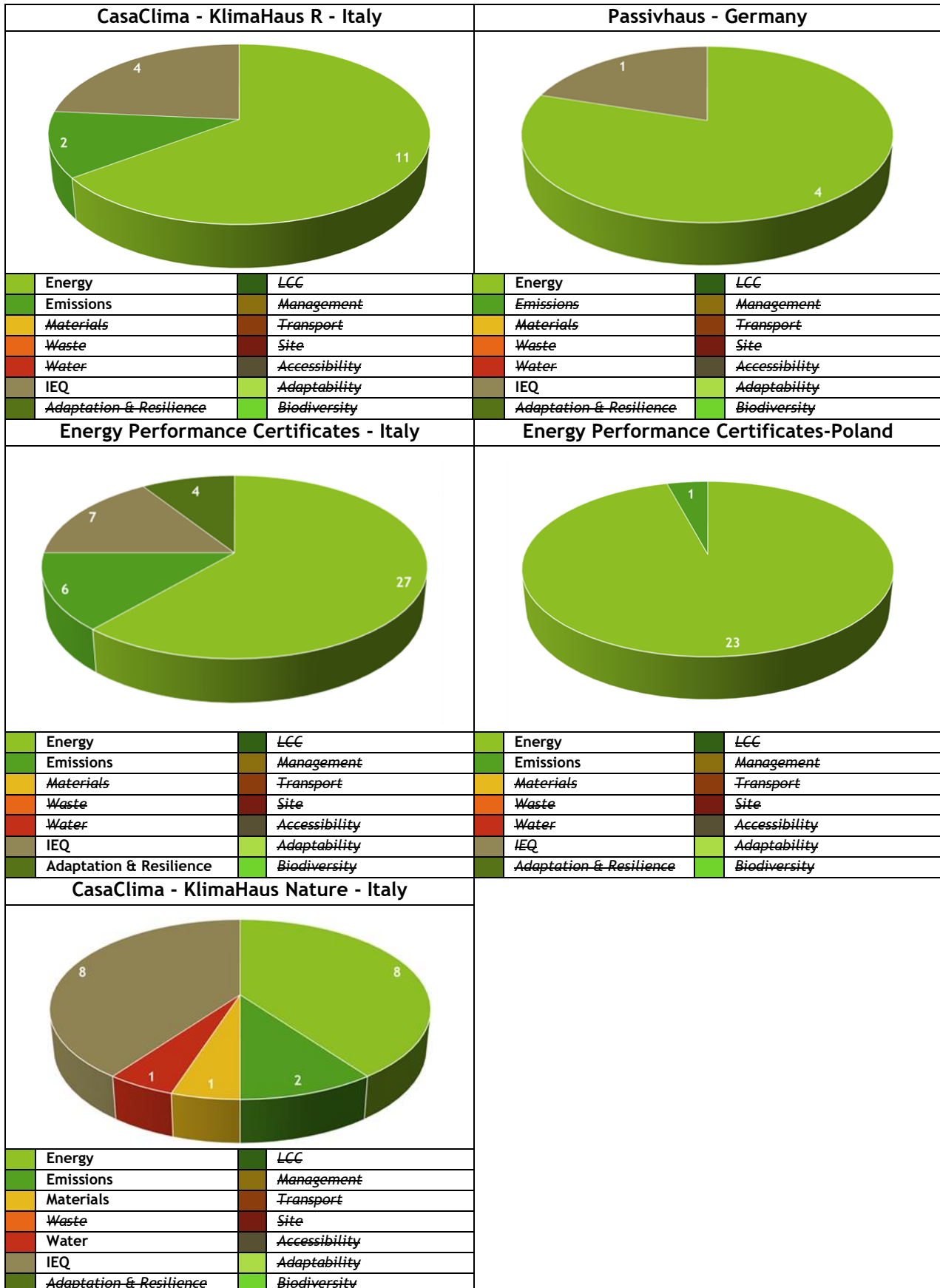


Figure 2 - Thematic areas covered and related number of indicators of the selected building assessment schemes

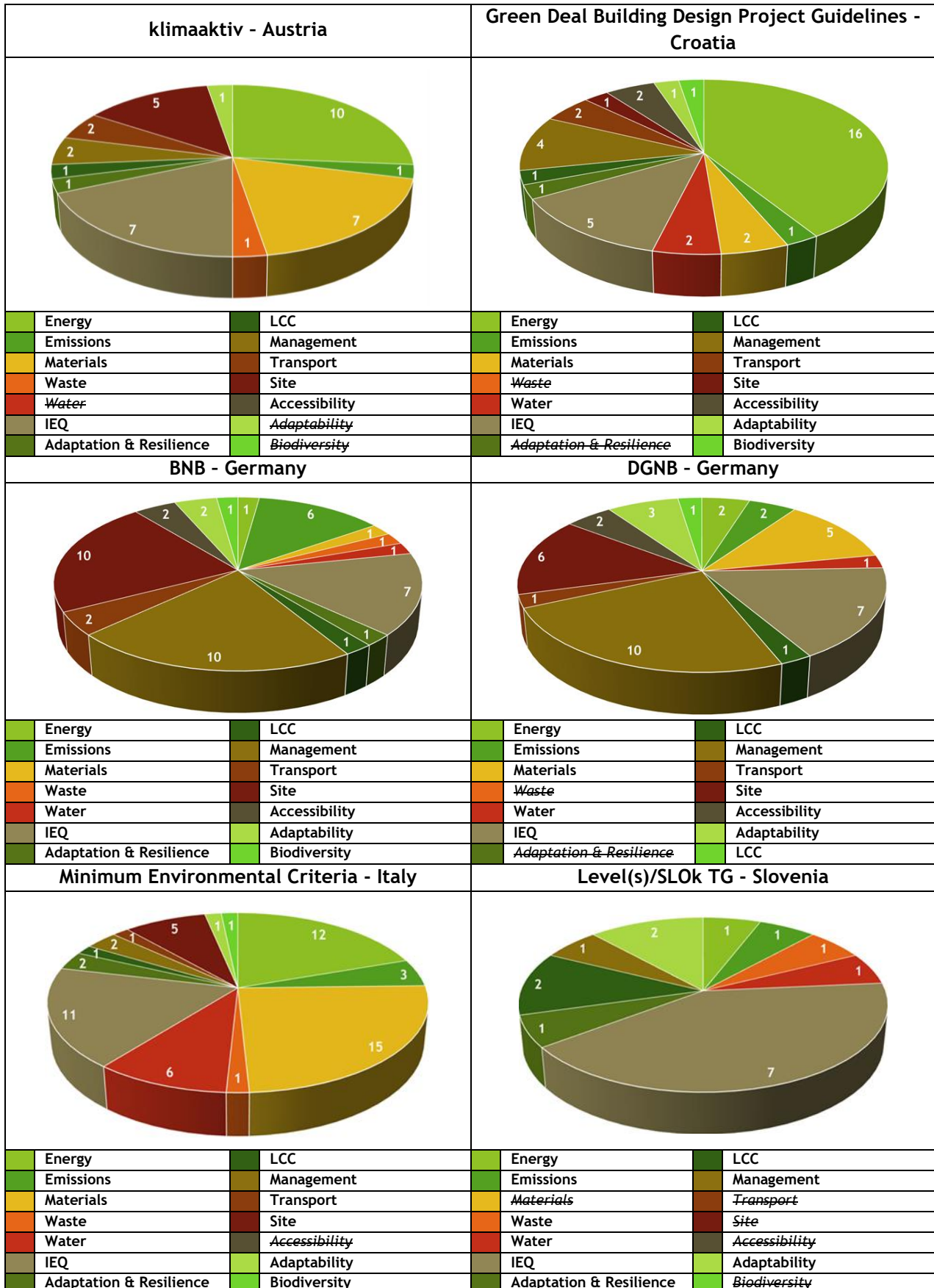


Figure 3 - Thematic areas covered and related number of indicators of the selected building assessment schemes



1. General Infos

The table “General infos” collects information about:

- **Scope /type of instrument:** project partners are asked to indicate whether the instrument could be described as a guidance document, a mandatory standard or a voluntary certification scheme verified by a third party. The definition Guideline is intended to cover all those instruments that do not allow the issuance of a certificate that can demonstrate the fulfilment of specific criteria or the achievement of a specific class or score.
- **Alignment with EU directives on building energy efficiency:** project partners are asked to indicate whether the instrument has transposed the European Directives on energy efficiency in buildings and on the use of energy from renewable sources: Directive 2002/91/EC (EPBD 1); Directive 2006/32/EC; Directive 2009/28/EC, Directive 2010/31/EU (EPBD 2); Directive 2012/27/EU; Directive 2018/844/EU (EPBD 3).
- **Building types to which the instrument can be applied:** project partners shall specify whether the tool can be applied to any type of building, or only to specific uses.
- **Type of intervention that can be assessed:** project partner shall specify whether the instrument can be applied to all types of building interventions or only to specific ones. Specifically, reference is made to: new buildings, major renovations (the total cost of the renovation of the building envelope or technical building systems exceeds 25% of the value of the building, excluding the value of the land on which it is situated; or the renovation concerns more than 25% of the surface area of the building envelope), non-major renovations.
- **Type of use:** project partners can specify whether the application of the instrument is compulsory, always compulsory or only for certain types of building interventions identified in the previous point; whether it is voluntary or linked to the obtaining of incentives (economic, volume, etc.).
- **Main target users:** project partners shall indicate which of the categories listed are the main users of the instrument; Project design teams, including architects, engineers, quantity surveyors and specialist consultants; Clients and investors, including property owners, developers, managers and investors; Public policy makers and procurers, at national, regional and local level; End users; All of them.
- **Country/region of origin and use:** project partners shall indicate the geographical origin of the tool and whether it is used only in its area of origin or whether its use has spread elsewhere.
- **Developer/owner/manager of the system:** project partners are asked to indicate who developed the tool and whether the developer is public or private and, in the latter case, who owns the property rights and who manages the system.
- **Year of first publication/launch:** project partners are asked to indicate the year in which the tool was made available to potential users.
- **Number of projects/buildings assessed/certified:** project partners shall indicate the number of buildings certified using the tool.
- **Literature/references for further information:** project partners shall indicate at least the type, language and repository of the documents related to the tool.
- **Frequency of updates:** project partners are asked to indicate how often the tool is updated and what is the motivation for updating it, i.e. the need to respond to a higher standard, be it local, national or European.



- **Ability of the project partner to develop/adapt/update the tool:** project partners shall indicate whether the project partner has the possibility to influence the development, modification and updating of the tool.

2. Process

- **Phase of the project at which the design assessment/reference is made:** project partners are asked to indicate to which of the following phases of the construction process the information contained in the tool can be applied and/or verified: conceptual design; detailed design and construction; as-built and in use; all.
- **Conceptual design for building construction:** includes early qualitative assessment of the basis for conceptual design and reporting on the concepts applied or to be applied.
- **Detailed design and construction performance:** includes the quantitative assessment of the designed performance and monitoring of construction according to standardised units and methods.
- **As-built and in-use:** refers to the performance of the building after completion and delivery to the client. It involves the monitoring and control of activities both on site and in the completed building and its first occupants.
- **Certified technician:** project partners shall indicate if an additional qualification beyond the standard professional qualification (architect, engineer or similar) is required to use the tool.
- **Assessor:** project partners are asked to indicate who can certify the correct application of the tool: architects, engineers or similar; accredited assessor; public authority.
- **Accredited assessor:** project partners shall indicate if the function of assessor can be performed by architects, engineers or similar, and whether they need to have an additional qualification.
- **Method of assessing the building's performance:** project partners are asked to indicate which of the following methods the tool uses to determine the building's performance: scoring, weighting, minimum target defined for each KPI.
- **Validation of the assessment:** project partners shall specify which of the following procedures can be used to verify the correct application of the tool: self-assessment, assessment certified by an accredited professional, validation/certification by a third party.
- **Certification and labelling:** project partners shall indicate whether only a certificate is issued at the end of the process or whether a label is also issued.
- **Certification levels:** if a certificate is issued, project partners shall indicate the certification levels (e.g. bronze-silver-gold, etc.).
- **Certification body:** project partners shall indicate if there is a body or similar responsible for issuing the certificate.
- **Short description of the verification/validation process:** a description of the process is required.



3. Framework and Methodology

3.1. Sustainability dimension: Environmental

Thematic areas: here project partners are asked to collect the relevant indicators present in their schemes/standards/guidelines.

- **Energy.** This thematic area collects all the indicators that have as their objective:
 - The measurement of the calculated or actual energy consumption of the building to meet the needs for heating, cooling, domestic hot water, ventilation, artificial lighting, transport of goods or people.
 - Improving the performance of the envelope, opaque or transparent, in terms of reducing heat loss, inertia, overheating.
 - Increasing the use of renewable energy sources.
 - The design and verification of the airtightness and thermal integrity of the envelope.
 - Improving the performance of the components of technological systems related to the production, distribution and emission of the building's thermal systems.
 - Improving the performance of the automation systems for the control, regulation and management of the building's thermal technologies and systems (BACS).
 - The installation of systems capable of recovering heat from wastewater.

All these metrics focus on assessing the energy performance of the building during its operational or "use" phase. The goal is to evaluate how efficiently the building utilizes energy resources for heating, cooling, lighting and other operational needs once it is in use. The assessment of the use stage energy performance considers factors such as energy needs/consumption, the use of renewable energy sources, and overall efficiency in maintaining a comfortable indoor environment for occupants. The aim is to encourage and measure sustainable practices that minimise the environmental impact associated with the building's ongoing energy usage.

- **Emissions.** This thematic area collects all the indicators that have as their objective:
 - The calculation of greenhouse gas (GHG) emissions associated with a building at different life cycle stages to quantify a building's contribution to global warming potential (GWP). Emissions can be calculated over the entire life cycle of the building, from cradle to grave, or in relation to a specific set of stages. The indicator can also include the calculation of other environmental impact indicators.

The metrics aim at reducing the embodied greenhouse gas emissions along the buildings' whole life cycle, including those associated with product manufacturing, maintenance, repair, adaptation, renovation and end of life.

- **Materials.** This thematic area collects all the indicators that have as their objective:
 - Reduction of the environmental impact of building materials and components.
 - Promotion of circularity using materials that can be easily recycled or reused at the end of their useful life, and construction solutions that encourage selective demolition.



The indicators aim at optimising material use, reduce waste and introduce circularity into designs and material choices to extend the buildings life cycle, the long-term material utility and reduce significant environmental impacts.

- **Water.** This thematic area collects all the indicators that have as their objective:
 - The installation of low water consumption taps (see the limits in l/min included in the European taxonomy).
 - Increased use of systems that allow the collection and reuse of rainwater on site or the reuse of greywater.

The metrics aim to promote the efficient use of water resources by introducing water efficiency measure and grey water reuse and rainwater harvesting.

- **Adaptation and resilience to climate change.** This thematic area collects all the indicators related to:
 - Analysis of climate risks and vulnerabilities specific to the geographical area in which the building is located, in order to make both the building itself and its surroundings more resilient and resistant to extreme weather events when they occur.
 - Implementation of green infrastructure
 - Assessing the thermal comfort conditions, calculated taking into account future climate scenarios, e.g. using climate files up to 2030 or 2050.

The indicators assess the exposition to climate risk and the vulnerability of the building and aims at ensuring the futureproof building performance against future changes in the climate in order to protect occupier health and comfort and to minimise long-term risks to property values and investments.

- **Adaptability.** This thematic area collects all the indicators that have as their objective:
 - The ability to adapt the building over time to changing occupant needs and market conditions without compromising the ability of the building to continue to perform its function and extend its useful life.

The metrics evaluate the capacity of a building to continue fulfilling its function and to extend the useful service life into the future with the objective of reducing environmental impacts and increasing the building's value.

3.2. Sustainability dimension: Social

Thematic areas

- **Health and comfort (IEQ).** This thematic area can collect all the indicators that have as their objective:
 - Improvement of IAQ
 - Improvement of thermal comfort conditions
 - Improvement of visual comfort conditions
 - Improvement of acoustic comfort conditions.

The metrics in this area aim at reducing human health risks related to inadequate indoor air quality due to the presence of pollutants or other air conditions (CO₂, humidity); at ensuring adequate levels of thermal comfort for occupants by reducing the risk of overheating in summer and avoiding situations of inadequate heating in winter; at assessing the availability and quality of lighting to ensure healthy and comfortable



homes and workspaces and at avoiding negative impacts on the health, comfort, well-being of occupants and their productivity and ability to communicate due to noise.

- **Mobility.** This thematic area collects all the indicators that have as their objective:
 - Promotion of mobility by public transport or by bicycle.
 - Promotion of low emission mobility.

The indicators assess the possibility to reduce of the environmental impacts connected to mobility. Proximity to facilities for daily life and infrastructure for sustainable mobility are also assessed.

- **Site & Biodiversity.** This thematic area collects all the indicators that have as their objective:
 - Reducing light pollution.
 - Promoting the implementation of green infrastructure.
 - Increasing the use of construction solutions for the surface treatment of elements exposed to rain that guarantee high permeability.
 - Increasing the use of systems that ensure the correct management and disposal of rainwater on a territorial scale.
 - The reduction of the "heat island" effect
 - Promoting the conservation and protection of the habitats that characterise the area of intervention.

These metrics aim at avoiding/reducing the heat island effect through measures that positively influence the microclimate around the building such as a minimal soil sealing degree, natural infiltration, greening and planting measures, the maintenance of existing natural ecosystems.

- **Accessibility.** This thematic area collects all the indicators that have as their objective:
 - Promotion of accessibility to the building for people with reduced mobility or disabilities.

3.3. Sustainability dimension: Economic

Thematic areas

- **Life Cycle Costing (LCC).** This thematic area comprises all the indicators that have as their objective:
 - Carrying out an LCC evaluation.

These metrics aim at optimising the life cycle cost and value of buildings to reflect the potential for long-term performance improvement, inclusive of acquisition, operation, maintenance, refurbishment, disposal and end of life.

- **Management.** This thematic area comprises all the indicators that have as their objective:
 - The implementation of building maintenance and management plans.
 - The use of building performance monitoring systems.
 - Use of automation and control systems.
 - The use of BIM.

The indicators aim at ensuring that the planned building performance is achieved and ultimately optimised.



C. Comparative analysis

1. Comparison of the existing systems in CE with the indicators contained in the EU instruments

In Deliverable 2.1.1, the indicators used by the building assessment schemes analysed were linked to thematic sub-areas. Each of these, in turn, related to one of the three dimensions of sustainability: environmental, social and economic. The pie charts and histograms, also presented in Figure 1-2-3 of this deliverable, made it possible to understand the current degree of coverage offered by the analysed systems with respect to the three dimensions of sustainability, regardless of the specific indicator or how it is calculated or evaluated.

In this Deliverable 2.1.2, the same indicators have been analysed in a different light. The aim is to understand whether they are capable of "overlapping" with the metrics proposed in the European reference systems for energy efficient and sustainable buildings and specifically with: the new version of the Energy Performance of Buildings Directive (EPBD), the European Taxonomy and the Level(s) Framework. These references will form the basis for the subsequent definition of the MESTRI-CE Sustainable Methodology.

The results of this analysis have been summarised graphically in the annexes A to G to this document. Annex A provides a global overview of all the indicators considered. The first four columns of Annex A (see D.2.1.2 Annex A - General overview) list the indicators proposed by the EPBD recast, the EU taxonomy and the Level(s) framework, the thematic area to which they belong, the method of performance assessment (qualitative or quantitative). The other columns list the indicators included in the 11 systems analysed by the project partners covering the same thematic area. The other annexes, from B to G, are simply an extraction of the indicators according to the thematic areas.

The instruments analysed by the project partners show a greater overlap with the indicators proposed by the European reference systems for the energy sector. This is easily explained by the fact that a large part of the indicators related to this thematic area come from the EPBD, which, even in its new version, seems to propose several metrics that were already part of the previous EPBD. As all the partner countries are EU member States, it is not surprising that most of these indicators are already included in both national instruments and voluntary certification schemes. Almost all the systems analysed use primary energy demand (PED) to determine the energy intensity of buildings. An exception to this is represented by the tools developed by the CasaClima - KlimaHaus Agency, which focus on the energy performance requirements of the building envelope. It is interesting to note that although airtightness is a relatively new metric within the European regulatory framework, introduced as a requirement by the European Taxonomy, the need for a Blower Door Test (BDT) appears in almost all the tools analysed. In contrast, the Smart Readiness Index seems to be the only indicator that does not appear in any scheme so far.

Indicators related to the thematic area "Emissions" are less common, and only Croatia and Slovenia refer to the calculation of the Global Warming Potential (GWP) indicator, an indicator on which much of the new EPBD is based. Greenhouse gas emissions during the life cycle of buildings are included as output data in almost all systems, but only the BNB and the protocols promoted by the CasaClima - KlimaHaus Agency set a benchmark for this indicator considering both the operational and embodied GWP. Also, in this thematic area we find an indicator that is currently not included in any of the analysed tools, namely the carbon emissions of buildings due to the use of fossil fuels.

Seven out of eleven systems analysed by the partners have indicators related to management and use of building materials. These indicators mainly relate to the management of waste from construction and demolition processes and strategies to increase the sustainable and efficient use of raw materials.



klimaaktiv and CasaClima - KlimaHaus Nature require a life cycle assessment to be carried out. In the case of the CasaClima - KlimaHaus Nature protocol, however, this is only linked to phases A1 to A3 of the life cycle of the building materials, but requires the achievement of a minimum score. LCA analysis is also included in the indicators of the MEC, but is not mandatory.

Indicators aimed at rationalising the use of water resources are also well distributed across the different systems, in particular for processes and installations related to rainwater storage and management, and flow requirements for sanitary installations.

On the other hand, indicators describing the building's ability to adapt to climate change or to protect biodiversity appear in only 4 systems (Green Deal Building Design Project Guidelines, DGNB, BNB and SLOkTG) for the former and only in the Croatian Green Deal Building Design Project Guidelines certification scheme for the latter.

Indicators describing the ability of the building to adapt to changes that may occur during its lifetime, e.g. related to a change of use or modernisation of installations and subsequent upgrading, appear only in the BNB, DGNB and the Croatian scheme.

With regard to the indicators belonging to the “Health&Comfort” thematic area, only the analysed energy certification schemes, i.e. those issuing an EPC, do not include indicators related to IEQ. On the other hand, all the other schemes already include some of these indicators, in particular with regard to the emission of potentially harmful substances by building materials, thermal and acoustic comfort and the availability of natural light.

The area of mobility seems to be one of the least present among the 11 systems, with only one indicator covered by the klimaaktiv scheme, concerning the availability of parking spaces for bicycles, and another covered by the Green Deal Building Design Project Guidelines, favouring the pre-cabing of parking spaces for electric cars.

With regard to the last two groups of indicators, Cost&Value and Management, LCC analysis is already required in 5 of the systems analysed, although in almost all of them it is not mandatory but voluntary, while the existence of a maintenance plan for the systems is only explicitly required in MEC.

2. Contribution of analysed schemes to the MESTRI-CE objectives

Based on the information provided by the compilation of the tables described above, it was decided to focus a more in-depth comparative analysis only on those schemes that can be managed/influenced by the project partners themselves. These are:

- klimaaktiv - Austria
- Green Deal Building Design Project Guidelines - Croatia
- CasaClima-KlimaHaus Nature - Italy
- CasaClima R - KlimaHaus R - Italy
- Minimum Environmental Criteria (hereafter MEC) - Italy
- Level(s)/SLOk TG - Slovenia
- Energy Performance Certificate (EPC) - Italy.



As far as the EPCs are concerned, since all European countries are obliged to harmonise their regulations for the energy certification of buildings with European standards and directives, it was decided to use the Italian EPC as a general reference.

For each of the selected instruments the more in-depth comparative analysis has been focused on their ability to contribute to the objectives in the scope of the MESTRI-CE project, i.e. their contribution to implement efficient building data and management, building sustainability methodology and financial models.

To carry out this comparative analysis each project partner has been asked to complete several tables structured according to following objectives:

- Contribution to implementing efficient building data and management
- Contribution to implementing the building sustainable methodology
- Contribution to implementing financial models.

3. Implementing efficient building data and management

The Building Data table (hereafter BD-table) contains information that can be used for the analysis of a building portfolio. It is based on the documents produced in WP1, in particular *Deliverable D1.2.1. Requirements for the creation of the MESTRI-CE Smart Data Hub*. As specified in the D1.2.1, the text must be considered as a living document that needs to be adapted, if necessary, within the process of developing the Smart Data Hub. The BD table, completed with all the information provided by the project partners, is attached to this deliverable as an annex (see D.2.1.2 Annex H - BuildingData).

The purpose of the BD-table is to find out whether the selected schemes can provide the data highlighted in Annex A to Deliverable 1.2.1 in relation to Step 1; if not available, whether they can be implemented or not. The required data are divided into two main groups. The first, called basic data, contains information on the building's location, type of intervention carried out or planned, intended use (defined according to Annex I of the EPBD recast), main dimensions and age of the building. The second, called the current state, provides data on how the building is used, the stratigraphy and thermophysical values that characterise the building envelope, the technical systems installed and the energy source used, the energy performance of the building described by the indicators contained in an EPC, the metered energy consumption and other aspects. If the requested data already exists in the system, the symbol P is used; if the requested data does not exist in the system and would be difficult to integrate, the symbol P- is used; if the requested data does not exist in the system but would be easy to integrate, the symbol P+ is used; n.a. is used to indicate data not applicable.

Before describing in detail which of the above data are readily available from the building schemes analysed, it is important to highlight a key difference between the instruments themselves. The Green Deal Building Design Project Guidelines, the MEC and the klimaaktiv can be seen as guidelines that define the indicators to be used and the thresholds to be reached, but in most cases they do not explain the necessary calculation approach. They often refer to other technical reports to be prepared at national level, such as the EPCs. This means that even if some information cannot theoretically be obtained directly from these instruments, it can be provided by the technical reports to which they refer.

For the reason explained above, all the information related to the "basic data" group, with the exception of the type of intervention, cannot be obtained directly from the Green Deal Building Design Project Guidelines, but are all included in the technical documentation, for which the Green Deal Building Design Project Guidelines directive provides instructions. The same can be said for the MEC.



The klimaaktiv evaluation system does not require cadastral information; only new construction or major renovation can be assessed by the system, while it is not possible to certify interventions identified as minor renovation. Buildings can be classified according to the end-use definition of the EPBD recast. It is not possible to identify the number of floors that characterise the building, and both the heated area and the volume are expressed in gross terms. It is not possible to determine the number of people living or working in the building, nor the number of operating hours.

Both CasaClima - KlimaHaus Nature and R, the Italian EPC and the Slovenian Level(s)/SLOk TG version provide directly all the information related to the “basic data” group through the technical documentation required to apply the certification scheme. More specifically, CasaClima - KlimaHaus Nature and R do not directly ask for the number of floors that characterise the building, since both systems certify the building as a whole, nor for data relating to its age. Otherwise, all this information could easily be included in both systems.

In the “current state” group, the klimaaktiv rating system does not need to specify the stratigraphy or the thermal transmittance of the opaque and transparent elements that make up the building envelope, since this information is implicitly included in the values related to the energy performance of the building, which can be calculated using different approaches but must respect a precise threshold. A similar consideration can be made for the MEC, as this data is provided by the technical report on energy performance. On the contrary, these data can be obtained directly from all the other systems analysed.

klimaaktiv asks to specify the technical system for heating and hot water and its energy source. Gas and oil are forbidden. It does not ask for information on the lighting system, nor does the MEC for residential buildings. CasaClima - KlimaHaus Nature and R take into account the consumption related to the lighting systems for all the intended uses of the building, such as Green Deal Building Design Project Guidelines and Level(s)/SLOk TG.

Data on energy consumption during operational use of the building are available for Green Deal Building Design Project Guidelines, klimaaktiv and Level(s)/SLOk TG. The Italian systems do not yet require this data.

The aspects related to seismic and fire safety are already considered only by Green Deal Building Design Project Guidelines.

In summary, almost all the data requested by the BD table, which is based on the requirements of *Deliverable D1.2.1. Requirements for the creation of the MESTRI-CE Smart Data Hub*, can be obtained more or less completely from the analysed instruments. Not all of these items are directly addressed by the system, but in these cases, they are part of the technical documentation that is retrieved from the system.

4. Contribution to the building sustainability methodology

One of the objectives of Work Package 2 is to assess the level of compatibility and synergy of the selected systems with the EU framework for sustainable buildings, more specifically Level(s) and the new version of the EU Directive on the Energy Performance of Buildings. The following EPBD table has been defined for this purpose while the alignment of the systems analysed by the project partners to the Level(s) framework is reported in D.2.1.3.

The EPBD table (see D.2.1.2 Annex I-EPBD) is based on the “*Interinstitutional File:2021/0426 (COD) - Consolidated compromise text 20 December 2023*” and focuses its attention on the requirements related to:

- the energy performance of buildings (Articles 5-7-8-9b). The project partners were asked to indicate whether the requirements of the new EPBD in Article 5 are already included in the current standards/legislation/schemes and to explain the main differences and where an update is needed.



- the methodology for the calculation of the energy performance of buildings described in the Annex I. Project partners were asked to indicate if the methodology in use for the calculation of the energy performance of buildings considers the requirements set in the new EPBD (Annex I) and add explanations or clarifications.
- the calculation of the life cycle Global Warming Potential cited in the Article 7 and described in the Annex III. Project partners were asked to indicate if the calculation of this indicator is already considered in the existing schemes, if there are differences with the EPBD requirements and if an update is needed.
- the implementation of the solar energy in buildings (Article 9a). Project partners were asked to indicate whether the requirement is already being considered, for what types of buildings and interventions, and with what exemptions, if any.
- the technical building systems (Article 11). Project partners were asked to indicate whether specific requirements for technical building systems are already considered, whether there are differences with those required by the EPBD and whether an update is needed.
- the Indoor Environmental Quality (IEQ). Project partners were asked to indicate if specific requirements for the indoor environmental quality are already considered in the current standards/legislation/schemes.
- the infrastructure for sustainable mobility (Article 12). Project partners were asked to indicate if the requirements exist in their current standards/ legislation/ schemes and whether they are in line with those of the new EPBD or even stricter even for existing buildings.
- the Smart readiness of buildings (Article 13 and Annex IV). Project partners were asked to indicate whether SRI has already been tested in their country and whether their standards/schemes require SRI assessment, and for which type of building.
- the renovation passport (Article 10 and Annex VIIa).
- the inspections (Article 20).

The aim of the new EU Directive on the energy performance of buildings (EPBD recast) is to encourage Member States to take action to reduce the environmental impact of buildings in with a view to achieving a zero-emission building stock by 2050. The key concept, as in the previous directives, is to first reduce the energy demand of buildings ("energy efficiency first" principle), then to increase the efficiency of technical systems and to cover the remaining energy demand with renewable energy sources.

For new buildings, the Zero Emission Building (ZEB) standard is introduced. New buildings will require for their use zero or a very low amount of energy, producing zero on-site carbon emissions from fossil fuels and producing zero or a very low amount of operational greenhouse gas emissions. The total annual primary energy use of a new or renovated zero-emission building will be covered by:

- (a) energy from renewable sources generated onsite or nearby,
- (b) energy from renewable sources provided from a renewable energy community
- (c) energy from an efficient district heating and cooling system
- (d) energy from carbon free sources.

As of 1 January 2028, all new buildings owned by public bodies and as of 1 January 2030, all new buildings shall be zero-emission buildings.

The new directive also introduces a calculation of the life-cycle Global Warming Potential (GWP), with the requirement for an indicator, measured in kgCO₂eq/m² per year, to be included in the energy performance certificate of every building: as of 1 January 2028 for all new buildings with a useful floor area greater than 1000 m² and as of 1 January 2030 for all new buildings.



Member States will also have to set minimum energy performance standards for existing buildings based on a national trajectory to ensure a decrease of the average primary energy use of the whole residential building stock of at least 16% by 2030 and 20-22% by 2035 compared to 2020. At least 55% of this reduction will have to be achieved by renovating the most energy-intensive residential buildings.

The phase out of fossil fuel boilers is set in the Directive by 2040, so Member States will have to take measures to decarbonise heating systems and eliminate fossil fuels in heating and cooling by then. Member States will also have to stop subsidising stand-alone fossil fuel boilers from 2025.

To encourage the use of solar energy, all new buildings will be 'solar ready', i.e. suitable for photovoltaic or solar thermal roof systems. The installation of solar energy systems will become the standard for all new buildings and partly also for renovated ones.

To promote sustainable mobility, the Directive includes provisions on pre-cabling, which will become the standard in new and renovated buildings to facilitate access to charging infrastructure; on the number of electric vehicles charging points in residential and non-residential buildings; and on bicycle parking.

An indicator and a methodology will be adopted for rating the smart readiness of buildings i.e. their predisposition and capacity to use smart technologies to adapt their operation to the occupants' needs, particularly as regards indoor environmental quality and thermal comfort.

In comparison to the previous versions, the new EPBD takes a more holistic approach to sustainability in buildings, referring several times to the need to integrate energy requirements with those ensuring optimal indoor environmental quality, adaptation to climate change, fire and seismic safety, accessibility for persons with disabilities.

All systems comply with previous versions of the European Building Performance Directive and have already introduced the concept of nZEB into their national regulations. The Green Deal Building Design Project Guidelines calls for a higher threshold than that required by law. On the contrary, the concept of a zero-emission building is not yet considered. With regard to the additional issues mentioned in Articles 5-7-8-9b of the new EPBD, beyond those strictly related to energy efficiency of buildings, the Slovenian system already takes into account indoor climate, fire safety, seismic safety, accessibility for people with disabilities for the new buildings. None of these issues are taken into account for major renovations. On the contrary, the Green Deal Building Design Project Guidelines considers all of them for both new buildings and major renovations. The Italian and Austrian instruments analysed consider issues related to IEQ and adaptation to climate change. The other topics are not addressed together with the energy and/or sustainable performance of the building, as the institutions responsible for assessing these aspects are different. Since klimaaktiv does not directly calculate the energy performance of the building, an EPC is required to obtain this information. Otherwise, all the requirements of the EPBD are already covered by the Austrian Energy Efficiency Ordinance. In addition, the klimaaktiv system already prohibits the use of gas and addresses issues related to IEQ for both new and renovated buildings.

Regarding the methodology for calculating the energy performance of buildings (Annex I), both the Croatian and Slovenian instruments are already in line with the EPBD recast. The Italian calculation methodology is still based on the EN ISO 13790 and is not able to take into account the influence of installed on-site renewable energy sources and storage, building automation and control systems and electrical and/or thermal storage systems on the energy performance of the building. Since klimaaktiv does not directly calculate the energy performance of the building, an EPC is required to obtain this information. Otherwise, all the requirements of the EPBD are already covered by the Austrian Energy Efficiency Ordinance.

The calculation of the lifecycle global warming potential (Article 7 and Annex III) is recommended by the Green Deal Building Design Project Guidelines but not required. Currently, the Green Deal Building Design Project Guidelines Directive expresses the environmental impact of the building as the amount of CO₂ emitted by the building itself during its lifetime due to the consumption of energy, water and raw materials, and is based on the values of the environmental impact indicators included in the EPDs. The CasaClima -



KlimaHaus Nature system also calculates a life cycle GWP in $\text{kgCO}_2\text{eq}/(\text{m}^2)$, but its calculation is not based on the Level(s) framework and standard EN 15978 and, in any case, the reference period is longer, equal to 100 years instead of 50.

The use of solar energy in buildings (Article 9a) is required. The same parameters are used in the Slovenian system and in the Austrian one, while the Green Deal Building Design Project Guidelines directive assesses it using different parameters than in the EPBD. Namely, if the available roof area allows it, a solar power plant is dimensioned to meet the highest possible percentage of electricity demand (high and low tariffs). At the same time, specific requirements are mentioned regarding the need to design buildings as to optimise their solar energy production. The same occurs with CasaClima - KlimaHaus Nature and MEC, but they do not include specific requirements for optimising the design of buildings in order to increase their solar energy production potential on the basis of solar irradiation.

The requirements related to the technical building systems are met in all the systems except the Italian ones. The Green Deal Building Design Project Guidelines does not contain specific requirements for greenhouse gas emissions, the type of fuel used by heat generators, or the minimum percentage of renewable energy used for heating at the building level, although all these aspects are indirectly controlled. The same can be said for the promotion of the use of low-temperature heating systems. Moreover, the system asks that non-residential buildings shall be equipped with building automation and control systems also capable of effective monitoring of indoor environmental quality.

The requirements related to the implementation of IEQ standards in new or renovated buildings (Article 11) are met in all the systems, with the exception of the EPCs. Only klimaaktiv and the Green Deal Building Design Project Guidelines request the installation of metering and control devices.

Among the systems analysed, klimaaktiv, the Green Deal Building Design Project Guidelines and the Level(s)/SLOk TG already fulfil all the aspects of Article 12 related to sustainable mobility infrastructure. The only issue not addressed is that of intelligent charging. The other systems analysed do not present metrics related to this topic.

In the Green Deal Building Design Project Guidelines, both the introduction of a smart readiness indicator and a renovation passport are in progress, while in the Slovenian system, the first has been defined and tested in public buildings within the H2020 project, while the second is not yet considered. klimaaktiv already asks for a renovation passport.

5. Implementing financial models

Regarding the need to understand if the selected tools can be used to support the requirements of green financing, and therefore the implementation of innovative financial models, the European Taxonomy was chosen as a reference. The European Taxonomy defines the criteria that economic activities must meet to be environmentally sustainable. By providing a common language for a clear definition of what is 'sustainable', it can help the EU to increase investment in the green transition and provide security for investors by protecting them from greenwashing.

The EU Taxonomy table (see D.2.1.2 Annex L - EU Taxonomy) focus on the requirements set by the EU Taxonomy for the building sector, considering both the new construction and the existing buildings undergoing major renovations. As for the table related to the Building Data, if the requested data already exists in the system, the symbol P is used; if the requested data does not exist in the system and would be difficult to integrate, the symbol P- is used; if the requested data does not exist in the system but would be easy to integrate, the symbol P+ is used; n.a. is used to indicate data not applicable.

The Slovenian systems already include all the requirements set out in the EU taxonomy, apart from quality control procedures for airtightness and thermal integrity during the construction process and those needed



to demonstrate the DNSH for new buildings in terms of protecting biodiversity and the ecosystem. It is considered that these aspects can be easily added.

Within the klimaaktiv system, only the requirements necessary to use the climate change mitigation target as a substantial contribution criterion are used, except for the calculation of the life cycle GWP for each phase in the life cycle of the buildings. For all of these, no better performance than that required by the EU taxonomy is required. For the Green Deal Building Design Project Guidelines guideline and the Italian systems all the requirements necessary to use the climate change mitigation target as a substantial contribution criterion are used, but better performance is required for all indicators.

Regarding the demonstration of DNSH for the Pollution Prevention objective, the klimaaktiv system requires specific certificates to demonstrate that the emission of formaldehyde and COV by building materials remains below a certain limit value. The same for the Green Deal Building Design Project Guidelines and the Italian systems. All other requirements related to the other environmental objectives, whether they are used as substantial contribution criteria or as DNSH, are not implemented in the klimaaktiv system and it is assumed that they cannot be inserted in the future.

On the contrary, the Green Deal Building Design Project Guidelines already requires a climate risk and vulnerability analysis to be carried out, and all European regulations on pollution prevention have already been transposed into Croatian legislation. Requirements related to the objective of transition to a circular economy will be updated in the next version of the guideline.

The Italian system also does not require a climate risk and vulnerability analysis and is unlikely to include one soon. Regarding the requirements related to the use of the transition to a circular economy as a substantial contribution criterion, the CasaClima - KlimaHaus Nature standard calculates the GWP only for the LCA phases A1 to A3 and for the substitution of the material during the life cycle, while the MEC standard does not require a LCA to be carried out. It can be requested by the contracting authority as a reward criterion. Furthermore, unlike the CasaClima - KlimaHaus standards, the MEC standard already includes information on the percentage of primary raw materials. Currently, these percentages are lower than those required by the EU taxonomy, except for some types of insulation materials. The percentages can be improved, and the same requirements can easily be introduced in both CasaClima - KlimaHaus standards. The same can be said for the requirements related to the use of water, apart from the requirements that operate at a territorial level. The reason is that the CasaClima - KlimaHaus standard only operates at the building level. The same can be said for the requirements related to pollution prevention and protection of biodiversity and ecosystems, which go beyond the dimension of the building.



D. Conclusions

The analysis of the instruments for energy efficiency and sustainability in buildings in the Central European partner countries, carried out in Deliverable D.2.1.1, highlighted that all national or regional regulations on the energy performance of buildings are essentially in line with the current European Energy Directives. At present, a broader approach to sustainability is mainly addressed by voluntary instruments, which try to achieve energy performance beyond the minimum legal requirements and focus on the overall sustainability performance of buildings.

The information collected provided the basis for the comparative analysis reported in this deliverable, which aims to understand whether the systems analysed already implement an efficient way of managing and storing building data, whether the analysis they require already goes beyond the building's energy efficiency to include aspects related to sustainability, and whether they are able to provide information useful for understanding their eligibility for the application of green financial instruments.

As underlined in the previous chapters, the comparative analysis focuses on specific references: namely, the Deliverable D1.2.1. Requirements for the creation of the MESTRI-CE Smart Data Hub, developed in Work Package 1 - Smart Data Management, the recast of the Energy Performance of Buildings Directive and the Delegated Acts of the European Taxonomy related to construction and real estate activities (construction of new buildings, renovation of existing buildings).

The multi-criteria analysis focused on only 6 of the 11 building assessment systems analysed, specifically those that could be easily updated and modified by the project partners.

Regarding the building data, it was found that not all the schemes analysed can directly provide the data requested, as some of them, i.e. klimaaktiv and Green Deal Building Design Project Guidelines, obtain this data in an indirect way, e.g. as a result of a calculation carried out by other instruments, such as the national EPCs. However, the project partners emphasised that the missing data can be easily obtained.

When compared with the EPBD recast, the tools analysed by the project partners show a greater overlap with the indicators proposed by the new European reference systems for the building energy sector. Indicators related to the assessment of GHG emissions are less common, while the management of construction and demolition waste and strategies to increase the sustainable and efficient use of raw materials is already part of many of the analysed systems. Only two schemes already require LCA analysis. Indicators related to the rational use of water resources are also well distributed among the different systems. Regarding the indicators belonging to the area Health & Comfort, the most common are those related to thermal and acoustic comfort and the availability of natural light. Only the analysed energy certification schemes, i.e. those issuing an EPC, do not include indicators related to IEQ. In the analysed building assessment schemes, mobility still seems to be rather overlooked while the indicators related to Cost&Value and Management, when present, are voluntary. The results of the comparative analysis clearly demonstrate that the themes faced by the EPBD recast are already quite well anchored in the building assessment systems analysed and that most of them are suitable to be upgraded using the MESTRI-CE Sustainable Building Methodology.

With respect to the compliance of the analysed existing building standards and systems with the actual requirements of the EU taxonomy, major gaps can still be identified with respect to indicators that analyse the intervention in terms of its capacity to adapt to climate change, due probably to the effort needed to carry out a climate risk and vulnerability analysis. The aim of the next activities of WP2 will therefore also be to better define indicators in this area through the MESTRI-CE Sustainable Building Methodology, also drawing on the experience of those project partners who have already introduced evaluation tools for climate adaptation.



E. List of literature

Deliverable D1.2.1. Requirements for the creation of the MESTRI-CE Smart Data Hub

Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the energy performance of buildings (recast) - Interinstitutional File:2021/0426 (COD) Consolidated compromise text 20 December 2023 (<https://data.consilium.europa.eu/doc/document/ST-6798-2024-INIT/EN/pdf>)

2023/2486 COMMISSION DELEGATED REGULATION (EU) 2023/2486 of 27 June 2023 supplementing Regulation (EU) 2020/852 of the European Parliament and of the Council by establishing the technical screening criteria for determining the conditions under which an economic activity qualifies as contributing substantially to the sustainable use and protection of water and marine resources, to the transition to a circular economy, to pollution prevention and control, or to the protection and restoration of biodiversity and ecosystems and for determining whether that economic activity causes no significant harm to any of the other environmental objectives and amending Commission Delegated Regulation (EU) 2021/2178 as regards specific public disclosures for those economic activities (https://eur-lex.europa.eu/eli/reg_del/2023/2486/oj)

https://environment.ec.europa.eu/topics/circular-economy/levels_en

https://www.klimaaktiv.at/dam/jcr:1747bd65-5134-4384-846f-5e192762af24/Kriterienkatalog%20Bauen%20und%20Sanieren%20Wohnbau_2020_bf.pdf

https://www.klimaaktiv.at/dam/jcr:56cfc2e3-ab4d-4586-b162-f832978e4fbd/klimaaktiv_Kriterienkatalog_Dienstleistungsgeb%C3%A4ude_bf.pdf

<https://mpgi.gov.hr/access-to-information/regulations-126/126>

<https://www.bnb-nachhaltigesbauen.de/dokumente/>

<https://www.dgnb.de/de/zertifizierung/gebaeude/sanierung>

https://passiv.de/de/03_zertifizierung/02_zertifizierung_gebaeude/04_enerphit/04_enerphit.htm

<http://greenbuildingstandard.eu/en/>

<https://www.gov.pl/web/rozwoj-technologie/Swiadectwa-charakterystyki-energetycznej>

https://gpp.mite.gov.it/sites/default/files/2022-08/GURI_183_06_08_22_Allegato_Edilizia.pdf

<https://www.agenziacasaclima.it/it/certificazione-edifici/documenti-per-la-certificazione-1539.html?&tag=640>



F. List of Annexes

- D.2.1.2 Annex A - General overview
- D.2.1.2 Annex B - Energy
- D.2.1.2 Annex C - Emissions
- D.2.1.2 Annex D - Materials&Adaptability
- D.2.1.2 Annex E - Water
- D.2.1.2 Annex F - AdaptationSiteMobilityCostManagement
- D.2.1.2 Annex G - Health&Comfort
- D.2.1.2 Annex H - BuildingData
- D.2.1.2 Annex I - EPBD
- D.2.1.2 Annex L - EU Taxonomy