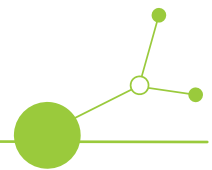


D2.6.1 Report on implementation of the Sustainable Building Methodology in designated building stocks



Version 1
03 2024





Content

A. Introduction	2
B. Report Summary.....	3
C. Country overviews	4
1. Austria	4
1.1. Description of the pilot buildings	4
1.2. Indicators applied in the detailed analysis	4
1.3. Overall review of the Sustainable Building Methodology	10
2. Croatia	11
2.1. Description of the pilot buildings	11
2.2. Indicators applied in the detailed analysis	11
2.3. Overall review of the Sustainable Building Methodology	16
3. Germany.....	17
3.1. Description of the pilot buildings	17
3.2. Indicators applied in the detailed analysis	17
3.3. Overall review of the Sustainable Building Methodology	21
4. Italy	22
4.1. Description of the pilot buildings	22
4.2. Indicators applied in the detailed analysis	22
4.3. Overall review of the Sustainable Building Methodology	32
5. Poland	33
5.1. Description of the pilot buildings	33
5.2. Indicators applied in the detailed analysis	Fehler! Textmarke nicht definiert.
5.3. Overall review of the Sustainable Building Methodology	40
D. Conclusion.....	41



A. Introduction

The transition to a sustainable, low-carbon built environment is a critical pillar in achieving the European Union's climate and energy goals. However, despite growing momentum toward green building practices, a significant barrier remains: the lack of harmonized sustainable building certification systems across EU member states. Each country currently employs its own set of standards, metrics, and assessment methods, which results in a fragmented landscape of evaluation schemes. This disparity makes it difficult to compare building performance across borders and complicates efforts to scale sustainable solutions at the EU level.

These differences not only create confusion among investors, developers, and public authorities but also limit the ability of stakeholders to collaborate effectively across regions. The inconsistencies reduce transparency, hamper benchmarking efforts, and discourage innovation in sustainable building design. The challenge, therefore, is not just technical—it is systemic, requiring a coordinated approach to align national frameworks and enable effective cross-border cooperation.

In response to this challenge, the MESTRI-CE project developed a unified Sustainable Building Methodology (SBM) and an accompanying Evaluation Toolbox. These tools aim to bridge the gap between disparate national systems by establishing a common, flexible framework that is applicable across diverse regional contexts. The methodology encompasses a wide range of sustainability dimensions, including energy performance, carbon emissions, water efficiency, materials use, economic viability, and health and comfort indicators.

The indicators for the Sustainable Building Methodology were derived from EU frameworks, selected through a participatory process. They were compared against national and regional standards to identify overlaps and potential improvements. Each indicator includes detailed guidance on metrics, units, methods, and targets. The SBM and Evaluation Toolbox were collaboratively developed and peer-reviewed by the MESTRI-CE project partners. Target groups such as building experts, certification auditors, and regional committee members actively contributed to the development of the Sustainable Building Methodology. They participated in national scheme analysis, provided feedback on draft indicators by assessing value and effort, and supported testing on pilot projects. Their involvement ensured the methodology was grounded in practical expertise. By promoting a shared evaluation framework, the project contributes to the EU's broader ambition of creating a sustainable, inclusive, and resilient built environment. Harmonized building assessments are not just a technical upgrade—they are a strategic enabler of the green transition in Europe.

The strategy of in this deliverable was to test the SBM in real-world conditions by applying them to pilot buildings across five EU countries: Austria, Croatia, Germany, Italy, and Poland. These pilot projects assessed the feasibility, applicability, and practicality of the indicators selected within the SBM framework and provided feedback for further refinement and alignment of the methodology with both local and EU-level standards. This report identifies strengths and limitations in the current approach, and offers concrete recommendations for further development.

As a result of this testing, CasaClima, as WP2 lead, will finalize the methodology. Each partner will continue implementing the approach during the rollout phase and beyond, engaging additional stakeholders. The established partner network will support ongoing knowledge exchange and promote regional collaboration, ensuring continuous refinement and broader adoption of the methodology across Europe. In the rollout phase, all experts will have free access to the final methodology, enabling broad application and knowledge transfer. This collaborative approach strengthens the methodology's relevance, usability, and long-term impact across regions and professional communities.



B. Report Summary

Each country applied the SBM indicators to selected pilot buildings, with the process revealing both the strengths of the methodology and areas requiring refinement. Common indicators such as primary and final energy use, greenhouse gas emissions, water efficiency, indoor environmental quality, adaptability, and lifecycle cost assessments were evaluated. Most countries found a good alignment between the SBM indicators and national standards or certification systems (e.g., DGNB in Germany, klimaaktiv in Austria, CasaClima in Italy). However, the depth of integration varied. Some advanced metrics—such as embodied emissions, climate risk assessments, and life cycle costing—were either not fully developed or not commonly used within existing national frameworks.

A key strength of the SBM is its holistic, multi-dimensional structure, enabling a balanced evaluation of energy, environmental, economic, and comfort-related criteria. The methodology also supports the transition toward climate neutrality and sustainability targets set at both EU and national levels.

However, challenges include varying data availability, the complexity of some indicators, and differing levels of regulatory readiness across countries. In some cases, qualitative judgments or workarounds were necessary to complete assessments. Moreover, integration with digital tools like the MESTRI-CE Smart Data Hub showed promise but also highlighted the need for better automation and user-friendliness.

In conclusion, the SBM proved to be a valuable and adaptable framework for evaluating sustainable buildings. With further refinement, standardization, and tool integration, it holds strong potential to guide policy, support certifications, and advance sustainable building practices across Europe.



Country overviews

1. Austria

1.1. Description of the pilot buildings

As a pilot in Austria, specifically the federal state of Styria, the municipality Bruck an der Mur is selected. Bruck an der Mur is situated in the Austrian state of Styria, nestled between the cities of Graz and Leoben, at the confluence of the Mur and Mürz rivers. Rich in history, it serves as a regional center for commerce and tourism, with easy access to scenic landscapes and outdoor activities in the surrounding mountains.

In Bruck an der Mur, the city owns around 34 public buildings. The 7 buildings with the greatest thermal weaknesses were analyzed in detail, where the need for a renovation is the highest. Therefore, the project is entitled as "the 7 sins of Bruck an der Mur". The building portfolio includes the city hall, a gymnasium, a townhall, the building yard, the music school, the elementary school and the kindergarten.

1.2. Indicators applied in the detailed analysis

Factors—such as **thermal integrity of the building envelope** and **thermal heat bridge correction**—are important for energy-efficient design but are already addressed through Austrian building codes like the **OIB-Richtlinie 6**, making them less relevant for additional consideration in certification processes. The **summer heat protection - decrement factor** is technically valuable for ensuring comfort in warmer months, but it is not a mandatory assessment criterion in certifications like **klimaaktiv** or **ÖGNB/TQB**, where simpler overheating indicators are often used. Similarly, **energy efficiency requirements for technical building systems** are assumed through compliance with national minimum standards and are not separately evaluated. The **Smart Readiness Indicator (SRI)** is an EU initiative still under development and not yet fully integrated into Austrian certification schemes. The **share of renewable energy in delivered energy** is considered indirectly, but the source-specific breakdown (e.g. from energy communities or district heating) is not yet a scoring criterion. **Thermal storage capacity**, while important for load shifting and comfort, is not directly scored due to the complexity of evaluating its performance in practice. In summary, while these factors support sustainable design, Austrian building certifications focus on standardized, outcome-based metrics and therefore do not explicitly score all such technical features. In Austrian building certification processes, **operational greenhouse gas emissions**, **embodied greenhouse gas emissions**, and **on-site carbon emissions from fossil fuels** are generally not the primary focus. Instead, these certifications emphasize energy efficiency, thermal comfort, and sustainable resource use. The factor of **operational greenhouse gas emissions** is indirectly addressed through energy consumption and demand criteria, rather than direct measurement of greenhouse gases. Similarly, **embodied greenhouse gas emissions**, which include emissions from material production and construction, are not yet fully integrated due to the complexity and lack of standardized methods.

Austrian certification schemes typically do not require detailed lifecycle assessments that would capture embodied emissions. The factor **on-site carbon emissions from fossil fuels**, meaning direct emissions from burning fossil fuels on the premises, is minimized by promoting renewable energy and excluding fossil fuel use, but not explicitly quantified. This simplifies the certification process while supporting national goals for energy reduction and sustainability. While these greenhouse gas emission factors are increasingly important in climate policy, Austrian certifications currently focus on achievable energy performance metrics. However, lifecycle carbon assessments including these factors are becoming more relevant and may be incorporated in future certification updates. Overall, the approach balances practicality and sustainability, prioritizing energy efficiency over comprehensive greenhouse gas accounting.



In Austrian building certification processes, factors such as **use stage water consumption** and **use stage water demand** are not usually the main focus. Instead, the certifications primarily concentrate on energy efficiency and indoor environmental quality. While water consumption during the use stage impacts sustainability, Austrian schemes often treat it as a secondary consideration. The management of **rainwater retention and harvesting** is recognized for its environmental benefits but is not commonly required or strictly evaluated in these certifications. Similarly, **requirements for water-saving sanitary fittings** exist as recommendations or guidelines rather than mandatory certification criteria. The reuse of **greywater** can reduce overall water demand but is typically not a standard feature assessed in Austrian building certifications. These factors involve technical complexity and user behavior, making standardized assessment challenging. Austrian certification systems prefer simpler, more quantifiable metrics like energy consumption and material sustainability. Nevertheless, water efficiency and management are gaining attention and may become more prominent in future certification versions. Overall, Austrian building certifications currently prioritize energy and resource efficiency over detailed water use and reuse strategies.

In Austrian building certification processes, factors such as **spatial Daylight Autonomy (sDA)** and **Daylight Glare Probability (DGP_e)** are not widely used, as certifications like **klimaaktiv** rely instead on simpler metrics like the daylight factor. Advanced dynamic simulations such as **sDA**, which measures the percentage of space receiving adequate daylight over time, are considered too complex or data-intensive for standard assessments. Similarly, **views to the outside**, which are important for psychological comfort, are not systematically evaluated, even though they contribute to occupant well-being. Technical lighting characteristics like **luminaire efficacy**, **Correlated Colour Temperature (CCT)**, and **Colour Rendering Index (CRI)** are typically not directly assessed, despite their relevance to energy efficiency and visual comfort. These parameters are often covered indirectly through compliance with electrical and lighting standards rather than through the certification process itself. **Lighting control systems**, which can improve energy savings and user satisfaction, are usually optional features and not core criteria for certification.

1.2.1. Energy

Sustainability indicator	Building status	Feedback
Primary energy use	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Primary energy is applicable because an EPC has to be calculated for a deep renovation of a building and there the value is illustrated. Primary energy has a strong value for the building assessment in terms of reaching climate targets that are often related to primary energy
Final energy	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Final energy is applicable because an EPC has to be calculated for a deep renovation of a building and there the value is illustrated. Final energy is not often referred in climate targets so the relevance is not that high. Final energy is more about costs for energy.
CO2 Emissions	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	CO2 emissions is applicable because an EPC has to be calculated for a deep renovation of a building and there the value is illustrated. CO2 has a strong value for the building assessment in terms of reaching climate targets that are often related to CO2
Heating demand	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Heating demand is applicable because an EPC has to be calculated for a deep renovation of a building and there the value is illustrated. Heating demand gives a good insight in the thermal performance of the building envelope and the solar architecture therefore we see the factor as relevant
Cooling demand	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Cooling demand is applicable because an EPC has to be calculated for a deep renovation of a building and there the value is illustrated. The cooling demand is specified in the energy performance certificate for non-residential buildings and is a criterion for assessing summer heat protection.



Airtightness of the building envelope (testing) - n50,lim	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Air tightness is essential because it minimizes unwanted heat loss or gain, improving a building’s energy efficiency and reducing utility costs. It enhances indoor comfort by preventing drafts and maintaining consistent temperatures. Good air tightness also protects the building structure from moisture damage caused by condensation. Lastly, it supports better indoor air quality by enabling controlled ventilation and keeping out pollutants.
Thermal comfort	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Calculating thermal comfort is essential in building certification because it ensures that indoor environments support occupant well-being and productivity. It verifies that temperature, humidity, and airflow are maintained within comfortable ranges throughout the year. Thermal comfort is a key criterion in many sustainability standards reflecting user-centered design. Accurate assessment helps identify and reduce energy use while maintaining a high quality of indoor living.
Additional control system for further optimisation	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	An additional control system is essential in building certification because it allows for fine-tuning of energy use and indoor environmental conditions. It helps optimize heating, cooling, lighting, and ventilation based on occupancy and usage patterns. This leads to improved energy efficiency, reduced operating costs, and enhanced comfort. Certification systems value such controls as they demonstrate advanced performance and intelligent building management.
PV yields	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	The consideration of PV yields in building certification is essential because it reflects the building’s capacity to generate renewable energy and reduce reliance on external energy sources. It directly contributes to lowering operational CO ₂ emissions and improving the building’s overall energy performance. Including PV yields supports national and EU climate targets by promoting on-site clean energy production. It also encourages cost savings for occupants through reduced electricity bills and potential energy self-sufficiency.
Additional thermal and electrical storage (water storage, electricity storage)	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	The consideration of additional thermal and electrical storage in building certification is essential because it enhances energy flexibility and resilience. These systems allow excess renewable energy, such as from PV, to be stored and used later, reducing grid dependency. They help stabilize indoor temperatures and energy supply, improving both comfort and efficiency. Recognizing storage in certification supports sustainable energy use and future-ready building design.

1.2.2. Emissions

Sustainability indicator	Building status	Feedback
Eco-index OI3	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	<p>The GWP alone is not used in Austrian building certificates and instead the Eco-index OI3 dominates the Field and is calculated in the EPC softwares.</p> <p>The optimisation of the production costs for a building and the longest possible usage phases are an important part of ecological construction. Reduced material flows, energy consumption and emissions in the production of the building materials used, the use of durable materials, a fundamentally optimised use of materials in the production of a building, but also in its maintenance and renovation, and the longest possible overall service life of a building have a significant influence on this.</p> <p>The production costs of building materials are assessed using the Oekoindex 3, which covers the environmental categories and material parameters with</p>



		the best data quality and informative value: ▪ Contribution to global warming (GWP) ▪ Acidification potential of soil and water (AP) ▪ Demand for non-renewable primary energy, total (PENRT) Detailed information on the various OI3 indicators as well as precise calculation instructions are presented in the current OI3 calculation guide, version 4.0 or higher (can be downloaded free of charge from www.ibo.at or www.baubook.at/oekoindex/). The less non-renewable energy is used and the fewer greenhouse gases and other emissions are generated during the production of building materials for initial construction and maintenance cycles, the lower the OI3 value.
--	--	--

1.2.3. Materials

Sustainability indicator	Building status	Feedback
Disposal indicator	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	The disposal indicator represents a volume weighted with disposal and recycling properties of all considered building component constructions and layers that are generated in the overall life cycle of the building. It can be calculated within the EPC and is established and used in Austria

1.2.4. Water

Sustainability indicator	Building status	Feedback
Use stage water consumption	<input type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Water meter have to be installed in the building and monitored. A measure that is easy to handle in existing buildings, specially in non residential buildings where water is metered anyway better than in residential ones.
Water impact	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Not practical in Austria because we do not have a standardized calculation method
Rainwater retention and harvesting	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Not often done in Austria, often not economically because water is cheap here
Requirements for water-saving sanitary fittings	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	Practicable in new buildings. The assessment is by collecting datasheets from appliances. Not regulated in Austria by now
Greywater reuse	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Not often used in Austria

1.2.5. Climate risk and adaptation

Sustainability indicator	Building status	Feedback
Climate risk & vulnerability assesement	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Not often done in Austria and hard to measure.
Time outside of thermal comfort range	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	See thermal comfort, this value is calculated according to ÖNORM 8110-3



(with future climate projections)		
Adaptation measures for increased risk of extreme weather events	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Metric in Austria not available
Sustainable drainage	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Metric in Austria not available

1.2.6. Adaptability

Sustainability indicator	Building status	Feedback
Design for adaptability and renovation	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	Klimaaktiv in Austria measures adaptability based on how flexibly a building can be used or modified over time, taking into account design, construction methods, and infrastructure. It rewards buildings that are prepared for future functional, spatial, or demographic changes.

1.2.7. Health and comfort

Sustainability indicator	Building status	Feedback
Use of low-polluting materials (formaldehyde, VOCs etc.)	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Timing has to be considered as the measurement has to be done right before handover of the building. The price for the measurement is often a topic
Radon risk exposure and constructive protection measures	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Radon risk assessment is done in Austria by using radon maps. With an air tight envelope the risk for radon is minimized anyway.
Ventilation strategy and quality requirements for ventilation systems	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Ventilation is always relevant because it reduces the thermal losses (with heat recovery appliance) and increases the indoor comfort. Often with higher costs encumbered and not realized. Ventilation systems still have a lot of prejudices.
Medium Daylight Factor	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	In Austria, the daylight factor is used in building certifications like klimaaktiv to assess the quality of natural lighting in indoor spaces. It supports energy efficiency by reducing the need for artificial lighting and aligns with national goals for low-energy buildings. A good daylight factor also enhances occupant comfort and well-being , which are key sustainability criteria. Overall, it promotes thoughtful architectural design that balances energy use with indoor environmental quality.

1.2.8. Mobility

Sustainability indicator	Building status	Feedback
Recharging points for e-vehicles/ e-bikes	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	A used factor in Austria to contribute to increase of green vehicles and to the decarbonisation of the electricity system and improve its efficiency.



Pre-cabling of parking spaces	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	A used factor in Austria to contribute to increase of green vehicles and to the decarbonisation of the electricity system and improve its efficiency.
Parking spaces for bicycles	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	A factor considered in the planning of non-residential buildings that is important to be used

1.2.9. Site and biodiversity

Sustainability indicator	Building status	Feedback
Green and open space factor GFF	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Established calculation method and within many building authority approves a factor that has to be delivered anyway
Microclimate analysis	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Metric not applicable in Austria
Solar Reflectance Index of materials used for external pavings and roof surfaces	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Metric not applicable in Austria
Biodiversity -promoting vegetation	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Metric not applicable in Austria
Light pollution: ULR of outdoor luminaires or maximum light intensity at 90° degrees and above of the installed lamps	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Metric not applicable in Austria

1.2.10. Cost and value

Sustainability indicator	Building status	Feedback
Life cycle cost calculation and optimisation (LCC)	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	In Austrian building certification processes, Life Cycle Cost (LCC) calculations are not a core requirement. Certifications like klimaaktiv focus on energy and environmental performance rather than long-term economic analysis. LCC is complex and hard to standardize, which limits its use in official scoring. While it may be encouraged in some projects, it is generally optional and not part of the main certification criteria.



1.2.11. Management

Sustainability indicator	Building status	Feedback
Inspection and maintenance of heating and air conditioning systems	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	It is necessary to ensure that HVAC systems are regularly serviced and inspected by qualified personnel to help maintain their correct

1.3. Overall review of the Sustainable Building Methodology

The Sustainable Building Methodology (SBM) offers a comprehensive and structured framework to evaluate building performance across multiple sustainability dimensions. In the Austrian context, the application of the methodology has proven to be both informative and largely compatible with national building standards, particularly for deep renovation projects in the public building sector.

A major strength of the SBM lies in its wide set of indicators, covering energy use, emissions, materials, water, health and comfort, adaptability, and more. This breadth allows for a holistic understanding of sustainability in buildings and aligns well with national objectives such as energy efficiency, decarbonisation, and resource conservation. The methodology also supports alignment with Austria's leading certification systems, such as klimaaktiv and ÖGNB, by integrating indicators commonly used in practice (e.g., primary energy, daylight factor, GWP (Eco-index OI3)).

In terms of usability, the methodology is relatively easy to handle, particularly for indicators where values can be extracted from EPC software or measured using established methods. The layout and categorization of sustainability indicators are logical and intuitive, facilitating cross-sector dialogue and decision-making.

However, challenges remain in areas that are not yet fully developed or standardized in Austria. These include indicators related to climate risk and adaptation, water reuse (e.g., greywater), biodiversity, and sustainable drainage. While technically relevant, these topics are not yet common practice in national certifications and therefore require additional interpretation or qualitative judgment when applying the methodology.

In addition, some technical indicators (e.g., Smart Readiness Indicator, thermal storage capacity) are valuable from a sustainability perspective but are currently not scored in Austrian certification schemes, which may limit their immediate practical relevance. Nevertheless, these indicators point to future directions in building sustainability and may gain importance as national frameworks evolve.

In summary, the Sustainable Building Methodology is a valuable and robust tool for evaluating building performance in Austria. It is especially well-suited for identifying renovation priorities, benchmarking sustainability measures, and guiding the integration of advanced performance features. While minor limitations exist due to gaps in national standardization, the methodology effectively supports current and emerging sustainability goals.



2. Croatia

2.1. Description of the pilot buildings

Karlovac County, Krapina-Zagorje County, Zagreb County, and the City of Zagreb, four counties that own more than 2000 buildings, were selected for piloting. In their portfolio, they have different types of buildings: kindergartens, schools, student dormitories, homes for the elderly and infirm, pharmacies, hospitals, health centres, buildings for sport and culture and others. As pilots are chosen eight (8) public buildings, two from each county. These buildings have the greatest potential for savings, with energy renovation needs, and are investment priorities for their owners. The pilot portfolio consists of buildings of the following types: kindergartens, schools, and buildings for health services.

2.2. Indicators applied in the detailed analysis

The Sustainable Building Methodology (SBM) offers a comprehensive approach for evaluating buildings throughout their entire life cycle - from detailed design and construction to as-built and in-use stages. From a Croatian perspective, the Sustainable Building Methodology (SBM) is largely aligned with national building standards.

Sustainable Building Methodology (SBM) includes many indicators that effectively describe energy consumption, emissions, materials, water, climate, health and comfort, and adaptability, allowing a clear interpretation of the sustainability of an individual building. Indicators such as **primary energy use, final energy use, airtightness of the building envelope (testing) - n50,lim, In-situ measurement of IAQ conditions and target pollutants, recharging points for e-vehicles/e-bikes** and etc. demonstrate good compatibility with national regulations.

However, some indicators - such as **embodied greenhouse gas emissions, design for deconstruction, and time outside of thermal comfort range** are not yet applied in Croatia.

Additionally, certain indicators like **GWP (Life-Cycle Global Warming Potential), SRI (Smart Readiness Indicator), and LCC (Life cycle cost calculation and optimisation)** are still in the testing phase or are applied voluntarily. Nevertheless, upon the adoption of the new version of the EPBD directive, these will become mandatory when constructing new buildings or reconstructing and renovating existing ones.

2.2.1. Energy

Sustainability indicator	Building status	Feedback
Primary energy use	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Primary energy is mandatory in Croatia, one of the key mandatory indicators/values for the nZEB standard. Energy Performance Certificate (EPC) must be issued for the construction of a new building and for the majority of existing buildings, and this value determines energy class and is shown in the certificate.
Final energy use	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	The indicator is mandatory in Croatia. During the preparation of the main design documentation for the renovation or construction of a new building, this indicator is included and calculated in the project on the rational use of energy and thermal protection in buildings.
Heating demand	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	The indicator is mandatory in Croatia. During the preparation of the main design documentation for the renovation or construction of a new building, this indicator is included and calculated in the project for the rational use of energy and thermal protection in buildings.
Cooling demand	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	The indicator is mandatory in Croatia for some types of buildings. During the preparation of the main design documentation for the renovation or construction of a new building, this indicator is included and calculated in



		the project for the rational use of energy and thermal protection in buildings.
Airtightness of the building envelope (testing) - n50,lim	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Airtightness of the building envelope (testing) - n50,lim is mandatory and is one of the indicators/values for the nZEB standard. An Energy Performance Certificate (EPC) must be issued for the construction of a new building and the majority of existing buildings, and this value is shown in the certificate.
Thermal integrity of the building envelope /Thermal heat bridge correction	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	The indicator is mandatory in Croatia. During the preparation of the main design documentation for the renovation or construction of a new building, this indicator is included and calculated in the project for the rational use of energy and thermal protection in buildings.
Summer heat protection - Thermal lag	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	One of the explicit technical requirements is to prevent overheating of indoor spaces due to solar radiation during summer. Designers must include technical solutions in the building project to address this—including passive strategies that rely on thermal mass and shading, contributing to thermal lag. The regulations set maximal Uvalues (heat transfer coefficients) for external walls, roof, and windows—based on climate zones—and differentiate between constructions with surface mass over 100 kg/m ² , which have greater thermal inertia.
Energy efficiency requirements for the technical building systems	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	The indicator is available in Croatia. Technical building systems that are installed are labelled with an efficiency class.
SRI (Smart Readiness Indicator)	<input type="checkbox"/> new <input type="checkbox"/> renov.	In Croatia, SRI is still not mandatory. Upon the adoption of the new version of the EPBD directive, it will become mandatory for the construction of new buildings and the reconstruction and renovation of existing ones. It is still in the design/preparation phase.
Renewable energy produced on site	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Renewable energy produced on site is mandatory in Croatia and one of the key mandatory indicators/values for the nZEB standard. Energy Performance Certificate (EPC) must be issued for the construction of a new building and for the deep renovation of an existing building, and this value is shown in the certificate.

2.2.2. Emissions

Sustainability indicator	Building status	Feedback
Life-Cycle Global Warming Potential (GWP)	<input type="checkbox"/> new <input type="checkbox"/> renov.	In Croatia, GWP is still not mandatory. Upon the adoption of the new version of the EPBD directive, it will become mandatory for the construction of new buildings and eventually for the reconstruction and renovation of existing ones. It is still in the design/preparation phase.
Total CO₂e emissions	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	The indicator is mandatory in Croatia. During the preparation of the main design documentation for the renovation or construction of a new building, this indicator is included and calculated in the project for the rational use of energy and thermal protection in buildings.
Embodied greenhouse gas emissions	<input type="checkbox"/> new <input type="checkbox"/> renov.	The indicator is not available in Croatia.



2.2.3. Materials

Sustainability indicator	Building status	Feedback
Design for deconstruction	<input type="checkbox"/> new <input type="checkbox"/> renov.	The indicator is not available in Croatia.
Avoidance of materials with high environmental impact/ dangerous substances	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	The indicator is available in Croatia. It is prescribed by the technical regulation and is treated as one of the essential requirements for the building.
Use of eco-labelled products	<input type="checkbox"/> new <input type="checkbox"/> renov.	The indicator is not mandatory in Croatia. Eco-labelled products are used on voluntary basis. According to the GDSG guidelines, this measure is included in the project requirements as a design recommendation.

2.2.4. Water

Sustainability indicator	Building status	Feedback
Use stage water consumption	<input type="checkbox"/> new <input type="checkbox"/> renov.	The indicator is not available in Croatia.
Rainwater retention and harvesting	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	The indicator is available in Croatia. The installation of rainwater retention and harvesting systems is encouraged. According to the GDSG guidelines, this measure is included in the project requirements as a design recommendation.
Requirements for water-saving sanitary fittings	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	The indicator is mandatory in Croatia. These requirements are prescribed in the main design documentation and are monitored during the execution of the construction works.

2.2.5. Climate risk and adaptation

Sustainability indicator	Building status	Feedback
Climate risk & vulnerability assesment	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	The indicator is available in Croatia. As part of the main design project documentation preparation, documentation for adaptation to the impacts of climate change is prepared, which includes this indicator.
Time outside of thermal comfort range (with future climate projections)	<input type="checkbox"/> new <input type="checkbox"/> renov.	The indicator is not available in Croatia. Although current Croatian regulations refer to climate data from periods like 1981-2010 as baseline, adaptation guidance suggests anticipating future conditions—from additional hot days, longer heatwave durations, and reduced cooling at night. While these future scenarios aren't yet formally embedded into statutory climate reference years, they are increasingly used in project-level assessments by forward-looking designers and planners.



Adaptation measures for increased risk of extreme weather events	<input checked="" type="checkbox"/> new	The indicator is available in Croatia. As part of the main project design documentation, documentation for adaptation to the impacts of climate change is prepared, which includes this indicator.
	<input checked="" type="checkbox"/> renov.	

2.2.6. Adaptability

Sustainability indicator	Building status	Feedback
Design for adaptability and renovation	<input type="checkbox"/> new <input type="checkbox"/> renov.	The indicator is not available in Croatia.

2.2.7. Health and comfort

Sustainability indicator	Building status	Feedback
In-situ measurement of IAQ conditions and target pollutants	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	The indicator is available in Croatia. Sensors are installed to measure the specified parameters during the use of the building voluntarily. According to the GDSG guidelines, this measure is included in the project requirements as a design recommendation.
Use of low-polluting materials (formaldehyde, VOCs etc.)	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	In Croatia, there are prescribed limits on how much construction elements and materials used in a building that may come into contact with users can emit formaldehyde. It is prescribed by the technical regulation and is treated as one of the essential requirements for the building.
Installation of measuring and control devices for monitoring and regulation of IAQ	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	The indicator is available in Croatia. Sensors are installed to measure the specified parameters during the use of the building voluntarily. According to the GDSG guidelines, this measure is included in the project requirements as a design recommendation.
Radon risk exposure and constructive protection measures	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	The indicator is checked during the use of the building.
Luminaire efficacy	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	The indicator is available in Croatia. During the preparation of the main design documentation for the construction of a new building and the reconstruction and renovation of existing buildings, this indicator is included and calculated in the electrical engineering main design project documentation.

2.2.8. Mobility

Sustainability indicator	Building status	Feedback
Recharging points for e-vehicles/ e-bike	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	This indicator is mandatory in accordance with the Building Act, which is the overarching law regulating the design, construction, use, and maintenance of buildings in Croatia.
Pre-cabing of parking spaces	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	This indicator is mandatory in accordance with the Building Act, which is the overarching law regulating the design, construction, use, and maintenance of buildings in Croatia.



Parking spaces for bicycles	<input checked="" type="checkbox"/> new	This indicator is mandatory in accordance with the Building Act, which is the overarching law regulating the design, construction, use, and maintenance of buildings in Croatia.
	<input checked="" type="checkbox"/> renov.	

2.2.9. Site and biodiversity

Sustainability indicator	Building status	Feedback
Solar Reflectance Index of materials used for external pavings and roof surfaces	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	The indicator is available in Croatia.
Radon risk exposure and constructive protection measure	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	The indicator is checked during the use of the building.
Biodiversity - promoting vegetation	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	The indicator is available in Croatia. Before the preparation of the project documentation, an opinion is issued by the competent department on whether it is necessary to carry out the procedure for assessing the need for an environmental impact assessment and the environmental impact assessment itself, as well as the procedure for the preliminary assessment of the project's compatibility with the ecological network.
Light pollution: ULR of outdoor luminaires or maximum light intensity at 90° degrees and above of the installed lamps	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	The indicator is available in Croatia. During the preparation the main design for the renovation or construction of a new building, this indicator is included and calculated in the project.

2.2.10. Cost and value

Sustainability indicator	Building status	Feedback
Life cycle cost calculation and optimisation (LCC)	<input type="checkbox"/> new <input type="checkbox"/> renov.	In Croatia, LCC is still not mandatory. Upon the adoption of the new version of the EPBD directive, it will become mandatory for new buildings.

2.2.11. Management

Sustainability indicator	Building status	Feedback
Inspection and maintenance of heating and air conditioning systems	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	It is necessary to ensure that HVAC systems are regularly serviced and inspected by qualified personnel to maintain their proper functioning.



2.3. Overall review of the Sustainable Building Methodology

The Sustainable Building Methodology (SBM) presents a comprehensive and practical framework that supports the integration of sustainability principles into both new construction and building renovation projects. One of its most notable strengths is the breadth and depth of its indicator set. The methodology encompasses a wide range of criteria, addressing essential aspects of sustainable development such as energy performance, greenhouse gas emissions, water efficiency, material sustainability, indoor comfort, and the adaptability of buildings over time. This holistic approach ensures that sustainability is not treated as a narrow technical issue, but as a multi-dimensional challenge requiring attention to environmental, social, and economic factors.

A particularly important advantage of the SBM is its strong alignment with Croatia's existing regulatory and policy framework. Key indicators, including primary and final energy use, building envelope airtightness ($n_{50,lim}$), indoor air quality (IAQ) metrics, and provisions for e-mobility infrastructure, correspond closely with national laws and technical standards. This regulatory alignment makes the methodology relatively straightforward to implement, particularly for stakeholders already engaged in projects that must comply with Croatian building codes. The consistency with national data sources further simplifies monitoring and reporting, increasing the likelihood that the methodology can be used not only at the project level but also as a policy-support tool.

The SBM also benefits from a logical and intuitive format. Indicators are grouped into coherent categories, and the layout facilitates navigation and understanding. For planners, designers, and public authorities, this ease of use enhances the tool's value. It supports more effective decision-making, particularly in the context of deep renovation strategies, where identifying high-impact interventions is crucial. The methodology proves particularly useful in helping prioritize sustainability measures and assess the long-term value of upgrades.

However, the methodology also faces certain limitations. Some of the more advanced indicators—such as design for deconstruction, and embodied greenhouse gas emissions—are not yet widely adopted or standardized within Croatia. Several important indicators remain in a testing or developmental phase. These include global warming potential (GWP), the smart readiness indicator (SRI), and life cycle costing (LCC). While these metrics hold considerable promise for driving innovation and improving long-term sustainability outcomes, their current lack of regulatory enforcement and technical clarity means they may not yet be consistently implemented in building assessments.

In conclusion, the SBM stands as a valuable and well-structured tool that can facilitate the pursuit of sustainable building practices in Croatia. While certain components still require further development and integration, the methodology provides a sound foundation for informed, goal-oriented decision-making in the built environment.



3. Germany

3.1. Description of the pilot buildings

For testing the MESTRI-CE building evaluation toolbox, three building projects were analysed. All of them are currently under construction or just finalized. The first building project consists of 5 building blocks with 116 residential units in total. The second and third building projects are both meant for mixed usage. On the ground floor of one building, there will be a business space whereas in the other building, there will be a kindergarden. The other floors will have 20 residential units.

The building have undergone the DGNB certification process which means that the owners have laid a high focus on sustainability and that there is a very good availability of data. The experiences of the DGNB auditing have contributed to the toolbox evaluation.

3.2. Indicators applied in the detailed analysis

In the detailed analysis for Germany, the testing targeted new buildings primarily. The chosen indicators reflected Germany's regulatory and certification environment, particularly leveraging insights from DGNB-certified projects.

Energy-related indicators were central to the analysis. These included **primary energy use (A1.1)** and **final energy use (A1.2)**, which are essential for assessing both overall energy demand and the reliance on fossil fuels versus renewables. **Thermal integrity of the building envelope (A2.2)** was also evaluated, emphasizing the importance of minimizing thermal bridges and optimizing the building's insulation.

In the **emissions category**, the analysis focused on **life-cycle Global Warming Potential (B1.1)**—a key metric that encompasses emissions over the building's entire lifespan. This indicator provided a thorough emissions benchmark and allowed fair comparison across buildings.

Material sustainability was captured through **building life cycle assessment (C2.1)** and the **avoidance of high-impact/dangerous substances (C3.2)**. These indicators ensure that both environmental and human health impacts of materials are considered.

For **water efficiency**, indicators such as **rainwater retention and harvesting (D1.2)**, **water-saving sanitary fittings (D1.3)**, and **greywater reuse (D1.4)** were included. While rainwater systems are common in Germany, greywater reuse remains less typical but increasingly relevant due to climate change and regional water scarcity.

Climate adaptation indicators involved **climate risk & vulnerability assessments (E1.1)**, with some reference to **adaptation measures for extreme weather (E2.1)**—highlighting growing concerns over resilience in the face of climate change.

Under **adaptability**, **design for renovation and flexibility (F1.1)** was acknowledged as valuable, encouraging future-ready and user-responsive architecture.

Health and comfort were addressed through several indicators: **low-polluting materials (G1.2)** for VOC control, **IAQ monitoring systems (G1.3)**, **thermal comfort range analysis (G2.1a)**, **daylight factor (G3.1a)**, and **sound insulation (G4.1)**. These enhance user well-being and ensure compliance with German indoor environmental standards.



The **mobility section** incorporated **charging stations for e-vehicles (H1)** and **bicycle parking (H3)**, supporting Germany's strong e-mobility and cycling infrastructure goals.

In **site and biodiversity**, **biodiversity-promoting vegetation (I2.1)** was evaluated as a qualitative but beneficial factor for local ecosystems and user quality of life.

Lastly, economic and operational indicators included **life cycle cost assessment (L1)** and **maintenance of HVAC systems (M1)**, ensuring long-term efficiency and financial viability.

3.2.1. Energy

Sustainability indicator	Building status	Feedback
A1.1 - primary energy use	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	The primary energy use is especially important if fossil energy sources are still used in the building. This indicator is a key parameter of the analysis and is very valuable for the building evaluation.
A1.2 - final energy use	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	The final energy use is crucial for the energy evaluation of the building. With renewable energy sources, this indicator fits better than the primary energy use.
A2.2 - thermal integrity of the building envelope /Thermal heat bridge correction	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	The thermal analysis of the building envelope is also a key coefficient that is important for every building evaluation. It is applicable to all building types and gives crucial information about the building performance.

3.2.2. Emissions

Sustainability indicator	Building status	Feedback
B1.1 - life-cycle global warming potential	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	Analysing the life-cycle GWP is the most accurate and efficient way of including emissions in the building evaluation. As it includes all life phases of the building, this method is very honest and holds a great value for comparing buildings.

3.2.3. Materials

Sustainability indicator	Building status	Feedback
C2.1 - Building LCA	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	The building life cycle analysis (all phases) is a good addition to B1.1 and highlights the life cycles of all materials in the building.
C3.2 - Avoidance of materials with high environmental impact/dangerous substances	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	This indicator handles one of the most important aspects for inhabitants of the buildings. In many cases, the material-check is one of the main motivations to do the certification. It is highly valuable and asked for.

3.2.4. Water

Sustainability indicator	Building status	Feedback
--------------------------	-----------------	----------



D1.2 - Rainwater retention and harvesting	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	The reuse of rainwater is completely usual in Germany and done anyways for most new building projects. It becomes even more important as the weather gets more extreme and long dry periods happen during the summertime.
D1.3 - Requirements for water-saving sanitary fittings	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	Saving fresh water is very important both for the regional water system and economically for the users. Knowing that the sanitary fittings match EU boundaries is a good indicator to fulfil this given need.
D1.4 - Greywater reuse	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	Greywater reuse systems are not yet usual in German buildings, but become more relevant as water regionally can get scarce as a consequence of climate change. The applicability highly depends on the building type.

3.2.5. Climate risk and adaptation

Sustainability indicator	Building status	Feedback
E1.1 - climate risk & vulnerability assessment	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	In Germany, recent extreme weather events and first catastrophes such as the floods in Ahrtal showed that climate change is already having a relevant influence on environmental parameters. As a result, the population is insecure about climate risks and values such an evaluation very much.
E2.1 - Adaptation measures for increased risk of extreme weather events	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	Following on the climate risk & vulnerability assessment, adaptation measures should always follow. The extend and depth needed for this plan depends on the assessment outcome.

3.2.6. Adaptability

Sustainability indicator	Building status	Feedback
F1.1 - design for adaptability and renovation	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	This indicator can be very valuable depending on the building type and size. If used in a certification scheme, it forces the architect an owner to think about possible scenarios and adapt to them. On the long term, users are often thankful for a thoughtful adaptable design.

3.2.7. Health and comfort

Sustainability indicator	Building status	Feedback
G1.2 - use of low-polluting materials (VOC)	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	Knowing about VOCs in residential buildings, but also in workspaces, is extremely relevant to the people spending time in the building. This metric is highly appreciated by the building owners and gives important information about the materials used. Moreover, as this metric is measured, it can give a hint if the building was not built as planned (f.ex. if only certified materials are used, but many VOCs are measured, a material could have been switched out).
G1.3 - Installation of measuring and control devices for monitoring and regulation of IAQ	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	Having a monitoring system that controls air quality is often wished by the users of new buildings for their comfort. In those cases, it is an easy indicator without extra costs.



		If the monitoring is not wished by the users, this can create relevant costs. The positive outcome depends on the type of building and the users.
G2.1 a - Time outside of Thermal comfort range	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	This analysis is very important for every building and adds great value to the building evaluation.
G3.1 a - daylight factor	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	The daylight factor is very important for everyone living or working in a building and thereby very important for the building evaluation.
G4.1 - Airborne and impact sound insulation	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	Analysing the sound qualities of new buildings is mandatory in Germany.

3.2.8. Mobility

Sustainability indicator	Building status	Feedback
H1 - Recharging points for e-vehicles / e-bikes	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	For larger buildings, charging points for e-vehicles and bikes are very valuable. For smaller buildings, the value depends on the use cases of the users and available infrastructure nearby.
H3 - Parking spaces for bicycles	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	Bicycle parking spaces add great value to building projects and is easy and are easy and cost-efficient in the implementation. They are a good addition to an evaluation scheme.

3.2.9. Site and biodiversity

Sustainability indicator	Building status	Feedback
I2.1 - Biodiversity promoting vegetation	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	This is a valuable side-factor that adds value to the micro-site both for nature and for the people living or working in the building.

3.2.10. Cost and value

Sustainability indicator	Building status	Feedback
L1 - Life cycle cost calculation and optimization LCC	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	Having a life cycle cost analysis is very valuable for any building or renovation project. It should be included in certification schemes in order to assure that economic decisions are reasonable.

3.2.11. Management

Sustainability indicator	Building status	Feedback
M1 - inspection and maintenance of heating and air conditioning systems	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	Good maintenance and inspection of the installed systems is crucial for their life span and performance over long periods. It is very important that the monitoring is started when the building is built or renovated. Including this factor in a certification scheme is very valuable.



3.3. Overall review of the Sustainable Building Methodology

During the test phase in Germany, the SBM proved to be a very valuable tool for a thorough building evaluation. As it includes very broad indicators, the SBM enables a holistic view on sustainability across the environmental, social and economic approaches. The structured and effective layout led to a positive user experience and overview.

Many SBM indicators, especially those related to energy efficiency, GHG emissions, thermal integrity, indoor comfort, and life cycle analysis, align well with Germany's DGNB certification system and national regulations. These indicators were considered both feasible and valuable.

Germany's existing practice already incorporates complex assessments like global warming potential (GWP), thermal comfort, daylight factor, and low-pollutant materials, making the SBM indicators in these areas highly applicable. Indicators such as primary and final energy use, building envelope performance, and life-cycle emissions were backed by robust data due to national standards and building certification practices.

Some SBM metrics—such as greywater reuse, climate risk assessments, and biodiversity-promoting vegetation—were less commonly applied in German projects. While technically feasible, these were seen as aspirational or context-dependent.

For some indicators, particularly those around biodiversity and site quality, the German team noted challenges in applying quantitative evaluations and recommended more qualitative or context-sensitive approaches.

The SBM was seen as largely compatible and useful for German projects. It provided a comprehensive structure that complements national certification systems and offers valuable benchmarking for public buildings.



4. Italy

4.1. Description of the pilot buildings

In Italy, the pilot partner is the Autonomous Province of Bolzano (APB). The APB is responsible for the management of more than 350 buildings in South Tyrol, and in 2019 the CasaClima agency was commissioned to carry out a status quo mapping of the energy performance of all these buildings. The aim was to identify those with the highest energy consumption and the worst envelope and system conditions. In particular, the focus was on 54 of these buildings, those characterized by the highest energy consumption for the same volume. Within this stock, those buildings with the worst envelope and systems conditions will be selected to identify those buildings where the cost-benefit ratio associated with the refurbishment intervention will be most favorable. Among them, seven buildings were analyzed, both in terms of energy efficiency and environmental sustainability, as well as economic feasibility. These include both school buildings and buildings housing provincial offices.

4.2. Indicators applied in the detailed analysis

All the metrics belonging to sub-thematic **area A1 ENERGY** can easily be applied, as they are already requested and calculated for the CasaClima standard and sustainability certification schemes. However, CasaClima currently does not consider final energy use (**metric A1.2**) as a target value, and the unit of measurement differs from that used in the MESTRI-CE Sustainable Building Methodology (SBM). Therefore, it will not be used. Different limit values apply to new and renovated buildings, and if a building is protected for historical or architectural reasons, it can avoid the limit relating to the applied class, but stricter requirements relating to other aspects are mandatory.

An airtightness test (**metric A2.1**) is required for all buildings, regardless of size. For residential buildings, the airtightness test is always mandatory. The number of units to be tested depends on the total number of units, and there are two n₅₀ limits depending on the building class. For buildings characterised by other intended uses, such as offices or schools, where it is difficult to divide the building in a way that would allow a reliable test to be carried out, it is not necessary to verify a specific n₅₀ value. However, if the test result is significantly different to the value required by the CasaClima Directives for new and existing residential buildings (1.50 and 3.00 vol/h respectively), specific measures must be defined to improve airtightness performance and a second test must be carried out to demonstrate improvement. A thermal integrity test (**metric A2.2a**) is not required, but a robust and traceable quality control process (**metrics A2.b1 and A2.b2**) must be applied to both new and existing buildings.

Thermal bridges must be corrected according to the CasaClima catalogue, for both new and existing buildings, regardless of their size. If this is not the case, a FEM analysis must be carried out to show that the surface temperature is above the threshold at which mould and surface condensation occur. The other two metrics in this sub-thematic area (**metrics A2.3a and A2.3b**), which are useful for detecting building behaviour during the summer, can be easily calculated using the official CasaClima software.

Metric A3.1, which evaluates the ability to automatically control technical building systems, thereby facilitating their management and optimising building performance, is required for all buildings with a non-residential intended use. However, as the **Smart Readiness Indicator (SRI)** is still under development at a European level, this metric has not been integrated into CasaClima certification schemes.



Regarding the sub-thematic area **A4 Renewable Energy Sources**, only one metric is considered and can be calculated, obtaining the amount of renewable energy used to run the building in comparison to the amount of total energy.

Metrics belonging to evaluation area **B, 'Emissions'**, are already partially included in CasaClima certification schemes and are used to define the efficiency class to which a building belongs (**metrics B1.2 and B1.4**). The remaining two metrics do not have a direct equivalent, but can be substituted with analogous metrics (i.e. metrics with the same objective as those that form part of the MESTRI-CE SBM). According to the CasaClima approach, **metrics B1.1 and B1.3** can only be used for new buildings.

The majority of metrics within thematic area **C - Materials (C1.1, C1.2 and C1.3)** could have been calculated due to the public nature of the pilot buildings selected; however, they have not been entered as "Applicable" as they are not included in the CasaClima certification schemes. Conversely, **metric C2.1** can be substituted by the analogous CasaClima metric ICC.

CasaClima sustainability protocols consider the efficient use of water to be an area of evaluation, but the measurement of water consumption during the building operational life is not yet mandatory. The calculated water demand (**metric D1.1b**) is, in contrast, contained within the analogous metric, Water Impact Wkw. **Metrics D1.2 and D1.3** can be applied to new construction without difficulty and are mandatory for existing buildings when the refurbishment intervention concerns the renovation of rainwater retention and harvesting systems or the installation of new sanitary fittings.

Metrics contained within thematic area **E - Climate risk adaptation** have not been utilised in the evaluation of pilot buildings. This is primarily due to the fact that they are not considered by CasaClima certification schemes. It is evident that the evaluation of building performance through the utilisation of these metrics is instrumental in ensuring future-proof performance, thereby safeguarding occupier health and comfort while minimising long-term risks to property value. However, the calculation methodologies employed to derive these metrics often exceed the conventional skillset of designers.

It has been demonstrated that the provision of an adequate level of comfort for occupants of a building enables more consistent calculations to be made with regard to the building's energy efficiency. In the majority of cases, the behaviour of the building's occupants represents the unknown variable in each calculation. This is due to the fact that the manner in which they interact with the building can have a significant impact on the results. Furthermore, it is imperative to acknowledge that favourable environmental conditions are indispensable for ensuring the preservation of human health. Some of the metrics listed in the thematic area **G - Health & Comfort** have been applied partially (metrics G1.1 and G1.2), while all the metrics that require a dynamic calculation to be obtained have not been used (metrics G2.1a, G2.1b, G3.1.b, G3.2).

On 20th March 2025, the APB published a new legal instrument in the Official Journal. This instrument was entitled 'Implementing regulation on energy performance in buildings and energy bonuses', and it was designated as DPP No. 6 of 18th March 2025. The APB has adopted the EU Directive 2024/1275, also known as the new EPBD, in accordance with this Regulation. All the points reported in the new EPBD that aim to facilitate the installation of infrastructures related to green mobility in buildings have been transposed into the Regulation and consequently adopted by the CasaClima protocols (**H Mobility**).

The L Cost & Value thematic area presents a single indicator for calculating an LCC. While the potential benefits of this type of analysis are clear, the CasaClima protocols do not consider it mandatory on account of its complexity.



4.2.1. Energy

Sustainability indicator	Building status	Feedback
A1.1 Primary Energy use	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Applicable. It is valuable for building evaluations, since it is used as a reference target for assessing a building's efficiency class, and also as a general reference for assessing climate targets.
A1.2 Final energy use	<input type="checkbox"/> new <input type="checkbox"/> renov.	Not applicable.
A1.3 Heating Demand	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Applicable. It is valuable to evaluate the performance of the building envelope during the heating season in order to reduce the heating demand.
A1.4 Cooling Demand	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Applicable. It is valuable to evaluate the performance of the building envelope during the cooling season in order to reduce the cooling demand
A2.1 Airtightness of the building envelope (testing) - $n_{50,lim}$	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Applicable. Useful to reduce/avoid energy consumption to operate buildings, improving indoor comfort conditions and avoiding internal condensation. Even if buildings intended for use in a way similar to that of the pilot buildings cannot be tested as a whole, a measurement campaign can detect possible weaknesses in the envelope.
A2.2a Thermal integrity of the building envelope /Thermal heat bridge correction	<input type="checkbox"/> new <input type="checkbox"/> renov.	Not applicable.
A2.2b1 Thermal integrity of the building envelope /Thermal heat bridge correction	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Applicable. FEM analysis enables the behaviour of thermal bridges to be verified while preserving the integrity of the building's elements.
A2.2b2 Thermal integrity of the building envelope /Thermal heat bridge correction	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Applicable. The ability to refer to a catalogue of verified building solutions that can be applied directly, safe in the knowledge that they guarantee thermal heat bridge correction, can speed up the design process.
A2.3a Summer heat protection - Thermal lag	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Applicable. Increasing the building's ability to preserve the indoor environment from overheating improves comfort levels while reducing energy consumption.
A2.3b Summer heat protection - Decrement factor	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Applicable. Increasing the building's ability to preserve the indoor environment from overheating improves comfort levels while reducing energy consumption.



A3.1 Building automation and control systems	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov	Applicable. For existing buildings, this metric can only be obtained if the refurbishment intervention aims to renovate the entire HVAC system, or part of it.
A3.2 SRI (Smart Readiness Indicator)	<input type="checkbox"/> new <input type="checkbox"/> renov.	Not applicable.
A4.1 Renewable energy produced on site	<input type="checkbox"/> new <input type="checkbox"/> renov.	Not applicable.
A4.2 Share of renewable energy in delivered energy	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov	Applicable. It is useful for improving energy independence from fossil fuels and increasing the use of energy from renewable sources. Specific percentages are set according to the intended use of the building in question.
A4.3a Electrical storage capacity	<input type="checkbox"/> new <input type="checkbox"/> renov.	Not applicable.
A4.3b Thermal storage capacity	<input type="checkbox"/> new <input type="checkbox"/> renov.	Not applicable.

4.2.2. Emissions

Sustainability indicator	Building status	Feedback
B1.1 Global Warming Potential (GWP) - A1, A2, A3, B4	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	Not yet applicable. From 01/01/28, the GWP of all new buildings with a net heated area of more than 1000 m ² will be calculated. From 01/01/30, this will apply to all new buildings. Until a European calculation method is adopted, the GWP will be calculated according to B1.3, respecting the limit of 1,000 kg CO ₂ eq/m ² of net heated area. This threshold will be reviewed at intervals of no more than 5 years and adjusted in line with decarbonisation targets.
B1.2 Total CO₂e emissions	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Applicable. This metric is one of four used to determine the CasaClima class. The ability to assess CO ₂ emissions related to the building's operational life is of primary importance in reducing greenhouse gas emissions.
B1.3 ICC - CasaClima Index	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	Applicable. The CasaClima sustainability protocols perform a simplified life cycle assessment (LCA) based on phases A1, A2 and A3 (from cradle to gate) and B4. This analysis not only calculates GWP as an environmental impact indicator, but also AP and PENRT. These three values are then 'mixed' and weighted to give a dimensionless score, which is linked to a target score of 250 points. The building's useful life is assumed to be 100 years. The same applies to all structural



		components, while other elements are assumed to last 50 or 25 years. The database used to define the environmental performance of building materials is based on the IBO Building Materials Database. It is also possible to insert values from an EPD. Three different environmental impact indicators are calculated to obtain ICC. Through this metric, it is possible not only to evaluate and eventually reduce the greenhouse emissions of construction products, but also to consider the impact of construction products on soil and water acidification and the demand for non-renewable primary energy in their production.
B1.4 On-site carbon emissions from fossil fuels	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Applicable. This metric is one of four used to determine the CasaClima class. The ability to assess CO ₂ emissions related to the building's operational life is of primary importance in reducing greenhouse gas emissions from fossil fuels.

4.2.3. Materials

Sustainability indicator	Building status	Feedback
C1.1 Bill of quantities, materials and lifespans	<input type="checkbox"/> new <input type="checkbox"/> renov.	Not applicable.
C1.2 Construction and demolition waste and materials (amount for reuse, recycling, recovery)	<input type="checkbox"/> new <input type="checkbox"/> renov.	Not applicable.
C1.3 Design for deconstruction	<input type="checkbox"/> new <input type="checkbox"/> renov.	Not applicable.
C2.1 ICC - CasaClima Index	<input checked="" type="checkbox"/> new <input type="checkbox"/> renov.	Applicable. For further information, please refer to the metric B1.3 described in the above table.
C3.1 Sustainable and efficient use of primary raw materials	<input type="checkbox"/> new <input type="checkbox"/> renov.	Not applicable.



4.2.4. Water

Sustainability indicator	Building status	Feedback
D1.1a Use stage water consumption	<input type="checkbox"/> new <input type="checkbox"/> renov.	Not applicable.
D1.1b Water impact - Wkw	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Applicable. This metric contributes to reducing pressure on freshwater resources by using water more efficiently.
D1.2 Rainwater retention and harvesting	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Applicable. This metric is applicable to existing buildings only for certain renovation projects. This metric contributes to reducing pressure on freshwater resources by using water more efficiently.
D1.3 Requirements for water-saving sanitary fittings	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Applicable. This metric is applicable to existing buildings only for certain renovation projects. This metric contributes to reducing pressure on freshwater resources by using water more efficiently.
D1.4 Greywater reuse	<input type="checkbox"/> new <input type="checkbox"/> renov.	Not applicable.

4.2.5. Climate risk and adaptation

Sustainability indicator	Building status	Feedback
E1.1 Climate risk & vulnerability assesement	<input type="checkbox"/> new <input type="checkbox"/> renov.	Not applicable.
E1.2 Time outside of thermal comfort range (with future climate projections)	<input type="checkbox"/> new <input type="checkbox"/> renov.	Not applicable.
E1.3 Adaptation measures for increased risk of extreme weather events	<input type="checkbox"/> new <input type="checkbox"/> renov.	Not applicable.
E1.4 Sustainable drainage	<input type="checkbox"/> new <input type="checkbox"/> renov.	Not applicable.



4.2.6. Adaptability

Sustainability indicator	Building status	Feedback
F1.1 Design for adaptability and renovation	<input type="checkbox"/> new <input type="checkbox"/> renov.	Not applicable.

4.2.7. Health and comfort

Sustainability indicator	Building status	Feedback
G1.1 In-situ measurement of IAQ conditions and target pollutants	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	<p>Partly applicable. It is important to note that not all of the measurements requested by the MESTRI-CE SBM are considered in the CasaClima protocols.</p> <p>The ventilation rate is a mandatory requirement only in the event of the installation of a Mechanical Ventilation System. The in-situ measurement of parameters targeting indoor and outdoor air pollutants (total VOCs, CMRs, VOCs, formaldehyde and benzene) is only required in the following circumstances: if the building is not equipped with a Mechanical Ventilation System; or if the construction products and materials contained in the airtight layer do not have proof of compliance with emission limit values; or are not certified with a type I eco-label.</p> <p>In-situ measurements related to radon risk are required, if the building is located in an area characterised by a radon risk of more than 300 Bq/m³.</p> <p>This metric is considered to be of high relevance in the absence of a Mechanical Ventilation System, or where it is not installed and correctly managed.</p>
G1.2 Use of low-polluting materials (formaldehyde, VOCs etc.)	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	<p>Applicable. In general, the presence of a technical certificate or the use of building materials with a type I eco-label is only required if the building is not equipped with a mechanical ventilation system. In such cases, the MEC requires the submission of test reports issued by accredited laboratories or the presence of specific labels or certifications, given that the pilot buildings are all public.</p>
G1.3 Installation of measuring and control devices for monitoring and regulation of IAQ	<input type="checkbox"/> new <input checked="" type="checkbox"/> renov.	<p>Partly applicable. This index is intended for use in existing office buildings where the installation of a Mechanical Ventilation System is not a viable option. In this instance, it is imperative to install CO₂ measurement devices.</p>
G1.4 Radon risk and exposure	<input checked="" type="checkbox"/> new	<p>Applicable. CasaClima certification schemes mandate the implementation of specific protection measures, contingent</p>



constructive protection measures	<input checked="" type="checkbox"/> renov.	on the radon risk exposure associated with the building construction site and the presence or absence of heated spaces in contact with the ground. In-situ measurements pertaining to radon risk are obligatory in instances where the edifice is situated within a geographical area characterised by a radon risk that exceeds 300 Bq/m ³ .
G1.5 Ventilation strategy and quality requirements for ventilation systems	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Partly applicable. This metric can only be used if the building being studied is a school.
G2.1a Time outside of thermal comfort range	<input type="checkbox"/> new <input type="checkbox"/> renov.	Not applicable.
G2.1b PPD (Predicted Percentage of Disatisfied) OR Acceptable summer indoor temperature range	<input type="checkbox"/> new <input type="checkbox"/> renov.	Not applicable.
G3.1a Medium Daylight Factor	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Applicable. In order to achieve CasaClima certification, it is necessary to demonstrate that the minimum of 20% of rooms designated for continuous occupancy have undergone testing to verify the achievement of the stipulated Medium Daylight Factor. In the event of existing buildings that are unable to modify the dimensions of the windows and that are unable to reach the requested value, it is necessary to demonstrate that the refurbishment intervention does not result in a reduction in the actual access to natural light.
G3.1b spatial Daylight Autonomy (sDA)	<input type="checkbox"/> new <input type="checkbox"/> renov.	Not applicable.
G3.2 DGPe	<input type="checkbox"/> new <input type="checkbox"/> renov.	Not applicable.
G3.3 Views to the outside	<input type="checkbox"/> new <input type="checkbox"/> renov.	Not applicable.
G3.4 Luminaire efficacy	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Applicable. In the event of existing buildings, the metric can be applied only if the refurbishment intervention requires the substitution of the existing luminaires.



G3.5 Correlated Colour Temperature (CCT)	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Applicable only to school buildings. In the event of existing buildings, the metric can be applied only if the refurbishment intervention requires the substitution of the existing luminaires.
G3.6 Colour Rendering Index	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Applicable only to school buildings. In the event of existing buildings, the metric can be applied only if the refurbishment intervention requires the substitution of the existing luminaires.
G3.7 Lighting control	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Applicable. In the event of existing buildings, the metric can be applied only if the refurbishment intervention requires the installation of a lighting control system.
G4.1 Airborne and impact sound insulation (testing)	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Applicable. In the event of existing buildings, the metric can be applied only to those structures that are modified by the refurbishment intervention.
G4.2 Reverberation time, speech intelligibility (testing)	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Applicable. In the event of existing buildings, the metric can be applied only to those rooms that are modified by the refurbishment intervention.

4.2.8. Mobility

Sustainability indicator	Building status	Feedback
H1 Recharging points for e-vehicles/ e-bikes	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Applicable.
H2 Pre-cabing of parking spaces	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Applicable.
H3 Parking spaces for bicycles	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Applicable.

4.2.9. Site and biodiversity

Sustainability indicator	Building status	Feedback
I1.1 Water impact - Wkw	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Applicable. Useful to maintain the natural water cycle. In the event of existing buildings, the metric can be applied only if the refurbishment intervention requires a modification of the external surfaces exposed to the action of the rain.



I1.2 Microclimate analysis	<input type="checkbox"/> new <input type="checkbox"/> renov.	Not applicable.
I1.3 Solar Reflectance Index	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Applicable. Useful to mitigate the urban heat island effect, since it results in a greater reflection of solar radiation. This phenomenon assists in maintaining lower temperatures within the urban environment, thereby enhancing thermal comfort for residents. In the event of existing buildings, the metric can be applied only if the refurbishment intervention requires the substitution of the actual covering materials.
I2.1 Biodiversity - promoting vegetation	<input type="checkbox"/> new <input type="checkbox"/> renov.	Not applicable.
I2.2 Light pollution	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Applicable. Useful to avoid the negative impact of light scattering upwards on wildlife. In the event of existing buildings, the metric can be applied only if the refurbishment intervention requires the substitution of the actual external lights.

4.2.10. Cost and value

Sustainability indicator	Building status	Feedback
L1 Life cycle cost calculation and optimisation (LCC)	<input type="checkbox"/> new <input type="checkbox"/> renov.	Not applicable.

4.2.11. Management

Sustainability indicator	Building status	Feedback
M1 Inspection and maintenance of heating and air conditioning systems	<input type="checkbox"/> new <input type="checkbox"/> renov.	Not applicable



4.3. Overall review of the Sustainable Building Methodology

As outlined in the document titled D.2.5.1, Step-by-Step Guide on MESTRI-CE Sustainable Building Methodology, the list of criteria, indicators and metrics identified has been evaluated based on the effort required to calculate, assess and evaluate them, as well as their potential impact in the development of an ambitious action plan aimed at achieving a carbon-neutral and sustainable building stock. The impact/effort analysis, conducted according to the responses of the experts from the partner countries, highlighted that the thematic areas related to the holistic concept of sustainability may not all have equivalent impact. Following a thorough evaluation, it was determined that the areas of 'Energy', 'Emissions', 'Materials', 'Adaptation and Resilience', 'Cost & Value' and 'Management' have the potential for a higher impact. Nevertheless, it was decided that a holistic approach to sustainability, and therefore the integration of all its dimensions into the building assessment, should remain the guiding principle for the design of the MESTRI-CE SBM. Therefore, in addition to the priority thematic areas underlined by the impact-factor analysis and their key indicators, the MESTRI-CE SBM includes all the indicators identified.

This approach has also been maintained when the MESTRI-CE SBM has been applied to the pilot buildings. It is important to note that the fact that all the pilot buildings belong to a public administration makes the application of the adapted MESTRI-CE SBM to the buildings chosen. Indeed, all new and renovated public buildings are required to comply with the Minimum Environmental Criteria (MEC). The introduction of these measures is attributed to the Ministerial Decree that initiated the implementation of Green Public Procurement in Italy. It is important to note that these measures have been made mandatory for all public construction contracts, covering both new construction and the renovation of existing buildings. These can be delineated as environmental requirements, established by the Ministry of the Environment, to guide public administrations in their procurement of goods and services, promoting sustainability and reducing environmental impact. MEC's primary objective is to promote the utilisation of eco-friendly products and services throughout their lifecycle. This encompasses the phases of design, construction, maintenance, and disposal. In 2023, CasaClima issued the version aligned to MEC of its two sustainability protocols dedicated to schools and offices. This development enabled designers and public administrations to verify the application of MEC indications using CasaClima protocols with ease.

The implementation of the MESTRI-CE SBM in a building undergoing certification under the CasaClima sustainability protocol facilitates the extension of the range of metrics that can be calculated and evaluated. The introduction of the concept of "analogous metric" increases the usability of the MESTRI-CE SBM, extending the sustainability aspects that can be covered even if the metric or the criteria do not comply perfectly with the official one.

However, certain thematic areas, such as L Cost & Value, I Site & Biodiversity and, naturally, E Climate Risk & Adaptation, are still underutilised, despite the impact/factor analysis recognising their potential to have a higher impact. It is related, undoubtedly, to the rare diffusion of the competencies required to calculate the metrics or verify the criteria related to those thematic areas. It is essential that the national government makes further efforts to enhance the competencies of designers in these areas.



5. Poland

5.1. Description of the pilot buildings

The pilot project in the Mazovia region (Województwo Mazowieckie), located in central Poland, was focused on supporting the decarbonisation of selected public buildings owned by rural and semi-urban municipalities. As the most populous and economically significant region in Poland, Mazovia is heavily shaped by the dominance of Warsaw, which serves as a central political, administrative, and financial hub. Nonetheless, the pilot initiative specifically targeted smaller municipalities across the region, many of which face significant challenges in modernising their building stock due to limited technical capacity and financial constraints.

The pilot involved a total of 20 public buildings, distributed across several municipalities. These included 15 school buildings, a hospital, a municipal cultural centre, a healthcare clinic, a multi-family public residential building, and a municipal administration building. The buildings were generally constructed in the second half of the 20th century, and several had undergone partial expansions or refurbishments over time, leading to inconsistencies in technical conditions and performance even within the same typology.

5.2. Indicators applied in the detailed analysis

Factors—such as thermal integrity of the building envelope and thermal bridge correction—are important for energy-efficient design and are already addressed through Polish building codes like WT2021, making them less relevant for additional consideration in certification processes. The summer heat protection—ensuring thermal comfort during warmer months—is technically valuable and regulated through WT2021 by requiring demonstration of compliance with indoor temperature limits, but it is not a mandatory assessment criterion in certifications like BREEAM or LEED, where simpler overheating indicators or simulation-based approaches are more common.

Similarly, energy efficiency requirements for technical building systems (such as heating, ventilation, cooling and domestic hot water) are assumed through compliance with WT2021 minimum standards and are not separately evaluated in most certification schemes. The Smart Readiness Indicator (SRI), as an EU initiative, is still under development and not yet fully integrated into Polish certification schemes. The share of renewable energy in delivered energy is considered indirectly through the primary energy (EP) limit required by WT2021, which incentivizes the use of heat pumps, solar PV or district heating, but the source-specific breakdown (e.g. from energy communities or specific renewable suppliers) is not yet a scoring criterion in certifications. Thermal storage capacity, while important for load shifting and comfort, is not directly scored due to the complexity of evaluating its performance in practice. In summary, while these factors support sustainable design, Polish building certifications focus on standardized, outcome-based metrics defined by WT2021 and international systems and therefore do not explicitly score all such technical features.

In Polish building certification processes, operational greenhouse gas emissions, embodied greenhouse gas emissions, and on-site carbon emissions from fossil fuels are generally not the primary focus. Instead, these certifications and regulations emphasize energy efficiency, thermal comfort, and sustainable resource use. The factor of operational greenhouse gas emissions is indirectly addressed through the EP requirement, which is linked to fuel mix and consumption, rather than through direct measurement of greenhouse gases. Similarly, embodied greenhouse gas emissions, which include emissions from material production and construction, are not yet fully integrated due to the complexity of data gathering and lack of standardized methodologies. Polish certification schemes and WT2021 typically do not require detailed lifecycle assessments that would capture embodied emissions. The factor of on-site carbon emissions from fossil fuels, meaning direct emissions from burning fossil fuels on the premises, is minimized by promoting renewable energy and discouraging fossil fuel use (e.g. through stricter EP limits and municipal bans), but not explicitly



quantified. This simplifies the certification process while supporting national goals for decarbonization and sustainability. While these greenhouse gas emission factors are increasingly important in climate policy, Polish certifications and WT2021 currently focus on achievable energy performance metrics. However, lifecycle carbon assessments including these factors are becoming more relevant and may be incorporated in future certification updates. Overall, the approach balances practicality and sustainability, prioritizing energy efficiency and regulatory compliance over comprehensive greenhouse gas accounting.

In Polish building certification processes, factors such as use stage water consumption and use stage water demand are not usually the main focus. Instead, the certifications and WT2021 primarily concentrate on energy efficiency and indoor environmental quality. While water consumption during the use stage impacts sustainability, Polish schemes often treat it as a secondary consideration. The management of rainwater retention and harvesting is recognized for its environmental benefits and is sometimes required locally due to flood prevention policies, but it is not commonly required or strictly evaluated in certifications. Similarly, requirements for water-saving sanitary fittings exist as recommendations or good practice rather than mandatory certification criteria. The reuse of greywater can reduce overall water demand but is typically not a standard feature assessed in Polish building certifications. These factors involve technical complexity and user behavior, making standardized assessment challenging. Polish certification systems prefer simpler, more quantifiable metrics like energy consumption and resource sustainability. Nevertheless, water efficiency and management are gaining attention in urban planning and may become more prominent in future certification versions. Overall, Polish building certifications and WT2021 currently prioritize energy and resource efficiency over detailed water use and reuse strategies. In Polish building certification processes, factors such as spatial Daylight Autonomy (sDA) and Daylight Glare Probability (DGP_e) are not widely used, as certifications like BREEAM or LEED applied in Poland rely instead on simpler metrics like the daylight factor, which is also regulated by Polish standards. Advanced dynamic simulations such as sDA, which measures the percentage of space receiving adequate daylight over time, are considered too complex or data-intensive for standard assessments. Similarly, views to the outside, which are important for psychological comfort, are not systematically evaluated, even though they contribute to occupant well-being. Technical lighting characteristics like luminaire efficacy, Correlated Colour Temperature (CCT), and Colour Rendering Index (CRI) are typically not directly assessed, despite their relevance to energy efficiency and visual comfort. These parameters are often covered indirectly through compliance with electrical and lighting standards rather than through the certification process itself. Lighting control systems, which can improve energy savings and user satisfaction, are usually optional features and not core criteria for certification.

5.2.1. Energy

Sustainability indicator	Building status	Feedback
Primary energy use	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Primary energy is applicable because an EPC (świadectwo charakterystyki energetycznej) has to be calculated for a new building and for a deep renovation. The value of primary energy (EP) is a regulatory limit defined in WT2021 and is the main metric to demonstrate compliance with national climate targets and building codes. Primary energy is therefore highly relevant for both regulatory compliance and sustainability assessment in Poland.
Final energy	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Final energy is applicable because it is presented in the EPC, which is required for new and deeply renovated buildings. Final energy use gives better insight into actual energy bills and operational costs for occupants, which are not directly addressed by climate policy targets. Therefore, final energy is important from an economic/user perspective but has lower regulatory relevance compared to primary energy in Poland.



Useful energy	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	<p>Useful energy is applicable because it provides a clear indication of the efficiency of the building envelope and internal heat gains before system losses are accounted for. Although not explicitly shown in the EPC, it is calculated as part of the energy balance and gives insight into how well the building itself (excluding technical systems) performs thermally. Useful energy is valuable for designers and auditors to evaluate the impact of insulation, airtightness, solar gains, and passive measures. In Poland, useful energy is increasingly discussed in the context of deep renovations and energy audits, though it is not a legal compliance metric under WT2021.</p>
CO₂ emissions	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	<p>CO₂ emissions are applicable because EPC calculations include CO₂ emission values as indicative figures. Although CO₂ emissions are illustrated in the EPC and relevant to climate policy, they are not yet used as a legal compliance metric in WT2021. They are increasingly relevant in voluntary sustainability assessments and reflect climate impact more directly than primary energy.</p>
Heating demand	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	<p>Heating demand is applicable because it is calculated and presented in the EPC as part of the building's thermal performance. Heating demand is a good indicator of the quality of the thermal envelope and solar gains and is used in practice to assess the envelope's efficiency and indoor comfort. It remains highly relevant in Poland, particularly in colder climates.</p>
Cooling demand	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	<p>Cooling demand is applicable because it is calculated for non-residential buildings and is shown in the EPC when applicable. It provides insight into summer thermal comfort and energy needs, which are becoming more relevant due to climate change. While not yet a decisive legal compliance metric in Poland, cooling demand is increasingly valued in building assessments.</p>
Airtightness of the building envelope (testing) - n50	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	<p>Airtightness is essential in Poland as it minimizes uncontrolled heat losses and improves energy efficiency. WT2021 sets recommended values for airtightness and requires verification for buildings with mechanical ventilation. Airtightness testing is a critical quality control step for achieving compliance and ensuring indoor comfort, moisture protection, and controlled ventilation.</p>
Thermal comfort	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	<p>Thermal comfort is essential in building assessment because it ensures occupant well-being. WT2021 requires checking compliance with maximum summer temperatures and appropriate thermal conditions. Although not quantified as a certification metric, thermal comfort remains a key design target and is valued in voluntary certification schemes for user-centered design and energy-efficient operation.</p>
Additional control system for further optimisation	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	<p>Additional control systems are increasingly relevant in Poland as they improve operational efficiency of HVAC, lighting, and other systems, adapting to actual use patterns. They support energy savings, comfort and intelligent building operation, although they are not yet mandatory under WT2021. In voluntary certifications, advanced controls demonstrate above-standard performance.</p>
PV yields	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	<p>PV yields are essential in Poland because they contribute to reducing EP, which is the main regulatory metric. WT2021 explicitly encourages use of on-site renewables to meet EP limits. PV systems reduce operational CO₂ emissions, support national renewable energy targets and lower occupant energy costs, making them highly relevant for both compliance and sustainability.</p>
Additional thermal and electrical storage	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	<p>Thermal and electrical storage systems are increasingly relevant in Poland for improving energy flexibility and resilience. Although not required by WT2021, they allow better use of renewable energy, stabilize indoor temperatures,</p>



(water storage, electricity storage)		reduce grid dependency, and improve comfort and efficiency. Recognition of such systems in certification aligns with future-ready and sustainable building concepts.
--------------------------------------	--	--

5.2.2. Emissions

Sustainability indicator	Building status	Feedback
GWP	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	<p>The GWP alone is not explicitly used in Polish building regulations (WT2021) nor in mandatory EPCs (świadczenia charakterystyki energetycznej). Instead, the focus remains on operational energy performance (EP) as the primary compliance metric. In voluntary certification schemes (like BREEAM, LEED, DGNB), GWP is increasingly addressed as part of the broader Life Cycle Assessment (LCA) of the building, covering both embodied and operational emissions.</p> <p>The optimization of material production impacts and maximizing the service life of buildings are important principles of ecological construction, yet they are not fully mandated in Polish law. Reducing material flows, energy use and emissions during the production of building materials, using durable materials, optimizing material use during construction, maintenance and renovation, and extending the overall lifespan of buildings all significantly influence the building's climate footprint and GWP.</p> <p>In Poland, embodied emissions are still rarely required in practice but are beginning to appear in large public tenders and sustainability-driven projects. Methodologies for calculating GWP follow EN 15804 and EN 15978 standards, using LCA software or EPDs (Environmental Product Declarations) for materials.</p>

5.2.3. Materials

Sustainability indicator	Building status	Feedback
Disposal indicator	<input type="checkbox"/> new <input type="checkbox"/> renov.	<p>The disposal indicator, which represents a volume weighted with the disposal and recycling properties of all considered building component constructions and layers generated over the full life cycle of the building, is currently not a standard metric in Polish building regulations (WT2021) nor in EPCs. Polish EPCs focus solely on operational energy and emissions and do not include material life cycle data.</p>
Thermal conductivity of materials (λ -values)	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	<p>The thermal conductivity of materials (λ-values), which indicates the ability of a material to conduct heat, is a fundamental parameter already regulated and explicitly used in Poland through WT2021. The λ-values of materials directly determine the thermal transmittance (U-value) of building components, which must meet maximum allowable limits specified for different types of partitions (walls, roofs, floors, windows, etc.) in WT2021.</p> <p>In Poland, thermal conductivity data for construction materials are standardized and published in national norms and technical approvals. Designers are required to use certified λ-values when calculating U-values to demonstrate compliance with WT2021. The lower the λ-value of a material, the better its insulating properties, which helps reduce heating and cooling demand and contributes to energy efficiency.</p>



		The regulation of thermal conductivity ensures that buildings achieve an adequate level of thermal protection and operational energy performance (EP), both for new construction and for deep renovations. It is thus a mandatory and integral part of the building code and not a voluntary indicator. EPCs reflect the results of these calculations indirectly through heating demand, cooling demand, and final/primary energy use.
--	--	---

5.2.4. Water

Sustainability indicator	Building status	Feedback
Use stage water consumption	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Water meters must be installed in all new and deeply renovated buildings in Poland, in line with building regulations and water utility requirements. Monitoring water consumption is standard practice, especially in non-residential buildings where sub-metering by tenant or department is common. In residential buildings, water metering is mandatory but often less granular. It is an easy-to-implement and low-cost measure, particularly effective for monitoring and managing water use during operation.
Water impact	<input type="checkbox"/> new <input type="checkbox"/> renov.	In Poland, the concept of water impact assessment (including water footprint) is not widely applied in building certifications or regulatory practice, primarily due to the lack of standardized calculation methodologies and limited market demand. While water scarcity can be an issue regionally, especially in summer, overall water resources are still considered sufficient in most areas, and water pricing does not strongly incentivize detailed water impact accounting.
Rainwater retention and harvesting	<input type="checkbox"/> new <input type="checkbox"/> renov.	Rainwater retention is increasingly required by local zoning plans and environmental permits, especially in areas prone to flooding or with limited stormwater drainage capacity. WT2021 (§124) allows for stormwater to be collected and used on-site or infiltrated into the ground if soil and water conditions permit. Systems for harvesting rainwater for irrigation, toilet flushing or maintenance use are not mandatory under national regulations but are encouraged in some municipal policies.
Requirements for water-saving sanitary fittings	<input type="checkbox"/> new <input type="checkbox"/> renov.	In Poland, there are no explicit WT2021 requirements obligating the use of water-saving fittings. In practice, water-saving fittings are widely adopted in new buildings as standard due to user expectations, cost savings, and compliance with voluntary certifications. In renovations, retrofitting such fittings is possible and common, though not legally required.
Greywater reuse	<input type="checkbox"/> new <input type="checkbox"/> renov.	Greywater reuse systems are not addressed by WT2021 or other binding Polish regulations. While technically feasible and sometimes implemented in innovative or high-profile projects, there are no national standards or guidelines regulating their design, approval, or operation. Local sanitary inspections often treat such systems cautiously due to water quality concerns. Consequently, greywater reuse remains a niche practice in Poland, limited to voluntary sustainable building projects or research initiatives.



5.2.5. Climate risk and adaptation

Sustainability indicator	Building status	Feedback
Climate risk & vulnerability assessment	<input type="checkbox"/> new <input type="checkbox"/> renov.	In Poland, a formal climate risk and vulnerability assessment at the individual building level is not required by WT2021 or EPC regulations. While the Polish National Adaptation Strategy to Climate Change (NAS 2020) and EU-level policies emphasize the importance of adapting buildings to climate risks (such as heat waves, floods, heavy rainfall), implementation at the building scale remains voluntary. Such assessments are rarely carried out in practice, and standardized methodologies or tools for measuring vulnerability and exposure at the building level are not widely available.
Time outside of thermal comfort range (with future climate projections)	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	In Poland, ensuring thermal comfort is required by WT2021, which mandates compliance with limits on maximum internal air temperature during summer (WT2021 §134 ust. 2), based on calculations using PN-EN ISO 13790 or dynamic simulations where appropriate. However, WT2021 does not require projecting comfort into future climate scenarios. Thus, time outside of thermal comfort range with future climate projections is not yet a regulatory requirement nor a common practice.

5.2.6. Adaptability

Sustainability indicator	Building status	Feedback
Design for adaptability and renovation	<input type="checkbox"/> new <input type="checkbox"/> renov.	In Poland, the concept of designing for adaptability—ensuring that a building can be easily modified, extended, repurposed, or renovated over its life cycle—is not formally regulated in WT2021 nor EPC requirements. Polish building law and WT2021 focus on meeting minimum energy, comfort, and safety standards at the time of construction or renovation, without explicit criteria rewarding flexibility for future functional, spatial, or demographic changes.

5.2.7. Health and comfort

Sustainability indicator	Building status	Feedback
Ventilation strategy and quality requirements for ventilation systems	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	In Poland, ventilation is mandatory in all buildings per WT2021 and must ensure adequate air exchange rates while minimizing energy loss. Mechanical ventilation with heat recovery is increasingly used in new buildings and deep renovations to meet EP limits and provide good indoor comfort.
Use of low-polluting materials	<input type="checkbox"/> new <input type="checkbox"/> renov.	In Poland, there is no explicit WT2021 requirement for measurement or certification of indoor air pollutant levels at handover. The actual indoor air quality measurement before occupancy is not mandatory and is typically done only in high-standard or certified buildings



5.2.8. Mobility

Sustainability indicator	Building status	Feedback
Recharging points for e-vehicles	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	In Poland, the installation of recharging points for electric vehicles is already partially regulated for new and substantially renovated buildings. For non-residential buildings with parking lots of more than 10 spaces, at least one charging point and infrastructure enabling installation of additional points must be provided at the construction or major renovation stage. For residential buildings with more than 10 spaces, pre-cabling infrastructure must also be installed.
Parking spaces for bicycles	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	In Poland, bicycle parking spaces are increasingly required in both new and renovated buildings, though the obligation stems primarily from local spatial development plans (MPZP) rather than national WT2021 regulations.

5.2.9. Site and biodiversity

Sustainability indicator	Building status	Feedback
Green and open space factor (GFF)	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	In Poland, there is no unified national regulation explicitly defining a Green and Open Space Factor (GFF), nor is such a calculation method mandated by WT2021 or EPC procedures. However, ensuring a minimum share of biologically active area is mandatory in both new buildings and buildings undergoing major renovations, as per WT2021 and is verified during the building permit process.
Microclimate analysis	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	Metric not applicable in Poland

5.2.10. Cost and value

Sustainability indicator	Building status	Feedback
Life Cycle Cost calculation and optimisation (LCC)	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	In Poland, Life Cycle Cost (LCC) calculations are not required by WT2021, EPC procedures, or building law, either for new buildings or for buildings undergoing deep renovation. LCC remains a voluntary analytical tool, used mainly in high-profile projects, public procurement (in rare cases), or buildings targeting voluntary sustainability certifications (such as BREEAM), where it is encouraged as good practice.



5.2.11. Management

Sustainability indicator	Building status	Feedback
Inspection and maintenance of heating and air conditioning systems	<input checked="" type="checkbox"/> new <input checked="" type="checkbox"/> renov.	In Poland, regular inspection and maintenance of HVAC systems is mandatory under several legal acts and is crucial to ensure energy efficiency, comfort, and safety in both new buildings and those after renovation.

5.3. Overall review of the Sustainable Building Methodology

The Sustainable Building Methodology (SBM) provides a comprehensive and structured framework to assess building performance across multiple dimensions of sustainability. In the Polish context, the application of the methodology is both informative and largely compatible with national building standards, particularly for deep renovation projects and new developments in the public and residential sectors, where compliance with WT2021 and the EPBD directive is already mandatory.

One of the key strengths of SBM lies in its broad set of indicators, covering energy use, emissions, materials, water, health and comfort, adaptability, and more. This wide scope enables a holistic view of sustainability and aligns well with Poland's national priorities: improving energy efficiency, reducing greenhouse gas emissions, conserving resources, and supporting adaptation to climate change. The methodology also facilitates alignment with internationally recognized certification systems commonly applied in Poland, such as BREEAM, LEED by integrating familiar and measurable indicators (e.g., primary energy [EP], daylight factor, embodied carbon (GWP), and airtightness).

In terms of usability, the methodology is relatively easy to implement, especially for indicators that are already standardized and routinely calculated in Poland, such as energy performance metrics derived from EPC software, U-values from WT2021, or daylight factor from Polish norms. The clear structure and logical categorization of indicators support effective communication between designers, investors, and public authorities, facilitating informed decision-making and project planning.

Nevertheless, certain challenges remain in areas that are not yet fully standardized or widely practiced in Poland. These include climate risk and adaptation assessments, greywater reuse, biodiversity enhancement beyond statutory biologically active area requirements, and sustainable drainage systems. While technically relevant, these topics are not currently embedded in Polish building codes or mandatory certifications and therefore require additional qualitative analysis or voluntary commitments when applying the methodology.

Furthermore, some advanced technical indicators – such as the Smart Readiness Indicator (SRI) or thermal and electrical storage capacity – are conceptually valuable but are not yet part of WT2021 or scored in mainstream certifications, limiting their immediate applicability. However, these indicators align with future trends in sustainable construction and are likely to gain importance as Polish and EU-level frameworks evolve.

In summary, the Sustainable Building Methodology is a robust and valuable tool for evaluating building performance in Poland. It is particularly effective for identifying priorities in renovation projects, benchmarking sustainability measures, and supporting the integration of innovative performance features. While minor gaps remain due to areas not yet fully standardized in national practice, the methodology provides strong support for achieving both current regulatory compliance and emerging sustainability objectives in line with WT2021 and the EPBD.



C. Conclusion

The implementation and testing of the Sustainable Building Methodology (SBM) across Austria, Croatia, Germany, Italy and Poland have yielded important insights into the feasibility, adaptability, and effectiveness of the proposed framework. While the methodology proved to be broadly applicable and aligned with EU policy goals, the pilot testing also revealed national-specific gaps, challenges, and opportunities for improvement.

Austria's implementation highlighted that many SBM indicators are already embedded in national certification systems such as klimaaktiv and ÖGNB. Indicators related to energy performance, indoor comfort (e.g., daylight factor, thermal comfort), and materials (e.g., Eco-index OI3) were found to be fully compatible. Moreover, the SBM layout and categorization proved to have a good handling during the testing. However, Austria identified several indicators as underutilized or impractical within the current certification framework. These were either not included in the current national schemes or rarely used in practice even though they are valuable in the evaluation. This showed room for further development of the Austrian certification frameworks.

Croatia's experience demonstrated that the holistic approach of the SBM is very helpful especially combined with the logical and intuitive format. The framework is highly compatible to the national regulations especially for important for core sustainability indicators. Challenges arose with advanced indicators such as life cycle costing (LCC), embodied emissions, and Smart Readiness Indicator (SRI), which are still in early adoption phases in Croatia and not easy to implement without consistent regularities. Here, the SBM showed options for long-term improvement of the national schemes.

Germany tested the SBM with pilot buildings undergoing DGNB certification offering a rich dataset for testing. The indicators related to life-cycle GWP, building LCA, thermal comfort, daylight, and indoor air quality monitoring were all deemed highly relevant and technically feasible. German stakeholders particularly valued the SBM's ability to integrate building performance data into broader sustainability goals. Some indicators align well with national laws and guidelines. Although many indicators were technically valid, the implementation cost was cited as a limiting factor for smaller buildings. As a result, most buildings undergoing an evaluation process in Germany are large buildings owned by big companies.

Italy tested the SBM through the lens of the CasaClima certification system, which already includes many sustainability metrics suggested in the SBM. As all pilots were public buildings, they have to fulfil a strong set of Minimum Environmental Criteria (MEC) by law which is also covered by CasaClima protocols. Using the SBM on those buildings enriched the range of aspects covered by the evaluation. It showed that including the aspects of Cost & Value, Site & Biodiversity and Climate Risk & Adaptation add important information to the building analysis and should be recognized more by the Italian government. Moreover, the flexibility provided through "analogous metrics" have been valuable as they make indicators applicable to more use cases.

In Poland, the SBM was applied to a portfolio of public buildings with varied ages and uses located in several municipalities. The methodology showed to be highly compatible with national building standards and the national climate goals. The holistic approach and effective structure was appreciated during the test phase. However, Polish certification systems (influenced by BREEAM and LEED) typically do not emphasize water efficiency, climate risk assessment, or biodiversity. As such, many indicators in these categories were not routinely evaluated, and their integration into practice was seen as aspirational rather than immediate. Polish stakeholders proposed prioritizing the most impactful and implementable indicators first while gradually introducing more advanced metrics over time.



Overall, the testing phase has confirmed that the Sustainable Building Methodology can be a very relevant tool to support the harmonization of sustainable building assessment in Europe. It enables cross-border comparability, fosters innovation, and strengthens policy coherence.

Across all five participating countries, the broad scope—spanning energy, emissions, materials, water, health and comfort, climate risk & adaptation, adaptability, mobility, site & biodiversity, cost & value and management—was evaluated particularly positive and went far beyond the width of the current national evaluation schemes. Thereby, the SBM facilitated the identification of priority areas for intervention, benchmarking of existing performance, and the integration of both environmental and human-centered design goals. As this broadness seems to be the biggest strength of the SBM, it also poses the most challenges as some indicators cannot be introduced easily and fast into national frameworks. The project partners are though confident that over time, legislation and evolving competences and tools will facilitate the further integration of those aspects.

The iterative development process—grounded in real-world applications—has proven effective in highlighting what works, what needs to be adjusted, and what future priorities should be. Moving forward, continued collaboration between EU-level initiatives, national governments, and local practitioners will be essential to scale the SBM and realize its full potential in driving the decarbonization of the building sector.