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BAUHALPS

D1.3.1 – Set of circularity maturity performing indicators

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Executive summary

This document aims to provide a set of circularity indicators to be used in the circularity assessment tool (described in deliverable D1.3.2 "Conceptualization of the online circularity maturity assessment tool").

It outlines the methodology applied to identify 12 circularity indicators, identified through a desk study that covered different sources on the broader theme of circularity assessment and on sustainability applied to the building sector.

The selection of indicators was also informed by feedback from project partners and stakeholders. This feedback was collected at various stages throughout the work period, through multiple interactions with the partners, who provided valuable insights and a critical review of the proposed indicators. In addition, partners organised local workshops with different stakeholder groups to collect further input on the indicator set.

The document is structured as follows:

- "Introduction and objective", where the context and the aim of the project are described;
- "Methodological approach", where the main sources and the adopted methodology are described;
- "Results", where the outcome of the conducted work is provided (i.e. the indicator set).

Glossary

- **Aesthetic value**: specific kind of value associated with a pleasure felt in connection to how an object or situation appears.
- **By-product**: a substance or object, resulting from a production process, the primary aim of which is not the production of the item, that is not considered waste if it meets the following conditions:
  - further use of the substance or object is certain;
  - the substance or object can be used directly without any further processing other than normal industrial practice;
  - the substance or object is produced as an integral part of a production process; and
  - further use is lawful, i.e. the substance or object fulfils all relevant product, environmental and health protection requirements for the specific use and will not lead to overall adverse environmental or human health impacts.

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- **Carbon footprint (of a product)**: sum of GHG emissions and GHG removals in a product system, expressed as CO_2 equivalents and based on a life cycle assessment using the single impact category of climate change.
- **Circular economy**: economic system that uses a systemic approach to maintain a circular flow of resources, by recovering, retaining or adding to their value, while contributing to sustainable development.
- **Circular procurement**: part of the broader concept of sustainable procurement that encompasses actions at strategic, management and operational levels to embed aspects of circularity into procurement policies and processes.
- **Circularity**: degree of alignment with the principles for a circular economy.
- **Community engagement**: a way of working with traditional, community, civil society, government, and opinion groups and leaders that facilitates their active participation in addressing the issues that affect their lives.
- **Construction and demolition (C&D) waste**: waste generated by construction and demolition of buildings and infrastructure, as well as road planning and maintenance, such as concrete, bricks, wood, glass, metals and plastic.
- **Cultural value**: the definition of value is complex, especially in the field of culture. Assuming that "value" exists only in a relationship and is determined by the encounter of at least two factors (a good/fact and a subject who experiences it), there is no clear and shared boundary on what cultural value is or what cultural impacts are. It is a concept that is often defined by absence, e.g. *everything that is not economic value* (Thorsby), or *everything that is neither economic nor social value* (McCarthy et al.). Holden (2004) has developed a conceptual framework for understanding cultural value through three different, often interdependent, forms: 1) intrinsic value (the unique value of the cultural experience itself, associated with ideas of aesthetics, individual pleasure, and a sense of personal and community identity); 2) instrumental value (linked to the uses of culture for social and economic purposes such as economic development, urban regeneration, or social inclusion in a territory or community); 3) institutional value (which concerns the way in which cultural organisations generate trust and esteem in the public, acting as responsible and accessible entities that create social capital).
- **Deconstruction**: process of selectively and systematically dismantling construction works to reduce the amount of waste created and generate a supply of secondary materials that are suitable for reuse and recycling.

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- **Design for disassembly**: approach to the design of a product or constructed asset that facilitates disassembly at the end of its useful life, in such a way that enables components and parts to be reused, recycled, recovered for energy or, in some other way, diverted from the waste stream.
- **Digital product passport**: structured collection of product-related data across a product's life cycle that is accessible via electronic means through a data carrier.
- **Disposal**: any operation which is not recovery even where the operation has as a secondary consequence the reclamation of substances or energy.
- **Energy recovery**: generation of useful energy through direct and controlled transformation of recovered resources.
- **Environmental impact**: change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects.
- **Life-cycle assessment (LCA)**: compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle.
- **Life-cycle perspective**: consideration of the value aspects relevant to a solution during its life cycle which includes consideration of the relevant environmental, social and economic impacts.
- **Material health**: impact of materials on human well-being and ecological integrity throughout their life cycle. It encompasses the evaluation and optimisation of materials to minimise or eliminate adverse effects on human health and the environment, promoting safer and more sustainable material choices. This involves assessing chemical composition, exposure pathways, and potential hazards associated with material use, aiming to foster a circular economy and reduce environmental burdens.
- **Material recovery**: method of recapturing and reutilising recoverable resources specifically for re-use, refurbishing, remanufacturing, recycling or other methods that add or retain value of a resource.
- **Modular design**: designing products by organising sub-assemblies and components as distinct building blocks (i.e., modules) that can be integrated through configuration to fulfil various customer and engineering requirements.
- **Pre-demolition audit**: preparatory activity with the purpose of (1) collecting and assessing information about the qualities of construction products for re-use, C&D waste materials with the potential for preparing for re-use and recycling as well as other types of C&D waste materials that will be released during the demolition works; and (2) giving general and site-specific recommendations regarding the demolition process. An

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important part of the pre-demolition audit is also the identification of materials containing hazardous substances or mixtures and those that might hinder re-use or recycling.

- **Recycling**: recovery operation by which materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations.
- **Renewable energy**: energy from a renewable resource.
- **Renewable resource**: resource that can be naturally or artificially grown or replenished within a foreseeable time frame by processes found in nature.
- **Resource efficiency**: sustainable resource use, seeking to minimise impacts on the environment.
- **Re-use**: use of a product or its component parts after their initial use, for the same purpose for which they were originally designed.
- **Secondary (recovered) material (resource)**: resource or material that is obtained from one that has already been processed or used.
- **Sense of belonging**: cultural motivation that drives human collaboration in creative efforts, closely tied to the establishment and development of settlements in specific places that have profound meaning and significance.
- **Social inclusion**: process that ensures citizens have the opportunities and resources necessary to participate fully in economic, social and cultural life and to enjoy a standard of living and well-being that is considered normal in the society in which they live. It encompasses, but is not restricted to, social integration or better access to the labour market, and also includes equal access to facilities, services and benefits.
- **Traceability**: tracking and documentation of the movement and management of (waste) materials. To ensure compliance with rules and encourage transparency, it requires tracking information about origin, transit, treatment, and final disposal.
- **Virgin resource**: material resource or energy that is used as a resource for the first time as input in a process or for creating a solution.
- **Waste**: any substance or object that the holder discards or intends or is required to discard.
- **Waste prevention**: measures taken before a substance, material or product has become waste, that reduce:

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    - the quantity of waste, including through re-use of products or the extension of the life span of products;
    - the adverse impacts of the generated waste on the environment and human health; or
    - the content of hazardous substances in materials and products.
- **Water use**: water services (providing (1) abstraction, impoundment, storage, treatment and distribution of surface water and groundwater; and (2) waste-water collection and treatment facilities which subsequently discharge into surface water) together with any other activity having a significant impact on the status of water.

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Introduction and objective

This section outlines the process initiated by the present document, which establishes the foundation for selecting the circularity indicators as a prerequisite for the development of the assessment tool. The sequence of activities characterising Activity 1.3 - including desk research, thematic workshops, and local workshops - is illustrated in Figure 1. Subsequently, the main outputs of Activity 1.3 are positioned within the overall framework (Figure 2) and linked to the other activities within WP1 (particularly activities A1.1, A1.2, and A1.4), as well as those of WP2 (notably A2.1 and A2.2).

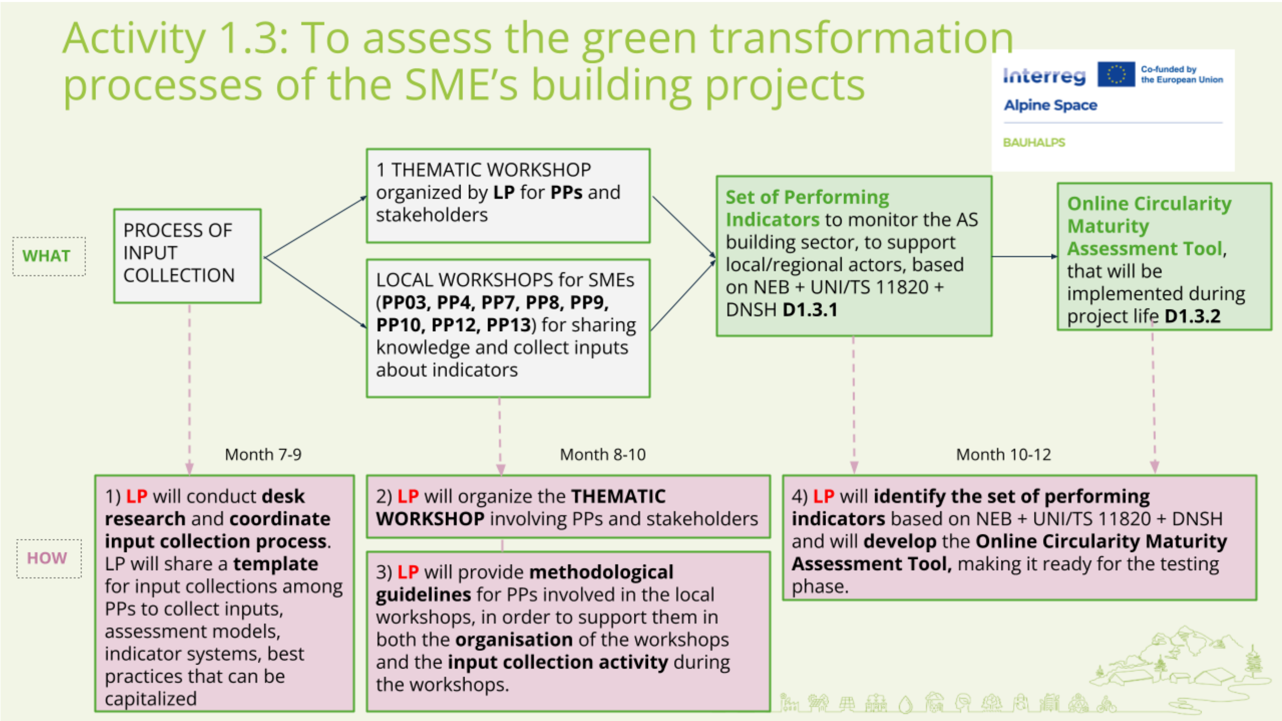

Figure SEQ Figure * ARABIC 1

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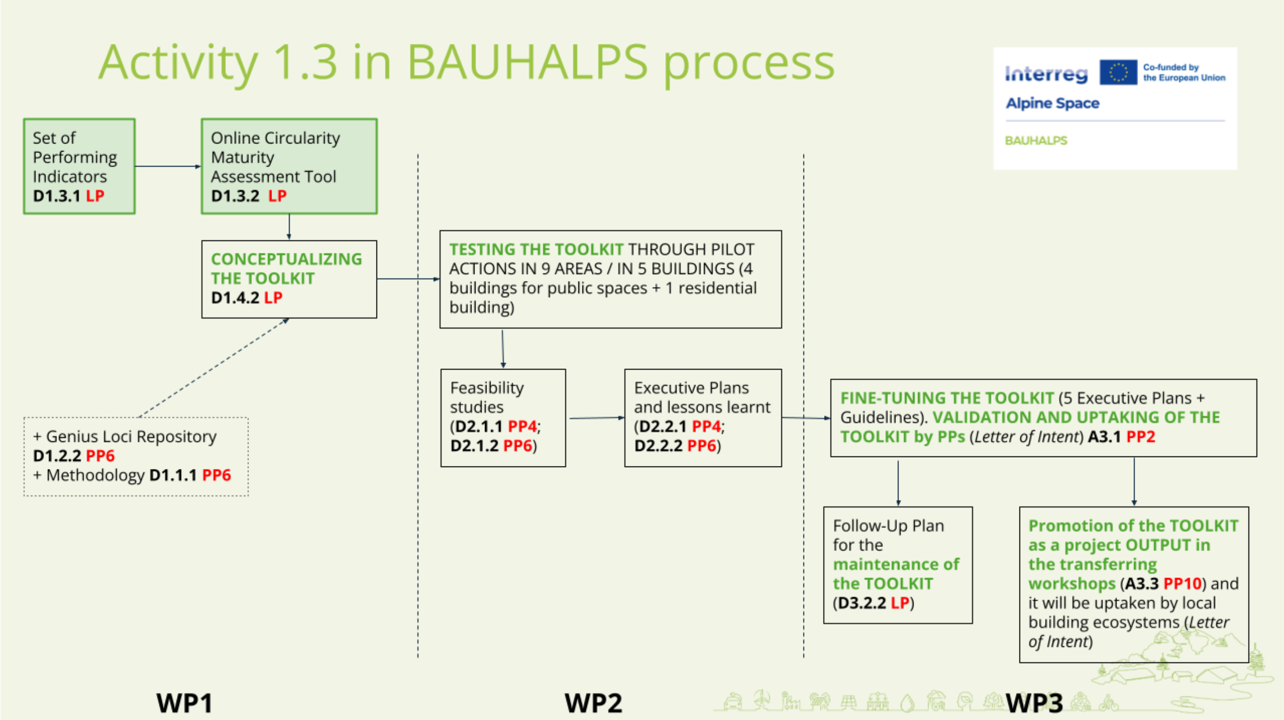

Figure SEQ Figure * ARABIC 2

The assessment tool (D1.3.2), developed on the basis of the set of circularity indicators identified in D1.3.1, represents one of the three core components of the "Toolkit" (D1.4.2). The other two components are the "Methodology to engage local communities in the building transformation" (D1.1.1) and the "*Genius Loci* Online Repository" (D1.2.2). Conceptualised within WP1, the Toolkit will be tested in the pilot actions of WP2, specifically across nine worksites in nine cooperation areas, comprising both residential buildings and buildings with a public function (A2.1, A2.2).

Within WP3, the Toolkit will undergo fine-tuning, validation, and adoption by project partners (A3.1). A follow-up plan for its maintenance will be developed (D3.2.2), and the Toolkit will be promoted as a key project output through transfer activities, thereby supporting its uptake by local building ecosystems (A3.3).

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Methodological approach

The methodological approach for identifying the circularity indicators is aimed at investigating circularity aspects related to the NEB principle of sustainability. For this purpose, a set of indicators is constructed from the currently existing sector specific tools, guidelines, standards, and certifications. In particular the following sources were assessed, based on the provisions of the Application Form: the NEB self-assessment tool and method - which is the most recent tool for the NEB project assessment - the ISO 59020:2024 and UNI/TS 11820:2024 standards, and the DNSH principle operational guidelines. In the following section, a brief description of each reference document is provided.

New European Bauhaus self-assessment tool and method

The New European Bauhaus (NEB) self-assessment tool and method represent the most recent and updated reference (published in October 2024) for assessing and evaluating where a project or activity stands in relation to the NEB dimensions. As described in the official website (new-european-bauhaus.europa.eu) the NEB Self-Assessment method is defined as "a groundbreaking, multidisciplinary, comprehensive and synergistic approach for the evaluation of projects and activities under the NEB values, principles and ambitions". The tool comprises a set of harmonised measurable criteria (i.e. key performance indicators) with specific thresholds, meant to quantify the quality of a project according to specific dimension assessment targets.

The self-assessment method[1] is structured hierarchically to provide feedback with three interconnected assessment levels: indicator, key performance indicator, and dimension. Specifically, the method defines three spatial scales (building, neighbourhood, and urban) and delineates two project types (new construction and renovation activities), and two main uses (residential and non-residential).

The Handbook[2] provides a complete guide to the NEB self-assessment method, designed to promote the three NEB dimensions, namely sustainability, beauty, and inclusiveness, in the built environment of Europe and beyond.

The online tool[3] is seen as the basis to establish a dialogue between all involved stakeholders, and the grounds for defining minimum performance levels within the NEB framework.

As mentioned, the NEB self-assessment method:

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- defines three spatial scales (building, neighbourhood, and urban), delineates two project types (new build and renovation), and two main uses (residential and non-residential) (Table 1);
- defines KPI and indicators for the NEB principles of sustainability (Table 2), togetherness (Table 3), and beauty (Table 4).

Table 1

SCALE	TYPE	MAIN USE
BUILDING / NEIGHBOURHOOD / URBAN	NEW BUILD / RENOVATION	RESIDENTIAL / NON-RESIDENTIAL

Table 2

KPI	INDICATORS
Minimise the use of fossil fuels in the built environment	Primary energy demand; Electricity peak demand; Smart readiness; Smart energy meters
Maximise the use of sustainable energy in the built environment	Share of renewables; Energy storage
Minimise greenhouse gas emissions from the built environment	Operational GHG emissions; Embodied GHG emissions; Carbon sequestration
Enhance sustainable mobility in the built environment	e-Mobility: electric vehicle (EV) parking; Alternative mobility: bicycle; Public transportation systems: extend; Public transportation systems: usage; Public transportation systems: accessibility;
Minimise non-energy related environmental impacts to air and water	Indoor air quality; Water consumption; Ground water recharge: permeability

[1] The method is available at the link: https://new-european-bauhaus.europa.eu/tools-and-resources/neb-self-assessment-method_en
[2] The handbook is available at the link:https://publications.jrc.ec.europa.eu/repository/handle/JRC139118
[3] The online tool is available at the link: https://knowledge-management.new-european-bauhaus.europa.eu/neb_selfassessment_method

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Minimise non-energy related environmental impacts from the built environment	Construction and demolition waste
Achieve the best possible greening of the public sector in terms of its economic involvement in sustainability of the built environment	Social return of investment; Degree of interdisciplinary integration; Gross value added to local economy from new business creation
Achieve the best possible greening of the private and financial sector in terms of its economic involvement in sustainability of the built environment	Green financial tools; Compliance with ESG standards and European Sustainability Reporting Standards for green transition investment from private companies
Promote circular economy in the built environment	Secondary, bio- based, recycled materials

Table 3

KPI	INDICATORS
Funding and land value	Main funding channels; Purpose of the land
Affordability	Criteria for allocation of housing units; De-commodification of the housing stock; Affordable adoption of high-quality housing conditions; Affordable access to services and amenities
Inclusive quality, equality and accessibility	Available dwelling space for households; Maintaining the quality of spaces and services; Rental scheme; Homeownership scheme; Pedestrian accessibility to essential services and amenities; Accessibility to services and amenities by public transport; Pedestrian accessibility to public transport
Rent regulation	Rental contracts; Rents setting
Impacts on neighbourhood social cohesion	Housing typology mix; Prevention of segregation at the micro-scale; Prevention of gentrification and displacement; Outreach activities for project-related social and cultural services

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Needs and resources for social accessibility	Active accessibility needs in the project strategy; Mapping of assets and resources; Diversification of activities in response to local needs
Needs of vulnerable and marginalised groups	Acknowledgement of cultural and social barriers to accessibility; Local support networks and trained social workers; Needs of vulnerable and marginalised groups covered by activities
Anti- discrimination initiatives	Anti-discriminatory action; Monitoring plan of safety and non-discrimination conditions
Involvement of stakeholders	Involvement of local stakeholders in project meetings; Involvement of public and private sector stakeholders in project meetings; Contribution of local civil society stakeholders to project design; Contribution of public and private sector stakeholders to project design; Diversity and representativeness of the stakeholders in project design; Contribution of stakeholders from vulnerable groups to project design; Project budget allocated to engagement events

Table 4

KPI	**INDICATORS**
Digitalisation in construction	Collaboration and information sharing; Pre-manufacturing and automation
Quality of design and delivery	Competencies of design team and contractors; Responsible material sourcing; Compliance with material efficiency opportunities
Improving building resilience to extreme events	Hazard characterisation; Hazard resilient design; Consequence mitigation
Ensuring occupant health, comfort and wellbeing	Indoor acoustic environment; Lighting environment; Thermal comfort; Promotion of physical movement
Improving accessibility of the built environment for everyone	Ease of circulation; Safe wayfinding; Usability and operation
Maximising durability and service life	Durability; Design for adaptability; Design for deconstruction

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Ensuring high level of aesthetic acceptance of buildings and spaces	Visual experience of architecture and space; Multisensory experience of architecture and space
Providing spatial coherence in planning and design	Spatial coherence and urban cohesion; Re-use of spaces and buildings; Green urban areas
Improving preservation of cultural and natural heritage	Historical fabric preservation; Integrated heritage landscape conservation; Improving preservation of cultural and natural heritage in renovated buildings
Maintaining genius loci and improving sense of belonging	Sense of place harmony
Understanding aesthetic perception of buildings and spaces through comparison to actual styles and tendencies in art and architecture	Cognitive experience

ISO 59020:2024 standard

This standard provides a structured framework of environmental, social, and economic indicators to assess the circularity performance of a selected system. The results of this assessment are intended to support the transition towards a circular economy. The methodology can be applied across different levels of the economic system, including regional, inter-organisational, organisational, and product levels. The framework also draws on inputs from a range of complementary methods (e.g. life-cycle assessment and material flow analysis). The framework comprises three main steps:

1. *Boundary setting,* which involves defining the system under consideration, identifying the circularity aspects to be measured, establishing data quality requirements, and pre-selecting complementary assessment methods.
2. *Data acquisition*, during which general circularity indicators are used for data collection. These can also serve as a basis for developing more detailed, sector-specific measurement approaches, where needed.
3. *Circularity assessment and reporting,* in which the results of the measurement are consolidated into a comprehensive statement outlining the circular outcomes of the examined system.

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The standard provides a set of core circularity indicators, grouped into five categories: resource inflow, resource outflow, energy, water, and economic. These core indicators may be complemented with additional indicators derived from other methods, to align with the specific goals and the scope of the circularity measurement and assessment.

UNI/TS 11820:2024 standard

The standard defines a set of indicators designed to assess circularity performance at both the micro level (i.e. individual organisation) and the meso level (i.e. inter-organisational networks, industrial clusters, supply chains, etc.). The assessment methodology is based on a 100-point rating system that integrates environmental, economic, and social dimensions.

The circularity indicators, which form the core basis for data acquisition, are grouped into six categories:

1. material resources and components;
2. energy and water resources;
3. waste and emissions;
4. logistics;
5. product/service;
6. human resources, assets, policies, and sustainability.

The indicators are further classified according to their applicability (indicators related to goods, services, or both) and by type (core, specific, and rewarding indicators). Each indicator is calculated using a ratio, producing a normalised circularity index value ranging from 0 to 1.
The preliminary steps of the assessment include defining the system boundaries, establishing data quality requirements, and selecting the type of assessment along with the corresponding indicator set. Following data collection and indicator evaluation, circularity performance scores can be calculated for each indicator category. The results are typically visualised using a radar chart encompassing all six categories.

DNSH principle operational guidelines

All measures under the “National Recovery and Resilience Plans” (NRRPs) must comply with the *Do No Significant Harm* (DNSH) principle, ensuring that no measure causes significant harm to the six environmental objectives identified in the European Green Deal:

1. mitigation of climate change;
2. adaptation to climate change;
3. sustainable use and protection of water and marine resources;

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4. transition to a circular economy, reduction and recycling of waste;
5. prevention and reduction of air, water or soil pollution;
6. protection and restoration of biodiversity and ecosystem health.

DNSH compliance is verified *ex-ante* for each measure through standardised self-assessment sheets, which provide specific guidance to minimise environmental impacts. These assessments, supported by the EU Taxonomy criteria, guide the implementation and monitoring of measures throughout their lifecycle. Within the 29 taxonomy clusters defined for DNSH assessments, two are particularly relevant to this project: "Construction of new buildings" and "Renovation and rehabilitation of residential and non-residential buildings". The *Operational Guidelines for Compliance with the DNSH Principle* provide technical sheets and checklists that summarise regulatory references, DNSH requirements, and verification elements for both *ex-ante* and *ex-post* assessment. Each technical sheet includes:

- Reference NACE code (where applicable);
- Scope and exclusions;
- Guiding principles;
- DNSH constraints with verification elements;
- Rationale for the constraints;
- Relevant EU and national regulations.

DNSH has not been further considered as a primary reference in this work, since explicit references to circular economy elements within it are limited and already well covered by other, more specific sources (as suggested by project partners, particularly certification schemes). By adhering to these sources, it can be assumed that DNSH compliance is inherently addressed with respect to circularity aspects.

Co-designing the indicator framework

The two phases of the co-design process

The co-design process for developing the set of indicators, conducted by LP-FCF, with partners and experts took place in two phases:

- **Phase 1 (April-July 2025):** activity of desk research & input collection by partners led to an initial proposal for a set of indicators, which was presented during the partner meeting in Nuremberg (16-17 July 2025)
- **Phase 2 (July-October 2025):** the proposal for a set of indicators was discussed at the transnational level, during the Thematic Workshop (July 24, 2025) and then, at the local

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level, throughout n. 7 local activities (workshops, bilateral meetings) conducted by n. 7 project partners in their territories. The input collected during these transnational and local workshops (with the involvement of almost n. 60 experts) was incorporated into the proposal and led to the definition of the set of indicators.

Table 5

A) THEMATIC WORKSHOP, online, 24 July, 2025
n. 32 participants: n. 20 representatives of BAUHALPS partners; n. 12 stakeholders (experts, professional, institutions, invited by project partners): - MR Energy, - Venetian Green Building Cluster, Green Building Council Italia; - CEREMA/DTerCE/DRIM/ECM; - Auvergne-Rhône-Alpes Energy Environment; - Engineering department, Trento University; - CSTB - The Scientific and Technical Center for Construction; - Venicepromex; - Parco Scientifico Galileo (Padova IT); - Padova Hall; - architects, NEB professionals

Table 6

B) LOCAL WORKSHOPS CONDUCTED BY 7 PARTNERS			
PARTNER	**Methodology adopted (workshop / bilateral meetings)**	**Number of stakeholders involved**	**Stakeholders**
PP3 Habitech	6 Bilateral Meetings	12	CasaClima - KlimaHouse; FEM - Fondazione Edmund Mach; LFE - Living Future Europe; EURAC Research; APRIE - Provincial Energy and Water Agency; HIT- Hub Innovazione Trentino

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PP4 Innovation Salzburg	5 Bilateral Meetings	6	Holzcluster Salzburg; Deisl-Beton GmbH; Fachhochschule Salzburg; BOKU University; Salzburg Wohnbau; Meiberger Holzbau
PP07 Wood Forum Allgau	5 Bilateral Meetings	5	Ingenieurbüro Rupp; ARchitekturforum Allgäu e.V.; Vier Gestalten / Innenarchitekt; ProHolz Tirol
PP09 TENERRDIS	Workshop	7	Ecole d'Architecture de Lyon; ENTPE; Ville de Montélimar; Ville de Belleville en beaujolais; Vicat; Almatere; Cycle Up
PP10 TPLJ	Workshop	10	ETRI skupina; ZAG; FSC; CoGreen Ltd; Experts on circular economy; GZS Architects; Non Tox Unikum; Georudeko Ltd
PP12 CCIAA PD	Workshop	5	ANCE; UCID; Parco Etnografico di Rubano; Confindustria Veneto Est; ASVESS
PP13 HSLU	1 Bilateral Meeting	1	Lucerne School of Design, Film and Art

<u>The process of co-design</u>

The working group deemed it necessary to complement the initial desk study (conducted using the previously mentioned sources) with additional, sector-specific references focusing on the built environment. In order to identify well-established sustainability and circularity assessment methodologies already applied within the construction sector, the support of project partners was solicited. Following a brief introduction to the existing reference sources, partners were provided with a structured data collection document comprising four main sections:

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1. NEB indicators: partners were invited to provide input on potential elements and indicators considered relevant to enhance the three NEB criteria of sustainability, togetherness, and beauty;
2. methodological approach: partners were asked to comment on the work presented on the proposed framework for the operationalisation of the indicators, and on the conceptual structure of the circularity assessment;
3. data sources: partners were requested to suggest additional datasets or references to enrich the desk study;
4. other feedback: an open section was made available for further remarks, observations, or recommendations.

Upon receiving the completed data collection documents from the partners, additional relevant sources were identified and incorporated into the desk study. These include a set of internationally recognised frameworks and strategic documents aimed at supporting the transition to a more sustainable and circular built environment. The newly integrated references are briefly outlined below:

- *Circular Built Environment Playbook*: developed by the World Green Building Council, it provides practical strategies and policy recommendations to embed circularity principles in the construction sector;
- *Level(s) Framework*: a common European framework for sustainable buildings, offering a harmonised set of indicators to assess and report on environmental performance;
- *Davos Baukultur Quality System*: a qualitative framework emphasising cultural, social and aesthetic dimensions of the built environment, with a strong focus on quality and inclusiveness;
- *BREEAM Circularity Strategy*: a strategic component of the BREEAM certification system, supporting the integration of circular economy principles into building design, construction and operation.

These sources have been selected for their technical robustness, international recognition, and relevance to the evaluation of circularity and sustainability in the construction sector. Together, they provide a solid basis for refining the methodological approach and strengthening the indicator framework developed within the project.

A primary use of these bibliographic resources was to provide a foundational framework for applying circular economy principles within the built environment context. Tools and references such as ISO 59020:2024, the Circular Built Environment Playbook, the BREEAM Circularity Strategy, the NEB Compass (specifically for the *sustainability* dimension), the

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Baukultur Quality System, and the Level(s) framework all offer guiding principles, objectives, and overarching ambitions. The working group analysed these sources to identify the principles most widely recognised and most relevant to circular economy practices in the construction sector, extracting key terms and thematic areas. Based on this analysis, three core circular economy principles were established to underpin the project's indicator set, as follows:

- **Efficient and circular resource use**: this principle summarises the commitment to reducing virgin material consumption, optimising resource flows, and turning waste into value - ensuring environmental sustainability and continued resource access for future generations;
- **Restoration of ecosystem health**: this principle emphasises the integration of building practices that actively restore and enhance surrounding ecosystems and biodiversity. It encourages regeneration of natural landscapes, supports carbon storage, and respects planetary boundaries to promote long-term ecological resilience within the built environment;
- **Enhancement of long-term socio-economic value**: this principle highlights how a circular building can generate lasting socio-economic value by supporting long-term use, adaptability to changing needs, and reduced lifecycle costs - contributing to social wellbeing and economic resilience without relying on continuous material input.

The selected indicators have been systematically aligned with these overarching principles through a dedicated correspondence matrix, which is presented in Table 5 to clearly illustrate their relationship and thematic coherence.

Following the selection of the reference sources, which was also informed by the input provided by project partners, the desk study process was initiated. The selected sources were systematically examined through a qualitative review aimed at extracting thematic areas, as well as circularity strategies and actions specifically relevant to the construction sector. The extracted content was then organised in alignment with the key dimensions of circularity previously defined through the guiding principles, leading to the identification of three main thematic areas: **sustainable and circular design**, **materials and resources efficiency**, and **waste management**. By advancing the coding process to a higher level of granularity, the working group identified concrete strategies and actions that can be monitored through the selected indicators. These strategies and actions were mapped against the thematic areas according to the following structure:

- sustainable and circular design
    - design for adaptability, disassembly and deconstruction;

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    - implementation of modularity;
    - material passport integration;
    - adoption of a life-cycle perspective;
- materials and resources efficiency
    - use of low-impact, recycled or recyclable materials;
    - promotion of Near Zero Energy (NZE) buildings;
- waste management
    - waste prevention and reduction.

Building on this initial structure, the working group identified a critical gap concerning the connection between the circularity maturity assessment tool under development and the broader toolkit to which it belongs. This toolkit also comprises a methodology for engaging local communities and the Genius Loci online repository, which are closely linked to the NEB dimension of *togetherness* and *beauty*. However, the circularity assessment tool lacked an explicit interface between the sustainability dimension of NEB and these two complementary dimensions. To address this, the working group aimed to strengthen the focus on the reciprocal relationship between circularity strategies, community engagement, and aesthetic quality, recognising how circular choices can both influence and be influenced by these aspects. As a result, a new thematic area was introduced, along with its corresponding strategies and actions:

- **connection between circularity and NEB criteria**:
    - integrating *beauty* in circular strategies;
    - integrating *togetherness* in circular strategies.

The first iteration of the indicator set was presented and submitted for review by the project partners during the partner meeting held in Nuremberg on 17-18 July 2025. Table 8 provides the list of indicators grouped by actions and strategies, and thematic areas.

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Table 7

Indicators	Circular economy principles		
	Efficient and circular resource use	Restore ecosystems health	Enhancement of long-term socio-economic value
Have demolition contractors or deconstruction experts been appointed as part of the design team? If yes, has the contractor conducted a pre-refurbishment or pre demolition audit?	X		
Does the building design incorporate modular and reconfigurable solutions that allow for adaptability over time?	X		X
To what extent does the project implement tracking systems (e.g. digital material passports) to document the material resources used across the building lifecycle?	X		
Does the project adopt a life-cycle approach (e.g. through LCA) to support circular design and material choices?	X		X
Does the project consider and document the carbon footprint of incoming material resources based on recognised standards?			X
Does the project prioritise the use of by-products, secondary materials, or virgin renewable resources over conventional raw materials?	X		X
Has a net-zero water approach been targeted and adopted?		X	

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Indicators	Circular economy principles		
Have circular performance-based procurement criteria been included in contract specifications?	X	X	
To what extent does the project rely on renewable or recovered energy sources across the different phases of the building's life cycle?	X	X	
To what extent does the project promote the prevention, reuse, and valorisation of C&D waste instead of disposal?	X		
How do circular design choices enhance (or diminish) the aesthetic, cultural, and contextual value of the project, or, conversely, how do these values influence circular design strategies?	X		
How do the adopted circular solutions promote (or hinder) social inclusion, user participation, and a sense of community belonging within the project, or, conversely, how do these social dynamics shape circular strategies?		X	X

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Main thematic area	Strategies and actions	Inspirational indicator	Reference	Indicator	Guiding assessment considerations
Sustainable and circular design	Design for adaptability, disassembly and deconstruction		"Circular-Ready" Built Environment Checklist	Have demolition contractors or deconstruction experts been appointed as part of the design team? If yes, the contractor conducted a pre-refurbishment or pre-demolition audit?	
	Implementation of modularity			Does the building design incorporate modular and reconfigurable solutions that allow for adaptability over time?	Consider if the design facilitates reuse or replacement of parts without invasive intervention. Evaluate the attention given to ease of maintenance and upgrades through modular components. Reflect on the flexibility of the layout and potential for future reconfiguration.
	Material passport integration	Are digital material passports available for all building materials, products and parts?	"Circular-Ready" Built Environment Checklist	To what extent does the project implement tracking systems (e.g. digital material or product passports) to document the material resources used across the building lifecycle?	
		3. Material resources (input) with a tracking system (e.g. product passport) compared to total material resources	UNI/TS 11820:2024UNI/TS 11820:2024		

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Main thematic area	Strategies and actions	Inspirational indicator	Reference	Indicator	Guiding assessment considerations
		(input)			
	Adoption of a life-cycle perspective			Does the project adopt a life-cycle approach (e.g. through LCA) to support circular design and material choices?	Consider whether a life-cycle perspective is integrated into the design and decision-making process (e.g. use of LCA tools or equivalent methods). Evaluate how life-cycle thinking informs the selection of materials, construction techniques, and end-of-life strategies. Reflect on whether trade-offs between environmental impacts across different life cycle stages are assessed and transparently communicated.
Materials and resources efficiency	Use of low-impact, recycled or recyclable materials	22. Carbon footprint of material input resources	UNI/TS 11820:2024	Does the project consider and document the carbon footprint of incoming material resources based on recognised standards?	
		4. By-products and/or secondary material resources and/or virgin renewable material resources (input) compared to total material	UNI/TS 11820:2024	Does the project prioritise the use of by-products, secondary materials, or virgin renewable resources over conventional materials?	

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Main thematic area	Strategies and actions	Inspirational indicator	Reference	Indicator	Guiding assessment considerations
		resources (input)			
			"Circular-Read" Built Environment Checklist	Has a net-zero water approach been targeted and adopted?	
			"Circular-Read" Built Environment Checklist	Have circular performance-based procurement criteria been included in contract specifications?	
	Promotion of Near Zero Energy (NZE) buildings			To what extent does the project rely on renewable or recovered energy sources across the different phases of the building's life cycle?	
Waste management	Waste prevention and reduction	10. Difference between input material resources and residues produced compared to total input material resources	UNI/TS 11820:2024	To what extent does the project promote the prevention, reuse, and valorisation of C&D waste instead of disposal?	Design phase: Does the project integrate renewable or recovered energy systems (e.g. photovoltaics, geothermal, solar thermal, heat recovery) into the building's energy strategy? Construction phase: Are construction site activities powered by renewable energy or energy from recovery
		18a-18b. Municipal/special waste disposed of in relation to total municipal/special waste generated	UNI/TS 11820:2024		
		32. By-products generated in relation to total production residues	UNI/TS 11820:2024		

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Main thematic area	Strategies and actions	Inspirational indicator	Reference	Indicator	Guiding assessment considerations
		generated			processes (e.g. grid-certified green electricity, biofuels, solar-powered equipment)? Operational phase: Is the building's energy demand during use met through renewable sources or recovery systems (e.g. on-site production, green energy contracts, waste heat reuse)?
		Has a zero-to-landfill approach been targeted and adopted across all stages of the building lifecycle?	"Circular-Ready" Built Environment Checklist		
Connection between circularity and NEB criteria	Integrating *beauty* in circular strategies			How do circular design choices enhance (or diminish) the aesthetic, cultural, and contextual value of the project, or, conversely, how do these values influence circular design strategies?	Consider whether the integration of reused, recycled, or low-impact materials contributes to the visual quality, harmony with surroundings, and architectural identity. Evaluate if circular solutions are creatively incorporated to preserve or reinterpret local traditions, materials, or forms. Reflect on any perceived limitations in aesthetic quality due to circular choices (e.g. material irregularities, visual dissonance, or contextual mismatch).

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Main thematic area	Strategies and actions	Inspirational indicator	Reference	Indicator	Guiding assessment considerations
	Integrating *togetherness* in circular strategies			How do the adopted circular solutions promote (or hinder) social inclusion, user participation, and a sense of community belonging within the project, or, conversely, how do these social dynamics shape circular strategies?	Consider how circular practices (e.g. shared use of resources, design for adaptability, participatory reuse strategies) can be leveraged to foster interaction and inclusivity. Evaluate whether the project involves stakeholders or local communities in the design or reuse processes, enhancing shared ownership and belonging. Reflect on any unintended barriers created by circular strategies (e.g. technical complexity, reduced accessibility, or lack of stakeholder engagement).

Table 8

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The following section outlines the additional elements (beyond the thematic areas and the strategies and actions previously described) that constitute Table 8:

- **inspirational indicator**: indicators identified from the reference sources consulted during the desk study. These indicators are associated with the corresponding thematic areas and strategies, and may vary in their relevance to the building sector depending on the origin of the source;
- **reference**: the source information from which each inspirational indicator was derived;
- **indicator**: the proposed circularity indicator developed for inclusion in the BAUHALPS tool;
- **guiding assessment considerations**: explanatory notes designed to support a consistent and informed evaluation process. These are structured around three components: a design and operational appraisal (*Consider…*) focusing on how the indicator is integrated into the project; an analysis of the indicator's influence on project objectives (*Evaluate…*), examining potential benefits and challenges; and a critical, contextual reflection (*Reflect…*), encouraging the assessment of broader implications, trade-offs, limitations, and unintended effects.

Rows in Table 8 that include both an inspirational indicator and its corresponding reference feature a BAUHALPS composite indicator, developed to consolidate and contextualise the key concepts emerging from the inspirational sources. When a reference is provided but no inspirational indicator is listed, the BAUHALPS indicator corresponds directly to the one identified in the reference source. In cases where neither an inspirational indicator nor a reference is available, the BAUHALPS indicator represents a new formulation developed by the working group.

Following the presentation and dissemination of the indicators to project partners, the working group held an online workshop on 24 July 2025. On this occasion, with the support of representatives from Green Building Council Italy and the RIR (Regional Innovative Network) "Venetian Green Building Cluster", the proposed set of circularity indicators was subjected to an interactive review involving all partners and stakeholders (i.e. international experts, institutions from the building sector). Through an online collaboration platform, partners and participants were invited to provide comments, observations, questions, and suggestions at both a general level (covering thematic areas as well as identified actions and strategies) and a specific level (focused on individual indicators). This feedback process was initially guided by a set of prompts developed by the working group to stimulate discussion.

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The workshop feedback highlighted several recurring themes that provide useful guidance for refining the proposed set of indicators. A key point concerns clarity and consistency in definitions and methodology. Partners suggested clarifying the scope of each indicator, including relevant life-cycle stages and the type of evidence expected. Introducing a concise **glossary** for key terms (e.g., "digital passport," "secondary materials," "pre-demolition audit") could help foster a common understanding among stakeholders. Some participants also noted potential **overlaps** between indicators, particularly regarding carbon footprint, net-zero water, and life-cycle assessment, suggesting opportunities to streamline and integrate them for greater coherence. Feedback emphasised the importance of **connecting circularity with NEB principles**. Partners highlighted the value of aesthetics, community engagement, and local context, and suggested ways to better capture these aspects in measurable terms. Participants also proposed considering how design choices and inclusive processes can actively support circular practices throughout the building's life cycle. **Health and well-being** emerged as an additional key consideration. Comments highlighted the need to account for the safety and non-toxicity of materials, both new and reused, as well as the broader impact of building design on occupant health. Integrating these aspects alongside circularity indicators was seen as important for promoting sustainable and safe built environments. **Material traceability and data management** were also emphasised. Partners recommended robust tracking mechanisms, such as material passports and demolition records, and noted that national differences in regulations and data availability may require flexible approaches to ensure comparability. Finally, suggestions pointed to making the tool more user-friendly and adaptable. Introducing tiers of indicators - basic versus advanced or mandatory versus optional - could make the framework accessible for both expert and non-expert stakeholders, while also supporting design decisions, procurement practices, and health considerations.

Overall, the feedback indicates a shared interest in consolidating and clarifying the framework, strengthening methodological consistency, and integrating social, cultural, and health dimensions in a practical way. These insights offered a solid foundation for refining and piloting the indicator set.

The identification of intervention areas based on partner feedback led to the following adjustments to the indicator set:

- a title has been assigned to each indicator;
- indicator descriptions have been revised to improve clarity regarding their objectives and scope;

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- a set of explanatory notes has been added to all indicators, further elaborating on specific topics and providing additional guidance for the assessment process;
- the theme of material health and safety was strengthened through the addition of two new indicators linked to two different strategies;
- indicators related to the building life-cycle perspective were consolidated into a single, overarching indicator;
- the "Guiding assessment considerations" section has been renamed "Assessment guide comments" and now includes the explanatory notes;
- the strategies and actions "Design for adaptability, disassembly, and deconstruction" and "Implementation of modularity" were merged into a single strategy: "Design for adaptability, deconstruction, and modularity";
- the strategy "Material passport integration" was revised to "Monitoring material data and traceability";
- indicators previously beginning with the phrase "To what extent does the project…" were reformulated to remove this introductory wording in their qualitative form;
- guiding assessment considerations have been adopted for all indicators;
- a glossary has been added to this report.

The overall methodology adopted to address the feedback can be summarised as follows:

- feedback from all stakeholders was collected for each indicator;
- the feedback was systematically analysed and rationalised to identify recurring issues and common themes for each indicator;
- the necessary actions to integrate the feedback were identified and, when possible, implemented;
- each indicator was complemented with a title and an updated description;
- finally, explanatory notes were introduced and linked to key terms across all indicators.

Annex I presents a comprehensive overview of the feedback received and the corresponding rationalisation process described above.

Other feedback concerning the structure of the indicator set and the overall assessment framework has been incorporated, with further details on its implementation provided in deliverable D1.3.2.

The following (Table 9) is the list of indicators resulting from the updates described above.

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Table 9

Main thematic area	Strategies and actions	Indicator	Assessment guide comments
Sustainable and circular design	Design for adaptability, deconstruction, and modularity	**Demolition contractor involvement and definition of a construction strategy** Provided there is local availability, has a demolition contractor been involved in the building project to conduct a deconstruction strategy (for new constructions) or a pre-demolition audit (for renovations)?	- A demolition contractor is a specialized professional responsible for planning and carrying out the safe, efficient, and compliant dismantling, removal, or clearance of buildings, structures, or other man-made facilities. - The pre-demolition audit is an activity resulting in the inventory of materials and components arising from the future demolition or renovation projects, and their management and recovery options (European Commission, 2017, EU Guidelines for the Waste Audits).
		Design for modularity, disassembly and adaptability Does the building project embed modular design and/or reconfigurable solutions that allow for disassembly and adaptability over time?	- Modular design (or modularity) refers to designing products by organizing sub-assemblies and components as distinct building blocks (i.e., modules) that can be integrated through configuration to fulfill customer and engineering requirements (Tseng M., Wang Y., Jiao R., 2018. Modular Design). - Reconfigurable solutions encompass three design principles for adaptability:

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			- Versatility, defined as the ability to accommodate different functions with minor system changes; - Convertibility, defined as the ability to accommodate substantial changes in user needs by making modifications; - Expendability, defined as the characteristic of a system to accommodate a substantial change that supports or facilitates the addition of new space, features, capabilities and capacities. - The scope of application of modularity and design for disassembly principles (following a proper examination) spans across five levels: - Systems: adaptable construction works that can change to suit changing requirements. In some cases, entire modular buildings can undergo wholesale disassembly, movement, and re-use; - Elements: major structural part of a construction work (e.g. a roof, foundation, wall); - Component or assembly: combination of several subcomponents that are often non-structural (e.g., valves, solar panels); - Subcomponent: smaller pieces of the components (e.g., the duct system of a heating or cooling system; the glazing used for curtain walls; gaskets in piping systems, or controllers and software in a fire protection system); - Material: basic materials to which a product can be reduced, and that can be re-used or serve as a feedstock in the recycling process to produce other materials.
	Monitoring material data and traceability	**Digital project management and material documentation** Does the building project implement digital tools and systems to support overall project management and the documentation of	- e.g. BIM, COBie, digital twin. Some sustainability benefits resulting from the adoption of digital information models – such as BIM – can be referenced (da Cheng et al., 2024): increasing the decrease in material waste; encouraging green building; improving resource management effectiveness; increasing the effectiveness of the design; encouraging the execution of price and quantity and surveying procedures required for

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		materials and components?	cost estimate; increasing the efficiency of building; supplying an all-inclusive database to facilitate the administration of the construction life cycle; assisting with the information entry, extraction, sharing, and transformation processes for projects; assisting in the seamless transfer of ideas from the design to the implementation, post-design, and maintenance stages. The Digital Product Passport (DPP) for construction products and materials will become mandatory starting in 2026. However, this requirement applies primarily to manufacturers of products and materials, while other economic operators – such as clients, de-installers, users, and national competent authorities – are granted access to the information contained in the DPP. - Required information should cover the origin of products and materials, their composition, and the strategies in place for their end-of-life management. Local sourcing of construction products and materials represents an added value for a building project in line with all NEB principles. It is therefore important to highlight their use, including through an “internal” tracking method capable of demonstrating selected sustainability aspects, as well as their cultural or social value.
		Traceability of health-related material properties Are traceability and documentation systems in place to monitor the health-related characteristics of materials (e.g. toxicity, emissions, contamination risks) over time?	- Health-related characteristics may include, but are not limited to: toxicity, emissions to indoor air, contamination risk, presence of hazardous substances, and potential exposure during use, maintenance, or end-of-use phase. - Different levels of implementation are acceptable, ranging from basic documentation at product level to more advanced systems integrated into digital building or asset management tools.
	Implementation of life-cycle perspective	**Assessment and mitigation of material-related health risks** Does the building project assess and mitigate potential health risks associated with the use of	- Health risks may be assessed at different stages of the building life cycle, including construction, use, maintenance, refurbishment, and end-of-use, depending on the project scope and available information. - For reused materials, particular attention may be given to contamination risks, unknown composition, or degradation over time.

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		materials, both new and reused, throughout the building's life cycle?	- The project should describe the assessment approach adopted and provide supporting evidence, such as risk analyses, technical reports, product documentation, or references to standards and guidelines. - The depth of assessment may vary according to project size, complexity, and regulatory context.
		Integration of life-cycle approach in circular design Does the building project adopt a life-cycle approach - ranging from life-cycle thinking to full LCA studies - to evaluate and optimise its environmental impacts, carbon footprint, water use, and to inform circular design and material choices?	- For broader applicability (particularly for SMEs and micro-enterprises) indications on a qualitative (life cycle thinking) life-cycle approach are acceptable, instead of a full LCA. A life cycle approach is a general method for evaluating the environmental, economic, and social impacts of a process throughout its entire life cycle. - A free and accessible option for performing LCA is OpenLCA. Another useful tool is OneClick LCA, which provides dedicated modules for buildings, manufacturing, and infrastructure. If an LCA or simplified assessment is carried out, used tools, databases and reference standards must be specified. - The indicator should describe how the life cycle approach informed decisions related to: material selection; structural system design; strategies for disassembly or adaptability; durability and scheduled maintenance; extension of useful life and avoidance of premature obsolescence; impact reduction. The extent to which these aspects can be examined depends on the completeness and relevance of the project data.
Materials and resources efficiency	Use of low-impact, recycled or recyclable materials	**Prioritisation of secondary, reused, and low-impact resources** Does the building project prioritise the sustainable use of by-products, secondary materials, reused or upcycled components, or virgin renewable resources over conventional	- Provide evidence that the chosen materials or solutions are genuinely sustainable, including: health and indoor environmental quality; energy performance and environmental impacts across the life cycle; certifications, safety aspects, and healthiness of secondary or waste-derived materials. Report any limitations or cases where a circular choice was not possible or not sustainable, including regulatory or administrative barriers.

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		raw materials, while ensuring their technical suitability for the project?	- If there are any, include references to on-site material reuse, upcycling practices, use of vernacular and traditional materials, and examples of materials substitution that replace conventional solutions with more sustainable alternatives. - Highlight the choice of circular materials or solutions that are compatible with the project's functional, structural, and safety requirements.
		Embedding circularity in contractual tender procedures Have circular performance-based procurement criteria been included in contract specifications?	- The purpose of including circular performance-based procurement criteria is to ensure documentable circular performance through contractual obligations. - Non-exhaustive list of applicable criteria (The Circular City Centre – C3, Circular Public Procurement in Cities, 2025): • Competencies and past experiences: demand proof of past experience with delivering a circular construction project (such as examples of contracts delivered within a given period of time, references, and the CVs of the relevant personnel); • Material inventories and passports: develop an inventory of reusable materials prior to selective demolition; require a pre-demolition audit to be conducted; require a material passport to be used. • Circular material requirements: incorporate a minimum amount (as a percentage or by weight) of: i. recycled materials; ii. secondary raw materials; iii. bio-degradable materials; iv. materials to be recovered for recycling. Install (and verify) low-environmental impact construction materials. Use supply chain management to ensure compliance with building assessment and certification systems and to support modelled resource efficiency strategies; • Circular building certifications: requirement to use Level(s), cradle-to-cradle, EPD, LEED, or BREEAM or equivalent certification;

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			• Use of life cycle assessment considerations: requirements to reduce the embodied impacts and resource use associated with construction materials. Use life cycle assessment (LCA) and similar tools to quantify the impacts; requirements to evaluate the life cycle impacts of the main building elements; • End-of-use requirements: separate material collection for reuse, recycling and recovery in line with the waste hierarchy in Directive 2008/98/EC; segregate recyclable materials and end-of-life products by material type. The contractors shall provide plans of the building showing the space(s) that have been designated for waste segregation and collection; require a minimum percentage by weight of the non-hazardous waste generated during demolition and strip-out works, and excluding excavations and backfilling, to be prepared for reuse and recycling; comply with existing EPR schemes on construction materials; require that construction and demolition waste be treated in accordance with EU legislation and with the full checklist of the EU Construction and Demolition Waste Management Protocol; require that at least 90% for new construction and at least 70% for renovations (by mass in kilograms), excluding backfilling, of the non-hazardous C&D waste generated on construction sites is prepared for reuse or recycling. - This indicator applies primarily to public projects. Private-sector projects may justifiably exclude it. Respondents should explain whether the selected procurement criteria are appropriate to the building's intended function, uses, and technical requirements. Any relevant regulatory, administrative, or market barriers hindering the adoption of circular procurement practices may be reported. Such barriers may justify the non-application of the indicator.
	Implementation of Near Zero Energy (NZE) buildings	**Adoption of renewable energy strategies in the project**	- The indicator is based on a descriptive approach, and its assessment is not linked to a direct measurement demonstrating the achievement of a specific performance level.

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		Does the building project include design choices that contribute to covering the energy demand through sustainable and renewable energy sources?	- The indicator refers to design-stage choices (rather than the broader legislative framework or general energy policy orientation) aimed at optimizing the building's energy demand during its operational phase. In particular, it seeks to highlight energy supply strategies based on sustainable sources. - Some decisions related to energy supply are not under the direct control of the project, since it may be constrained by external factors that limit its ability to introduce more sustainable energy choices. Some examples include: buildings connected to a centralized energy network without the possibility of choosing the energy mix; renovation projects where the integration of renewable sources is not technically feasible; limitations imposed by the urban, infrastructural, or contractual context; lack of expertise, data, or decision-making power on the part of the project team. So, acceptable grounds for excluding this indicator from the assessment set include the project's limited sphere of influence. Acceptable reasons also include the lack of available data sources demonstrating targeted choices aimed at improving the building's energy sustainability. Respondents can also indicate whether the subject of the indicator is already covered by mandatory regulatory requirements; compliance with such requirements does not result in a penalty in the assessment.
Waste management	Waste prevention and reduction	**Circular management of construction and demolition waste** Does the building project allow for the prevention of construction and demolition waste through reuse and other forms of valorisation of the residues from construction activities?	- Waste prevention and valorisation (i.e., the "non-classification" of materials as waste) refers to different life-cycle stages of the building project, from design choices (as part of "circular design") to construction phase activities. Respondents should also identify the roles of different actors involved during the project life cycle, that help in integrating circular practices for waste management. - The term "waste" does not only refer to the materials that are classified as such: it also includes material resources that could potentially be classified as such but, through conscious project decisions, are diverted from disposal with actions of reuse, repurposing, upcycling,

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			reintroduction into new production cycles. The indicator aims to descriptively assess the incorporation of the circular economy principle of Resource Stewardship and does not refer solely to recycling activities. - A (partially) negative assessment of the indicator can be justified based on technical limitations arising from the composite nature of materials generated by construction activities. Respondents should report time, budget, or know-how constraints related to the implementation of actions for the recovery/reuse of material resources that would otherwise be classified as waste. It is possible to refer to LCA and/or material inventories to obtain the necessary information to support the assessment of the indicator.
Connection between circularity and NEB criteria	Integrating beauty in circular strategies	**Circular design effects on aesthetic and cultural qualities** Do circular design choices influence - positively or negatively - the aesthetic, cultural, and contextual qualities of the building project? How, conversely, do these values influence circular design strategies? Is there evidence of any meaningful interaction between circularity and architectural or cultural expression?	- Circular choices may have positive effects, such as: highlight visible reuse, repair, or material layering as an aesthetic language; support cultural continuity through local and traditional materials; enhance place identity through adaptive reuse or heritage conservation; introduce new aesthetic expressions linked to circularity. The major positive contribution of circular practices to aesthetic and cultural quality was identified as support for local procurement, and this was made explicit in the quantitative assessment. - Circular choices may also introduce negative effects, such as: undesired changes in the aesthetic character of the project; lack of architectural harmony; visual decontextualization; lack of landscape harmony. - The indicator should reflect on the interaction between circular choices and: alignment with local identity, materials, and construction culture; perceived quality and sensory experience (visual, tactile, spatial); architectural coherence, contextual integration, and landscape harmony; user experience, cognitive/sensory qualities, and emotional perception; preservation, enhancement, or reinterpretation of heritage elements. - The indicator does not evaluate aesthetic or cultural quality in general. It

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			focuses on whether circular strategies: support aesthetic or cultural value; alter or challenge these values; have no direct relation. A positive outcome does not require to improve aesthetics; it only requires a clear and reasoned reflection on their interaction.
	Integrating togetherness in circular strategies	**Circular design effects on community value and participation** Do circular design choices influence - positively or negatively - social inclusion, user participation, and a sense of community belonging within the project? How, conversely, do these values influence circular design strategies? Is there evidence of any meaningful interaction between circularity and local community participation and involvement?	- Include potential indirect effects of circular strategies, e.g.: local employment, collaboration with cooperatives, exchange/reuse platforms, social networking – preferably supported by concrete examples. - The accessibility of the building can be influenced by circular design choices (e.g. use of recycled, reused, or refurbished resources and materials). This aspect falls under the “Inclusiveness” criteria of the NEB. - When assessing the indicator, consider topics such as: user participation, community benefits, inclusiveness, post-occupancy accessibility. If participation processes are present, describe their quality by clarifying who was involved, how they were involved, and what outcomes were achieved. - Specify the project’s intentions and expected outcomes related to social inclusion and participation, and describe any unexpected developments that emerged during the process.

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Results

The following section provides an explanation of the circularity indicators included in the final set presented in Table 8.

Demolition contractor involvement and definition of a construction strategy *Provided there is local availability, has a demolition contractor been involved in the building project to conduct a deconstruction strategy (for new constructions) or a pre-demolition audit (for renovations)?*	This indicator reflects how effectively a project anticipates end-of-life scenarios, coordinates stakeholders, and preserves material value, aligning demolition and refurbishment processes with circular economy principles. By involving specialised contractors from the outset, projects can conduct pre-demolition audits, identify reusable components, and plan selective dismantling.
Design intent for modularity, disassembly and adaptability *Does the building project embed modular design and/or reconfigurable solutions that allow for disassembly and adaptability over time?*	This indicator investigates how well the design anticipates future uncertainties, extending the building's lifespan and aligning it with circularity and sustainability objectives. Modular and flexible design supports maintenance, upgrades, and functional changes without major structural interventions, while allowing components to be replaced, reused, or relocated efficiently.
Digital project management and material documentation *Does the building project implement digital tools and systems to support overall project management and the documentation of materials and components?*	This indicator assesses both the degree of adoption and the quality of tracking systems, evaluating how comprehensively materials are tracked and how effectively the data inform procurement, maintenance, and recovery strategies to support data-driven circularity. These systems enhance transparency and traceability, enabling informed decisions on material sourcing reuse, and end-of-life management. Material passports - ideally provided by manufacturers - record essential information on product composition, origin, performance, and reuse potential.

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Traceability of health-related material properties *Are traceability and documentation systems in place to monitor the health-related characteristics of materials (e.g. toxicity, emissions, contamination risks) over time?*	This indicator assesses whether traceability and documentation systems are in place to record and monitor the health-related characteristics of materials - such as toxicity, emissions, and contamination risks - throughout the building's life cycle. These systems help ensure a healthy indoor and outdoor environment by supporting informed decisions on material maintenance, reuse, or replacement. The indicator also reflects the project's ability to provide reliable, long-term data that comply with health standards and regulations, strengthening the link between circularity and human well-being.
Assessment and mitigation of material-related health risks *Does the project assess and mitigate potential health risks associated with the use of materials, both new and reused, throughout the building's life cycle?*	This indicator evaluates whether the project identifies and mitigates potential health risks related to the use of both new and reused materials across the building's life cycle. It considers how material selection, design, and maintenance practices prevent exposure to harmful substances, ensuring safe indoor environments and compliance with health regulations. The indicator reflects a proactive approach to integrating health protection within circular design and material management.
Integration of life-cycle approach in circular design *Does the building project adopt a life-cycle approach - ranging from life-cycle thinking to full LCA studies - to evaluate and optimise its environmental impacts, carbon footprint, water use, and to inform circular design and material choices?*	This indicator examines how life-cycle thinking informs decisions on material selection, carbon footprint reduction, and water efficiency, ensuring that environmental trade-offs are transparently addressed. The indicator reflects the project's commitment to holistic and evidence-based design strategies that enhance circularity and sustainability performance.
Prioritisation of secondary, reused, and	This indicator reflects the project's capacity

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low-impact resources *Does the building project prioritise the sustainable use of by-products, secondary materials, reused or upcycled components, or virgin renewable resources over conventional raw materials, while ensuring their technical suitability for the project?*	to reduce dependence on finite resources and promote circular material flows. By considering the proportion of alternative material inputs compared to total resources used, the indicator highlights how material selection supports waste reduction, resource efficiency, and the transition toward a regenerative construction model.
Embedding circularity in contractual and tender procedures *Have circular performance-based procurement criteria been included in contract specifications?*	This indicator assesses whether support to circularity has been integrated into project procurement. It reflects the extent to which developers and architects engage early with contractors and manufacturers to embed measurable circular performance criteria in tender and specification documents. Such criteria set specific performance targets related to material and design choices that may include designing for reuse, reducing the use of virgin raw materials by incorporating reused or recycled content, and ensuring material traceability through tools such as material passports. The indicator measures how effectively circular principles are translated into binding procurement requirements, thereby influencing construction practices and material selection.
Adoption of renewable energy strategies in the project *Does the building project include design choices that contribute to covering the energy demand through sustainable and renewable energy sources?*	This indicator evaluates how sustainable and circular energy sources are integrated into the project energy demand. It considers energy used during construction, operation, maintenance, and end-of-life phases, focusing on how renewable or recovered energy replaces or reduces dependence on conventional fossil fuels. It captures both on-site generation (e.g. solar, geothermal, or biomass) and the procurement of renewable energy from external sources, as well as the

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	potential for energy recovery from waste streams or building systems. The indicator reflects how energy choices contribute to lowering environmental impacts, enhancing resource efficiency, and supporting long-term decarbonisation goals.
Circular management of construction and demolition waste *Does the building project allow for the prevention of construction and demolition waste through reuse and other forms of valorisation of the residues from construction activities?*	This indicator reflects the project's capacity to minimise residual material flows and close resource loops by prioritising reuse, recycling, and upcycling strategies. It draws on approaches such as measuring differences between input materials and generated residues, monitoring waste disposal rates, and tracking the share of by-products recovered. Projects targeting a zero-to-landfill strategy demonstrate a commitment to maximising the recovery of products and building components for reuse, in line with contractual requirements and design strategies. The indicator highlights how effective waste prevention and recovery practices can reduce environmental impacts, lower disposal costs, and support broader circular economy goals.
Circular design effects on aesthetic and cultural qualities *Do circular design choices influence - positively or negatively - the aesthetic, cultural, and contextual qualities of the building project? How, conversely, do these values influence circular design strategies? Is there evidence of any meaningful interaction between circularity and architectural or cultural expression?*	This indicator considers how design choices such as the reuse of materials, the integration of low-impact solutions, or the reinterpretation of traditional techniques can enhance architectural identity, visual harmony, and alignment with the surrounding environment. It recognises that cultural and aesthetic values may shape circular strategies, for example by influencing material selection or design approaches to maintain or reinterpret local character. It allows for critical reflection on potential tensions or trade-offs, such as irregularities in reused materials or aesthetic dissonance with the existing context. This

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	indicator highlights how circularity can be both a driver and a recipient of cultural and aesthetic value, reinforcing place identity and contributing to more meaningful and contextually grounded design outcomes.
Circular design effects on community value and participation *Do circular design choices influence - positively or negatively - social inclusion, user participation, and a sense of community belonging within the project? How, conversely, do these values influence circular design strategies? Is there evidence of any meaningful interaction between circularity and local community participation and involvement?*	This indicator focuses on how strategies such as shared resource use, adaptable spaces, or participatory design can enhance social cohesion, empower local stakeholders, and encourage shared ownership of spaces. It acknowledges that social dynamics may influence circular strategies, shaping priorities and implementation methods. The indicator also invites reflection on potential barriers or unintended consequences, such as reduced accessibility, complexity of maintenance, or limited community engagement. It highlights the mutual reinforcement between circularity and social value, emphasising the role of inclusive and participatory approaches in delivering resilient and community-oriented built environments.

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Appendix - Documentation of the co-design process (Thematic Workshop and local workshops)

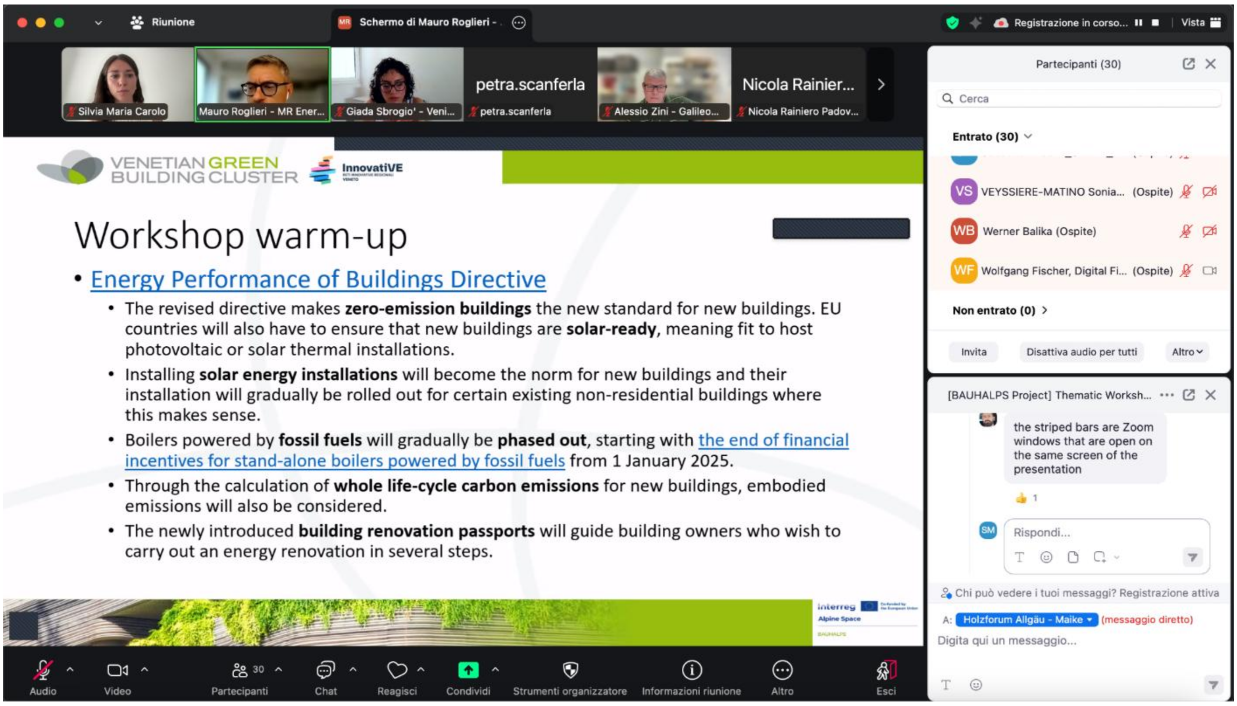

Figure 3. Thematic Workshop, July 24

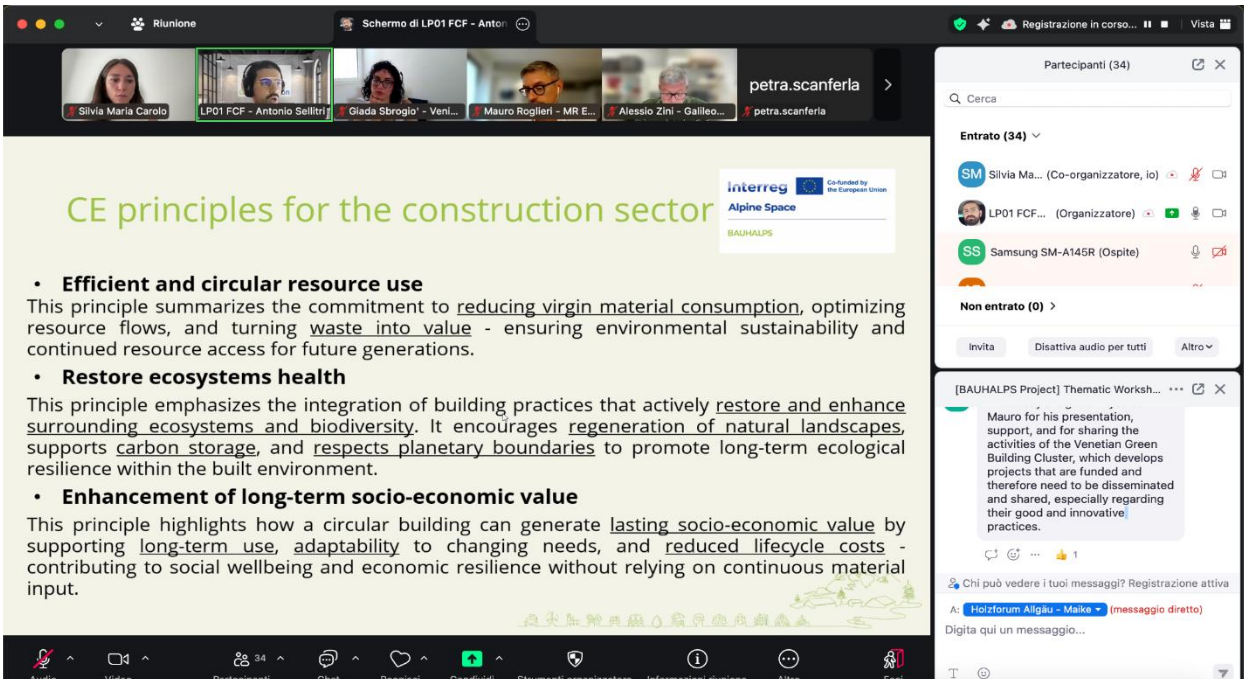

Figure 4. Thematic Workshop, July 24

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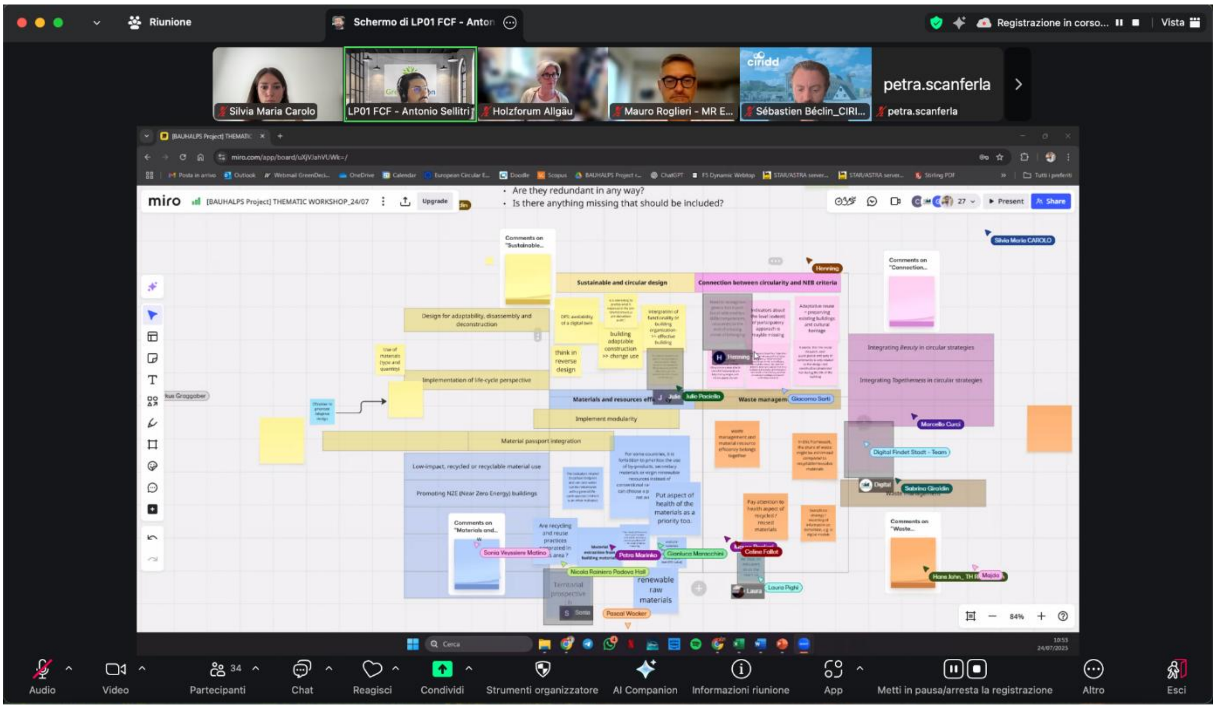

Figure 5. Thematic Workshop, July 24

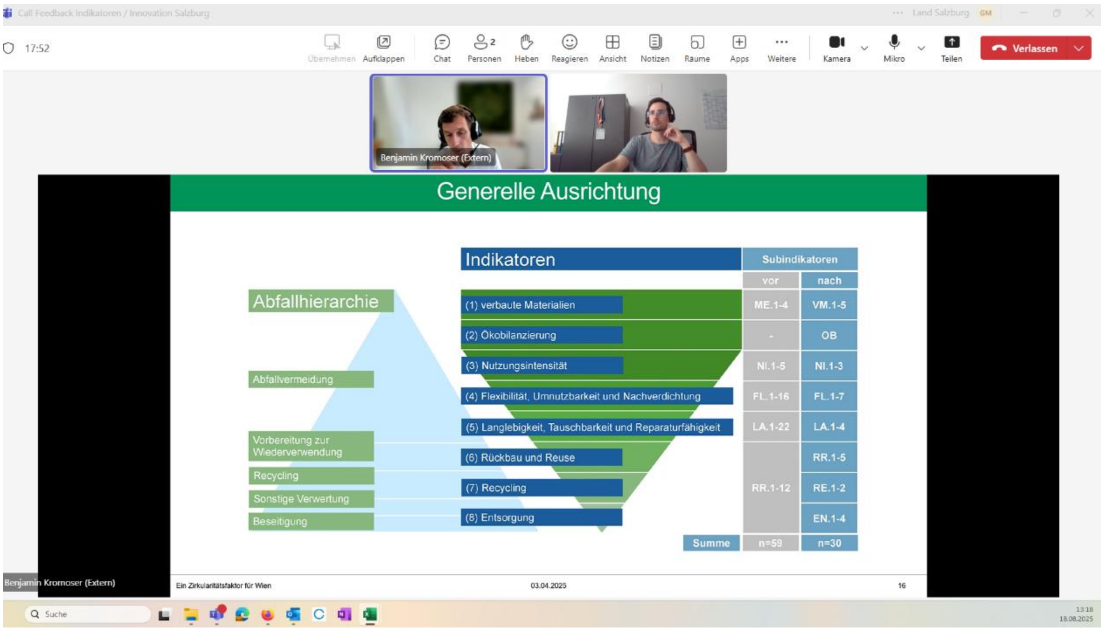

Figure 6. Local bilateral meeting (online) by PP4 Innovation Salzburg

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Figure 7. Local bilateral meeting by PP4 Innovation Salzburg

Figure 8. Local workshop by PP10 TPLJ

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Annex I – Review of the circularity indicators set

Have demolition contractors or deconstruction experts been appointed as part of the design team? If yes, has the contractor conducted a pre-refurbishment or pre-demolition audit?

FEEDBACK

Introduce a scoring system to quantify qualitative aspects, enabling a clearer assessment of adaptability in design.
Good idea, but there could be a problem with an unattached decision.
Something that will be relevant in about 30 years, currently difficult.
The demolition contractor is not determined during the planning phase. It is chosen only during demolition, thus at the end of the building's lifespan. A more sensible approach would be to conduct a standardized assessment of the recyclability of the materials used.
That should not be the first indicator, because before demolishing a building, it should be adapted. Attention! Demolition contractor and deconstruction experts are not the same. Deconstruction experts have a different goal, and they need a higher education.
That is a good point to consider the deconstruction early in the building process. There is currently a tension conflict between time timework and badly sorted construction rubble.
It is important but it depends on the type of building.
Very clear & practice-relevant; no current project; deconstruction/sorting already practiced indicator serves as a marker.
Understandable, relevant in refurbishment; raise architects' awareness (where do materials go?); private clients mostly just want change thus less needed there.
Clarify which check (structural/material/other); relevant & feasible; raise client awareness; consider pollutant loads and use-dependent scope; clarify warranty/liability.
Comprehension: partial | rare in small projects | no (works solo) | Note: simple guidance, not complex audits
Clear & relevant; mind logistics; feedback loop with demolition contractors; crucial: circular mindset in deconstruction.
This indicator is unrealistic/ irrelevant; what interest would a demolition expert have in working during the design phase, when there is no budget? expand the dissemination of the Ecoscale database proposed by the CSTB (https://ecoscale.cstb.fr/)
The inclusion of deconstruction experts should be formalized already at the concept stage, not only during execution.
Does this apply to newly built projects?
How is this measured? Quantified? If there is an audit made for one material, does it apply to the whole project?

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The indicator should assess capacity. Do qualified deconstruction specialists actually exist locally? Who is a deconstruction specialist?
Evaluation should consider the quality and scope of the deconstruction strategy, not merely the presence of an expert. Does criteria for this exist?

RATIONALIZATION OF FEEDBACK

A. **Clarification of the professional figures involved**: a clear distinction must be made between demolition contractors and deconstruction experts, explaining their roles, skills, and purposes.
B. **Feasibility in the different stages of the building life cycle**: it is often impossible to involve demolition contractors in the design phase, especially in new buildings.
C. **Relevance by project type**: the indicator is particularly useful in renovation projects, less so in new buildings or small-scale interventions.
D. **Subject of the assessment**: the mere presence of an expert does not guarantee the quality of the work.
E. **Availability of skills in the local market**: the lack of qualified specialists can make it difficult to apply the indicator.
F. **Need for supporting tools and information**: the indicator could be more applicable if supported by databases and technical tools.
G. **Need for a quantitative component**: many stakeholders are calling for a scoring system that makes the indicator assessable.
H. **Partial case management**: it is unclear how to evaluate situations in which only part of the project or materials are analysed.

ACTIONS CONNECTED TO FEEDBACK

A. Clarify what role is required and for what type of assessment, including an operational definition of "audit."
    a. The specific role of the "demolition contractor" has been identified and is defined as a specialized professional responsible for planning and carrying out the safe, efficient, and compliant dismantling, removal, or clearance of buildings, structures, or other man-made facilities.
    b. The pre-demolition audit is defined as *an activity resulting in the inventory of materials and components arising from the future demolition or renovation projects,*

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and their management and recovery options (European Commission, 2017, EU Guidelines for the Waste Audits).

B. Shift the focus of the indicator to the preparation of a deconstruction strategy, rather than the early appointment of a demolition contractor.
    a. Both aspects may be considered, but for different type of projects: the deconstruction strategy is relevant for new construction, while the appointment of a demolition contractor applies to refurbishment projects that are expected to generate C&D waste. Osaily et al. (2019) also highlight, among the benefits of the EDCI, the opportunity to *develop an Integrated deconstruction methodology for whole of life cycle*.
C. Add an explanatory note that differentiates the requirements based on the type of project and clarifies when the indicator is applicable.
    a. This issue is addressed in the answer to point B.
D. Transform the indicator into an assessment of the quality and completeness of the deconstruction strategy.
    a. This assessment should not evaluate the quality of the produced audits. The focus should remain on the proactive intention to integrate circular economy principles into the building design.
E. Include a preliminary check on the local availability of experts and in the definition of minimum requirements for recognizing a "deconstruction expert."
    a. A reference to the "local availability" of a deconstruction expert is added to the indicator's description.
F. Suggest the use of databases such as Ecoscale and standardized checklists to assess the recyclability of materials.
    a. The use of any tool or database that supports the identification and execution of a pre-demolition audit, carried out with the involvement of a deconstruction expert, is considered valuable and is encouraged.
G. Establish performance levels.
    a. Addressed in the semi-quantitative and quantitative assessment tiers.
H. Establish a minimum coverage threshold and define how to treat limited or incomplete audits.
    a. In line with the reasoning presented in point D., this assessment should not evaluate the quality or completeness of the audit reports. Instead, it should verify whether there is an explicit and proactive intention to embed circular economy principles within the building project.

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UPDATED INDICATOR

Title: **Demolition contractor involvement and definition of a deconstruction strategy**

Description: Provided there is local availability, has a demolition contractor[1] been involved in the building project to conduct a deconstruction strategy (for new constructions) or a pre-demolition audit[2] (for refurbishment projects)?

[1] A demolition contractor is a specialized professional responsible for planning and carrying out the safe, efficient, and compliant dismantling, removal, or clearance of buildings, structures, or other man-made facilities.

[2] The pre-demolition audit is *an activity resulting in the inventory of materials and components arising from the future demolition or renovation projects, and their management and recovery options* (European Commission, 2017, EU Guidelines for the Waste Audits).

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Does the building design incorporate modular and reconfigurable solutions that allow for adaptability over time?

FEEDBACK

Intelligent planning is very important!
It doesn't make sense for every type of building (residential, public buildings, industrial building).
To consider a modular construction approach is something desirable, but it also depends on the type of building.
Is only one part of the whole important planning indicator! What is with existing buildings?
Appropriate indicator!
A suitable indicator. It is already often a topic in our company.
Clear; growing relevance; project concept aims to benefit from adaptability over time.
Challenging; modular logic → adaptable/reusable; relevance will grow with a new mindset; prerequisite: buildings must enable it.
Clear & practice-relevant; for renovation: advance adaptive concepts (e.g., Mies-style); build awareness.
Comprehension: yes |relevant esp. in renovation | mostly no (cost/demand) | Note: good idea, economically hard
Comprehension: partial | rare in small projects | no (works solo) | Note: simple guidance, not complex audits
Clear & increasingly relevant; a scale would help; adaptability increases project quality; possibly revise room concepts; interface with social sciences.
At what time are maintenance issues integrated? and the need to engage the user in monitoring building maintenance? Questions about standards and technology remain an obstacle to modularity.
We need to consider which PMIs are considered since some of them are mainly involved in the constructing phase, thus not being involved in designing.
Is this meant for physical modularity and functional flexibility (changes of use over time). Modular is a broad word, needs to be defined, and again if for example the project uses modular furniture but not modular materials, does it qualify and how is this measured? Is it even possible to quantify?
Does the indicator cover "design for disassembly," or only modularity?
Traditional and vernacular building methods sometimes provide high adaptability, but how could that be quantified? They should be recognized as valid circular models.

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RATIONALIZATION OF FEEDBACK

A. **Clarity of the concept of modularity**: the term "modular" is too broad and ambiguous, encompassing both structural modularity and functional or furnishing-related modularity.
B. **Applicability to different types of buildings**: the indicator is not always relevant for every type of use: industrial buildings, residential buildings, public buildings, and small structures have different economic and design constraints.
C. **Relevance in renovations and existing buildings**: spatial and functional modulation is particularly important in interventions on existing buildings, but the criteria are not currently adapted to this condition.
D. **Integration with maintenance and lifecycle**: some stakeholders ask when and how future maintenance and user management are integrated into adaptive design.
E. **Economic and technical feasibility**: modularity is perceived as useful but difficult to implement in small-scale projects or those with limited budgets.
F. **Need for verifiable metrics and criteria**: many point out the difficulty of measuring modularity if it is not specified what should be evaluated and how.
G. **Recognition of traditional construction methods**: some vernacular techniques guarantee high adaptability even though they are not "modular" in the modern sense of the term.

ACTIONS CONNECTED TO FEEDBACK

A. Clearly define what is meant by modularity and reconfigurability, specifying the scope (materials, components, layout, functions) and indicating whether the concept includes "design for disassembly."
    a. Modularity (or modular design) *refers to designing products by organizing sub-assemblies and components as distinct building blocks (i.e., modules) that can be integrated through configuration to fulfill customer and engineering requirements* (Tseng M., Wang Y., Jiao R., 2018. *Modular Design*).
    b. Design for disassembly is an *approach to the design of a product or constructed asset that facilitates disassembly at the end of its useful life, in such a way that enables components and parts to be reused, recycled, recovered for energy or, in some other way, diverted from the waste stream* (ISO 20887:2022 – Sustainability in buildings and civil engineering works – Design for disassembly and adaptability – Principles, requirements and guidance).

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c. Reconfigurability encompasses three design principles for adaptability:
    - Versatility, defined as the ability to accommodate different functions with minor system changes;
    - Convertibility, defined as the ability to accommodate substantial changes in user needs by making modifications;
    - Expendability, defined as the characteristic of a system to accommodate a substantial change that supports or facilitates the addition of new space, features, capabilities and capacities.

d. The scope of application of modularity and design for disassembly principles (following a proper examination) spans across five levels:
    - Systems: adaptable construction works that can change to suit changing requirements. In some cases, entire modular buildings can undergo wholesale disassembly, movement, and re-use;
    - Elements: major structural part of a construction work (e.g. a roof, foundation, wall);
    - Component or assembly: combination of several subcomponents that are often non-structural (e.g., valves, solar panels);
    - Subcomponent: smaller pieces of the components (e.g., the duct system of a heating or cooling system; the glazing used for curtain walls; gaskets in piping systems, or controllers and software in a fire protection system);
    - Material: basic materials to which a product can be reduced, and that can be re-used or serve as a feedstock in the recycling process to produce other materials.

e. The indicator description is updated to include an explicit reference to “design for disassembly”.

B. Add a note that contextualizes the indicator based on the type of building, clarifying when modularity is essential, when it is desirable, and when it is not particularly relevant.
    a. If the subject of an indicator is not relevant/applicable to a specific type of building project (due to design decisions, economic or regulatory constraints, etc.), the indicator shall not be assessed. Any decision not to assess an indicator shall be supported by appropriate justification.

E. Clarify that the assessment does not require complex or costly solutions, but can also recognize minimal or incremental interventions, provided they are supported by a clear design intention.

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   a. The purpose of the indicator and the related assessment is to evaluate the clarity of the design intent, specifically regarding the integration of circular practices and principles into the building project. It is not considered a limitation if DfD/A principles cannot be implemented in a particular project due to the intervention being too limited in scope.

F. Introduce verifiable minimum criteria, such as the presence of replaceable components, repositionable walls, flexible system configurations, or reconfigurable layouts, while avoiding a formal scoring system unless required.
   a. There is no requirement to achieve a minimum level of modularity or adaptability. The overall purpose of the assessment is to evaluate the efforts undertaken to integrate circular economy principles into the building project. The objective of this indicator is to examine the extent to which DfD/A principles are embedded in the project.

G. Include in the indicator description explicit recognition of traditional solutions that guarantee flexibility of use over time, so as not to penalize non-industrialized circular models.
   a. The indicator notes also refer to traditional and vernacular building methods that allow for high adaptability. This kind of data is closely related to the utilization of the Genius Loci repository.

UPDATED INDICATOR

Title: **Design intent for modularity, disassembly and adaptability**

Description: Does the building project embed modular design[1] and/or reconfigurable[2] solutions that allow for disassembly and adaptability[3] over time?

[1] Modular design (or modularity) *refers to designing products by organizing sub-assemblies and components as distinct building blocks (i.e., modules) that can be integrated through configuration to fulfill customer and engineering requirements* (Tseng M., Wang Y., Jiao R., 2018. *Modular Design*).

[2] Reconfigurable solutions encompass three design principles for adaptability:

- Versatility, defined as the ability to accommodate different functions with minor system changes;
- Convertibility, defined as the ability to accommodate substantial changes in user needs by making modifications;
- Expendability, defined as the characteristic of a system to accommodate a substantial change that supports or facilitates the addition of new space, features, capabilities and capacities.

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[3] The scope of application of modularity and design for disassembly principles (following a proper examination) spans across five levels:

- Systems: adaptable construction works that can change to suit changing requirements. In some cases, entire modular buildings can undergo wholesale disassembly, movement, and re-use;
- Elements: major structural part of a construction work (e.g. a roof, foundation, wall);
- Component or assembly: combination of several subcomponents that are often non-structural (e.g., valves, solar panels);
- Subcomponent: smaller pieces of the components (e.g., the duct system of a heating or cooling system; the glazing used for curtain walls; gaskets in piping systems, or controllers and software in a fire protection system);
- Material: basic materials to which a product can be reduced, and that can be re-used or serve as a feedstock in the recycling process to produce other materials.

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Does the project implement tracking systems (e.g. digital materials or product passports) to document the material resources used across the building lifecycle?

FEEDBACK

It was suggested to clarify the regulatory references of the Digital Product Passport indicator, ensuring alignment with existing standards, and it was noted that its actual applicability and added value in the context of circularity in construction at European level should be carefully assessed.
The "product passport" is still far from being realized, with a risk of overlapping existing regulations or make this requirement too difficult to address. EPDs coul be also considered as tracking systems.
Really important/should be easier in the future.
It makes sense, but there is the difficult fact that you don't know what happens with the materials in the whole lifetime, and the question is, where can I preserve the data for the next 70-100 years?
It is a very important approach that can be included pretty well.
Is a good and important indicator.
For the shell construction (the structural framework), it could be very easy without much more effort. But the real challenge arises in the building sector because so many components are made of composite materials. These materials are often not pure anymore, which makes separation, recycling, or reuse much more difficult.
It should be implemented in the procurement.
Clear & practice-relevant; clarify complexity (granularity vs. product groups); define responsibility & record-keeping.
Clear & very important; materials as a "vault"; feasible; but mind liability/approval loss when components are reused.
Very clear, desirable, possibly too academic; digital product passport: material handling, use/pollutant uptake, responsibilities (who has what, where), preservation, and changes over time.
Comprehension: no (product passport unfamiliar) | Practice: low | Implementation: no (no systems) | Note: digital proofs too onerous
Clear & relevant; early-stage; diversity/material mix is challenging; clarify element- vs. component-level approach.
Digital documents are quickly (10 to 15 years) obsolete. It is necessary to be able to integrate monitoring devices throughout the life of the building -systems. Very important indicator. A BIM-sa build model is essential. These models do not comply 100% with European standards. The data is not standardized.

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What kind of tracking is implied here? Tracking for compliance or tracking for learning. This makes a big difference in the answer. Data collection must serve improvement, not bureaucracy.
Transparency should be evaluated: is data about this even accessible to the community and end users?
And if it does implement is implementation of one tracking system enough to claim it.
What if the project sources local materials and the official documentation and certification is not available.

RATIONALIZATION OF FEEDBACK

A. **Clarity on the type and purpose of tracking systems**: the comments highlight the need to specify whether tracking is used for regulatory compliance, internal management, learning, or transparency towards the community.
B. **Regulatory references and standards**: it has been suggested that the indicator should be aligned with existing European regulations and standards for Digital Product Passports, while also highlighting the critical issues of applicability and added value.
C. **Data retention and storage**: some comments highlight the difficulty of ensuring traceability throughout the entire useful life of the building (70-100 years) and the obsolescence of digital documents.
D. **Technical complexity and granularity**: the management of composite materials, component diversity, and granularity (element vs. component) represent significant challenges.
E. **Responsibility and accessibility of data**: it is important to clarify who is responsible for collecting and maintaining data, how to ensure the validity of information, and whether data is accessible to end users or communities.
F. **Flexibility in case of local or missing certified materials**: projects may use local materials without official certifications.
G. **Integration with design and procurement**: tracking should be planned from the early stages of design and procurement in order to simplify data collection.

ACTIONS CONNECTED TO FEEDBACK

A. Clarify in the indicator text the purpose of tracking systems (compliance, material management, transparency, circular learning) and distinguish the associated levels of responsibility.

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a. This indicator aims to highlight the digitalization of building design. It would be more appropriate to broaden the focus towards digitalization in a wider sense, rather than limiting it to material or product traceability alone. In this regard, some sustainability benefits resulting from the adoption of digital information models – such as BIM – can be referenced (da Cheng et al., 2024):
    - Increasing the decrease in material waste
    - Encouraging green building
    - Improving resource management effectiveness
    - Increasing the effectiveness of the design
    - Encouraging the execution of price and quantity and surveying procedures required for cost estimate
    - Increasing the efficiency of building
    - Supplying an all-inclusive database to facilitate the administration of the construction life cycle
    - Assisting with the information entry, extraction, sharing, and transformation processes for projects
    - Assisting in the seamless transfer of ideas from the design to the implementation, post-design, and maintenance stages

b. For compliance purposes, the Digital Product Passport (DPP) for construction products and materials will become mandatory starting in 2026. However, this requirement applies primarily to manufacturers of products and materials, while other economic operators – such as clients, de-installers, users, and national competent authorities – are granted access to the information contained in the DPP.

B. Include explicit references to European regulations and guidelines (e.g., Digital Product Passport, ISO standards, national regulations) and indicate any practical limitations in their application.

a. Already addressed under point A.

C. Define data storage criteria, including updatable formats, integration with BIM models and monitoring systems, and provide for periodic updates to ensure traceability over time.

a. The integration with BIM has already been discussed under point A., the digital passport for construction products must remain accessible for 25 years after the placing on the market of the last product corresponding to its product type, and the economic operator must make the digital product passport available for at

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least 10 years, provided that any longer period does not impose disproportionate costs or burdens on economic operators (Art. 75 (2)(*i*) of Regulation (EU) 2024/3110)

D. Indicate the level of detail required for tracking, distinguishing between structural materials, components, and finished products, and include guidelines on the management of complex or composite materials.
   a. The primary purpose of this indicator is to support the traceability of products and materials from a circular-economy perspective. Accordingly, the required information should cover the origin of products and materials, their composition, and the strategies in place for their end-of-life management.

F. Provide alternative criteria for documenting local materials or materials without official certification, for example through self-certification or internal traceability protocols.
   a. Local sourcing of construction products and materials represents an added value for a building project in line with all NEB principles. It is therefore important to highlight their use, including through an “internal” tracking method capable of demonstrating selected sustainability aspects, as well as their cultural or social value.

G. Suggest integrating tracking systems into BIM and procurement processes, starting from the concept design phase, and include information on responsibilities throughout the supply chain.
   a. Already addressed under point A.

UPDATED INDICATOR

Title: **Digital project management and material documentation**

Description: Does the building project implement digital tools and systems[1] to support overall project management and the documentation of materials and components[2]?

[1] e.g. BIM, COBie, digital twin. Some sustainability benefits resulting from the adoption of digital information models – such as BIM – can be referenced (da Cheng et al., 2024):

- Increasing the decrease in material waste;
- Encouraging green building;
- Improving resource management effectiveness;
- Increasing the effectiveness of the design;

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- Encouraging the execution of price and quantity and surveying procedures required for cost estimate;
- Increasing the efficiency of building;
- Supplying an all-inclusive database to facilitate the administration of the construction life cycle;
- Assisting with the information entry, extraction, sharing, and transformation processes for projects;
- Assisting in the seamless transfer of ideas from the design to the implementation, post-design, and maintenance stages.

The Digital Product Passport (DPP) for construction products and materials will become mandatory starting in 2026. However, this requirement applies primarily to manufacturers of products and materials, while other economic operators – such as clients, de-installers, users, and national competent authorities – are granted access to the information contained in the DPP.

[2] Required information should cover the origin of products and materials, their composition, and the strategies in place for their end-of-life management. Local sourcing of construction products and materials represents an added value for a building project in line with all NEB principles. It is therefore important to highlight their use, including through an "internal" tracking method capable of demonstrating selected sustainability aspects, as well as their cultural or social value.

Does the project adopt a life-cycle approach (e.g. through LCA) to support circular design and material choices?

FEEDBACK

Indicators, such as those requiring a detailed LCA, may be too complex and they risk making the tool impractical, particularly for micro- and small enterprises, as they often require additional specialized personnel and resources; it is therefore important to balance reliability, accuracy, and applicability, taking into account the possible absence of LCA and the economic/building scale thresholds of the construction projects.
Acknowledge the challenges of applying LCA due to its complexity but highlight the need to carefully consider how it can be integrated into the tool's evaluation framework.
It is something that will come, but from today it is a long way to get there.
In some pilot projects it is already implemented.
It is related to the product and material passport. Good would be a generally valid assessment.
It is essential to define clearly if there is an LCA included or not. A life cycle approach is not enough.
It is crucial to consider the entire lifetime of a building. Even if the materials used have a low CO_2 footprint, the building cannot be considered sustainable if its lifespan is only half as long as comparable structures. Durability and longevity are therefore just as important as material selection when assessing sustainability.
Very essential!
Clear; elaborating the concept is sensible; feasibility depends on storage/interim depots; fast build vs. circularity tension.
Relevant & clear; a guideline for implementation/life-cycle; best practice: Cityförster ~83% circular.
Very general but relevant; beware greenwashing/marketing in life-cycle claims.
Comprehension: known | Practice: limited | Implementation: theoretical only (effort too high) | Note: LCA sensible, not for private clients
Clear & future-relevant; unusual but feasible; LCA already exists—can be integrated.
This indicator adds nothing compared to the regulations in force. What is its usefulness? If the digital model is well designed, sustainable materials are already favored.
It is important to consider transparency and reliability of data communicated by the PMIs of the sector. Is there a way to certify the sources? How can they support their affirmations?
The indicator should verify not only the use of LCA but also boundaries and quality of LCA. There are different LCA tools available (online, official - often very expensive), do all reach criteria? What is the criteria?
LCA results must inform actual design decisions rather than being used as a mere compliance tool.

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A social LCA should be also included, covering health, community, and labour impacts.
Are LCA used to educate and engage stakeholders?

RATIONALIZATION OF FEEDBACK

A. **Complexity and cost of LCA**: the requirement for a complete LCA risks making the indicator inapplicable for many operators, especially SMEs, because it requires skills, costs, and tools that are not always available.
B. **Need to clearly define whether LCA is present**: some stakeholders want the indicator to clarify the difference between declaring a "life cycle" approach and demonstrating the actual implementation of an LCA.
C. **Durability, longevity, and design quality**: a project team may choose low-CO_2 materials but design buildings that are not very durable, thereby invalidating the circular approach.
D. **Quality, transparency, and reliability of LCA data**: the risk of using unverified data or non-compliant tools can lead to "LCA greenwashing."
E. **Integrating LCA into decision-making**: LCA is often performed solely for compliance purposes rather than as a tool for improving circular choices.
F. **Relationship with other tools (DPP, BIM, etc.)**: some of the feedback sees LCA as complementary to digital systems (DPP, BIM), or even redundant if the digital model already incorporates sustainability criteria.
G. **Applicability and added value of the indicator**: some consider the indicator too general, others redundant in relation to existing mandatory standards.
H. **Inclusion of a Social LCA**: social sustainability is often ignored in traditional LCA tools.
I. **Education and stakeholder engagement**: LCA can be a tool for communication and engagement, not just technical calculation.

ACTIONS CONNECTED TO FEEDBACK

A. Distinguish between the life-cycle approach (conceptual) and full LCA (methodological). Provide for levels of application: basic (e.g., qualitative impact analysis) and advanced (ISO-compliant LCA). Indicate accessible and free tools for simplified analysis.
   a. A free and accessible option for performing LCA is OpenLCA. Another useful tool is OneClick LCA, which provides dedicated modules for buildings, manufacturing, and infrastructure.

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b. A note has been added to clarify that, for broader applicability – particularly for SMEs and micro-enterprises – the indicator may also accept a life-cycle approach instead of a full LCA.

B. Add a distinction in the indicator between:
   - LCA actually carried out;
   - Qualitative or partial analyses;
   - Intentions/justified non-applicability.

   Require the tools, databases, and standards used to be indicated (EN 15978, ISO 14040/44).

   a. Partially addressed in point A. A life cycle approach is a general method for evaluating the environmental, economic, and social impacts of a process throughout its entire life cycle, that range from qualitative (life cycle thinking) to comprehensive quantitative (life cycle assessment studies) methods.
   b. Added the requirement to specify the used tools, databases and reference standards if a proper LCA study is conducted.

C. Integrate references to durability, scheduled maintenance, extension of useful life, and design strategies that reduce premature obsolescence into the indicator. Include a request to describe how the results of the analysis influence design decisions.

   a. Observations concerning durability, maintenance, the extension of service life, and premature obsolescence are left to the assessor, provided that sufficient information is available. The extent to which these aspects can be examined depends on the completeness and relevance of the project data. The purpose of the tool is to determine whether a project demonstrates a certain degree of circularity.
   b. The indicator currently states "[…] to support circular design and material choices." An additional section has been introduced requesting information on the specific decisions made to support sustainable and circular design – using a life-cycle approach – that influence material selection, structural system design, disassembly strategies, and impact reduction.

E. Request a section describing how the analysis influenced:
   - material selection;
   - structural system design;
   - disassembly strategies;
   - impact reduction in the most critical phases.

   Evaluate the integration of LCA in the preliminary phases (concept design).

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a. Addressed in point C.

UPDATED INDICATOR

Title: **Integration of life cycle approach in circular design**

Description: Does the building project apply a life cycle approach – ranging from life-cycle thinking[1] to full LCA studies[2] – to inform circular design and material choices[3]?

[1] For broader applicability (particularly for SMEs and micro-enterprises) indications on a qualitative (life cycle thinking) life-cycle approach are acceptable, instead of a full LCA. A life cycle approach is a general method for evaluating the environmental, economic, and social impacts of a process throughout its entire life cycle.

[2] A free and accessible option for performing LCA is OpenLCA. Another useful tool is OneClick LCA, which provides dedicated modules for buildings, manufacturing, and infrastructure. If an LCA or simplified assessment is carried out, used tools, databases and reference standards must be specified.

[3] The indicator should describe how the life cycle approach informed decisions related to: material selection; structural system design; strategies for disassembly or adaptability; durability and scheduled maintenance; extension of useful life and avoidance of premature obsolescence; impact reduction. The extent to which these aspects can be examined depends on the completeness and relevance of the project data.

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How do circular design choices enhance (or diminish) the aesthetic, cultural, and contextual value of the project?

FEEDBACK

Quantitative measurement of NEB-related indicators can be challenging and restrictive, as these indicators are often generic; they may need clearer definitions or a division into more specific, actionable elements. As a reference, the WELL protocol can be useful, as it already incorporates similar dimensions.
For both indicators, the suggestion is to de-couple circularity from beauty and inclusivity. In this way, the designers could be more at ease to find appropriate solutions, without being forced to integrate everything in a single indicator. Again, the NEB Compass (and the NEB philosophy in general) considers the 3 principles as separated.
It enhances it a lot, because it is related to simple construction, e.g., building with wood that grows in the region and reducing building costs.
In no way. Aesthetic and circular design are both important, but this two topics should be considered individual.
Aesthetic and circular design should be considered individually. It depends on the perspective and building culture. The preservation of existing structures with history is generally considered beautiful and desirable. However, this must work in harmony with new structures.
When something is sustainable and inclusively constructed, it is beautiful in a specific way and has a cultural value.
It is important, but it depends on the type of building.
Clear; hard to position (new-build mindset) yet in principle integrable.
Clear; needs a new aesthetic (patchwork, lively/social); coverage in lifestyle media would help adoption.
Clear, desirable (e.g., storage/buffering options); weigh administrative effort vs. benefit; often less relevant for private clients.
Yes | Practice: low (optics/price dominate) | Implementation: rather no | Note: nice idea, irrelevant for single-family homes
Clear; relevance uncertain; regional recognizability can help; more demanding in planning.
These scores cannot be used as binding criteria in public procurement processes. Nevertheless, the more durable the material, the easier it is to integrate cultural value.
Possibility of reversing inclusiveness and aesthetics.
Assessment should include alignment with local identity and landscape context.
How is the criteria of this assessed? It is very subjective to say what aesthetic is and to what extent.
Circular aesthetics should be seen as an evolution of beauty, not as a limitation. Reuse can also be a new form of cultural expression.

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Early involvement of artists and designers could be recognized as a positive factor.
The indicator could also assess whether circular choices strengthen the community's sense of place and belonging, but again criteria…

RATIONALIZATION OF FEEDBACK

A. **Need to distinguish between NEB dimensions and circularity**: several comments point out that the indicator combines distinct concepts (circularity, aesthetics, inclusion), creating rigidity and confusion in the assessment. Stakeholders believe that forcing designers to demonstrate a direct relationship between circularity and aesthetics/culture risks forcing connections that are not always present. The NEB Compass philosophy considers the three pillars separately, and this approach should be maintained.

B. **Subjectivity of aesthetic evaluation and the need for clear criteria**: many comments highlight that aesthetics are highly subjective and difficult to measure. The lack of objective criteria can reduce the reliability of the indicator and limit its use in regulated contexts (public procurement, formal evaluations).

C. **Circularity as a potential contribution to aesthetics and cultural value**: some stakeholders recognize that circularity can generate new aesthetics, cultural value and recognizability. The use of local materials, creative reuse, preservation of existing elements or integration into regional building traditions are aspects that can enrich the identity of the project.

D. **Context of application and typological sensitivity**: the relevance of the relationship between aesthetics and circularity depends on the type of building and the design culture. The weight of the indicator varies according to the project (renovation vs. new construction; public vs. private buildings). A uniform requirement could penalize many cases.

E. **Integration with artistic and creative skills**: one comment suggests added value in interdisciplinary collaboration. Circular aesthetics can benefit from contributions from the worlds of art, design, craftmanship, or cultural curation.

F. **Risk of aesthetic and cultural greenwashing**: some stakeholders point out that linking aesthetics and circularity without clear criteria increases the risk of empty claims. We must avoid presenting circularity as an aesthetic value for mere communication strategy.

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ACTIONS CONNECTED TO FEEDBACK

- Explicitly separate the assessment of aesthetic and cultural effects from that of circularity, while allowing designers to highlight any synergies. Clarify that circularity can contribute to aesthetic and cultural values, but that it is not mandatory to demonstrate this in order to obtain a positive score.
    a. The indicator does not explicitly aim to measure and evaluate the aesthetic and cultural components of a building project. The focus is on the demonstrable presence of a cause-effect relationship between circular choices and the aesthetic/cultural value of the building under assessment. The aim is to assess whether circularity in some way supports or hinders the affirmation of the cultural identity of the building (change in aesthetics, decontextualization, lack of architectural or landscape harmony).
    b. In the qualitative assessment, there is no positive or negative score, but only a reflection consistent with the available information.
- Add guidelines with minimum criteria for assessing aesthetic/cultural impact (e.g. reference to local identity, perceived quality, relationship with the context). Where possible, request evidence (e.g. consultations, aesthetic concept, artistic contributions).
    a. From paragraph “4.2.7 High-level aesthetic acceptance” of the NEB Compass: *To achieve a high level of aesthetics in the built environment, the creation of buildings and spaces with desirable visual qualities and a positive impact on the sensory and cognitive user experience should be reinforced. [...] Formal qualities include order, contrast, transparency and novelty, and their appropriate compilation has a positive impact on visual richness. Beauty is also associated with pleasant sensory experiences for users that go beyond a sense of comfort, defined by interior temperature, light intensity, ergonomics, and basic functionality, as assessed by the target of health and wellbeing. [...] It has been proven that there is a close relationship between multisensory architectural and spatial experiences and the wider wellbeing of users. [...] Material and technological innovations can enrich the sensory experience and provide interactive and engaging stimulation, but do not determine the overall value of the aesthetic experience of architecture. The intellectual and emotional factor of the perception of spaces and buildings is not less important.* This excerpt presents various criteria for assessing the aesthetic qualities of a building, articulated according to different modes of perception and use.

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   b. The reference methodology of D.1.3.2 requires that the qualitative assessment of indicators be supported by adequate evidence.

- Incorporate examples of how circularity can contribute positively (visible reuse, local materials, heritage conservation, evolution of aesthetic languages).
   a. The main positive contribution of integrating circular practices into aesthetic and cultural quality was identified as support for local procurement, but this was made explicit in the quantitative assessment.

E. Add an optional note highlighting collaboration with artists, designers or cultural curators. Integrate this aspect into a section dedicated to advanced or innovative design practices.
   a. This aspect is also addressed in the quantitative assessment tier.

UPDATED INDICATOR

Title: **Circular design effects on aesthetic and cultural qualities**

Description: Do circular design choices influence – positively[1] or negatively[2] – the aesthetic, cultural, and contextual qualities[3] of the building project? How – conversely – do these values influence circular design strategies? Is there evidence of any meaningful interaction[4] between circularity and architectural or cultural expression?

[1] Circular choices may have positive effects, such as: highlight visible reuse, repair, or material layering as an aesthetic language; support cultural continuity through local and traditional materials; enhance place identity through adaptive reuse or heritage conservation; introduce new aesthetic expressions linked to circularity. The major positive contribution of circular practices to aesthetic and cultural quality was identified as support for local procurement, and this was made explicit in the quantitative assessment.

[2] Circular choices may also introduce negative effects, such as: undesired changes in the aesthetic character of the project; lack of architectural harmony; visual decontextualization; lack of landscape harmony.

[3] The indicator should reflect on the interaction between circular choices and: alignment with local identity, materials, and construction culture; perceived quality and sensory experience (visual, tactile, spatial); architectural coherence, contextual integration, and landscape harmony; user experience, cognitive/sensory qualities, and emotional perception; preservation, enhancement, or reinterpretation of heritage elements.

[4] The indicator does not evaluate aesthetic or cultural quality in general. It focuses on whether circular strategies: support aesthetic or cultural value; alter or challenge these values; have no direct relation. A positive outcome does not require to improve aesthetics; it only requires a clear and reasoned reflection on their interaction.

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How do the adopted circular solutions promote (or hinder) social inclusion, user participation, and a sense of community belonging within the project?

FEEDBACK

Quantitative measurement of NEB-related indicators can be challenging and restrictive, as these indicators are often generic; they may need clearer definitions or a division into more specific, actionable elements. As a reference, the WELL protocol can be useful, as it already incorporates similar dimensions.
For both indicators, the suggestion is to de-couple circularity from beauty and inclusivity. In this way, the designers could be more at ease to find appropriate solutions, without being forced to integrate everything in a single indicator. Again, the NEB Compass (and the NEB philosophy in general) considers the 3 principles as separated.
Consider also the existence of social organizations/associations that could benefit from secondary materials recovery, such as social cooperatives or digital/physical exchange platforms, to strengthen the social value of circularity.
Not really, because the time span is too long.
That should only be considered in larger projects like neighbourhood developments.
It should be considered in larger projects. Another approach could be: Are there any compensation measures, e.g., financing a new playground for the local authority? E.g. Anif Elementary School: Parts of the old school were incorporated into the new school (concrete, wood, etc.). This strengthened the sense of community (parents and children both attend the "same" school).
When something is sustainably an inclusive constructed, it is beautiful in a specific way and has a cultural value.
Sustainable construction not only reduces environmental impact but also brings people together and broadens the mindset of everyone involved in the process.
That is an appropriate indicator, because sustainable building decisions lead to regional companies.
Clear; scope unclear (coordination with client yes, group dimension not always applicable).
Clear; fosters identification with the project; helps reveal which actors are motivated.
Very clear & very relevant; align all stakeholders; keep users in focus; more effort that pays off.
Clear | Practice: high (user focus) | Implementation: yes if all align | Note: more effort that pays off
Clear & relevant; foster participation; learn from other countries (e.g., Switzerland).

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Re-use platforms create local jobs. Even if they are not very visible, the added value remains in the local area. This is in contrast to manufacturers of equipment and components, which are rarely produced in France.
It could be interesting to evaluate if the project has connection with other entities (example: societal organizations) which can benefit from discarded materials.
The indicator should measure the quality of participation, not only the number of workshops or consultations.
Special focus can be given to engaging vulnerable or underrepresented groups in the process.
Circular systems such as repair, sharing, or exchange hubs can directly build social cohesion. This could be quantifiable.
Evaluation can include whether the project remains socially accessible also after implementation. The question of quantifying this?

RATIONALIZATION OF FEEDBACK

A. **Need to distinguish between NEB dimensions and circularity**: several comments point out that the indicator combines social aspects (inclusion, participation, community) with circularity, creating a link that is not always natural or justified. It should not be mandatory to demonstrate that every circular solution has an impact on inclusion or community spirit. Forcing this link can make the indicator less credible and difficult to apply, especially for small-scale projects or those with limited social dynamics.

B. **Difficulties in measurement and the need for clearer criteria**: some comments highlight that concepts such as inclusion, sense of belonging, "quality" participation and cohesion are difficult to quantify reliably. Without clear criteria, there is a risk that designers will limit themselves to generic lists of participatory activities (workshops, consultations) without assessing the real social impact. Some stakeholders call for inspiration from protocols such as WELL, which distinguish quality, accessibility and inclusiveness in a more structured way.

C. **Valorization of the indirect social impacts of circular solutions**: several stakeholders point out that circularity can generate positive impacts that are not immediately visible, such as the activation of local networks, work in the area, exchange platforms or benefits for social cooperatives. The indicator should recognize that circularity not only generates direct social impacts (participation, access, inclusion), but also indirect community values through local economies, solidarity networks and new forms of cooperation.

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D. **Applicability by project scale and social context**: different comments emphasize that some aspects of the indicator are more relevant to neighborhood, campus, school, or public building projects, and less so to individual or small-scale interventions. An overly ambitious indicator risks being useless in contexts where there is no structured or formalized community. It is necessary to specify when the indicator applies fully, partially, or only in a descriptive form.
E. **Importance of including vulnerable or underrepresented groups**: some stakeholders emphasize the importance of considering not only generic participation, but inclusive participation, especially for weaker groups. The risk is that participatory processes only involve groups that are already strong or active, losing their inclusive dimension. Social accessibility must be considered not only in the process, but also in the future use of the building.
F. **Need to avoid vague or self-referential narratives**: some comments show a risk of generalizations ("brings people together", "aligns stakeholders", "more effort but it pays off") which, if not supported by evidence, can turn the indicator into a statement of principle without substance. Generic formulations without verifiable evidence should be avoided. The indicator should lead to concrete answers, not unmeasurable claims.

ACTIONS CONNECTED TO FEEDBACK

A. Separate the assessment of circular strategies more clearly from that of participatory/community dynamics, allowing the designer to discuss synergies only when relevant. Clarify that the indicator does not require proof of a "strong" social impact for each circular intervention. Introduce a description that assesses the potential or actual relationship, without assuming that it always exists.
    a. As with the previous indicator, this one does not aim to evaluate the presence, quality, or effectiveness of local community involvement in absolute terms. Instead, it seeks to identify any cause–effect relationship between circular choices and community engagement. The goal is to assess whether circular solutions promote or hinder aspects such as social inclusion, user participation, and a sense of community belonging.
B. Specify subcategories: user participation, community benefits, inclusiveness, post-occupancy accessibility. Ask to describe the quality of participation (who was involved, how, with what results), not just the quantity. Introduce guiding questions that reduce vagueness and self-referentiality. Include, where relevant, evidence or proof:

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consultation reports, inclusion of vulnerable groups, agreements with local organizations.

   a. Topics of user participation, community benefits, inclusiveness, and post-occupancy accessibility have been added to the indicator's description.
   b. A note has been added requesting a description of the quality of participation, focusing on the actors involved, the methods used, and the outcomes achieved.

C. Add a section dedicated to indirect contributions: local work, cooperatives, platforms, social networks. Request concrete examples (e.g., donation of materials to cooperatives, repair spaces). Also evaluate scenarios in which circular strategies do not directly involve end users but still bring significant benefits.
   a. A note has been added inviting consideration of indirect contributions (local employment, cooperatives, platforms, social networks), ideally supported by concrete examples.
D. Indicate that the indicator is particularly relevant for projects with a public or community impact. Provide for "light" or adaptive methods for small-scale projects. Distinguish between direct contributions (participation, accessibility) and indirect contributions (cooperatives, local supply chains), applicable to different types.
   a. During the preliminary phase of the circularity assessment, a set of indicators appropriate to the specific case under evaluation is selected. At this stage, it is possible to specify whether the indicator in question is relevant to the project type being assessed.
E. Add an explicit request to describe how and whether the project has integrated vulnerable groups.
   a. As indicated for the quantitative analysis, and consistent with the NEB Compass framework, the adoption of circular practices involving specific design choices may affect the accessibility of the property. A note referencing this aspect has been added for the qualitative indicator as well.
F. Request examples, evidence, documents, processes, agreements with local authorities. Encourage clear distinction between project intentions and actual or expected impacts. Include guiding questions that limit the risk of social greenwashing.
   a. A note has been added requesting that project intentions and expected outcomes be specified, including details on any unforeseen developments.

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UPDATED INDICATOR

Title: **Circular design effects on community value and participation**

Description: Do circular design choices influence – positively or negatively[1] – social inclusion, user participation[2], and a sense of community belonging[3] within the project? How – conversely – do these values influence circular design strategies? Is there evidence of any meaningful interaction[4] between circularity and local community participation and involvement?

[1] Include potential indirect effects of circular strategies, e.g.: local employment, collaboration with cooperatives, exchange/reuse platforms, social networking – preferably supported by concrete examples.

[2] The accessibility of the building can be influenced by circular design choices (e.g. use of recycled, reused, or refurbished resources and materials). This aspect falls under the "Inclusiveness" criteria of the NEB.

[3] When assessing the indicator, consider topics such as: user participation, community benefits, inclusiveness, post-occupancy accessibility. If participation processes are present, describe their quality by clarifying who was involved, how they were involved, and what outcomes were achieved.

[4] Specify the project's intentions and expected outcomes related to social inclusion and participation, and describe any unexpected developments that emerged during the process.

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Does the project prioritize the use of by-products, secondary materials, or virgin renewable resources over conventional raw materials?

FEEDBACK

It also should be considered if the product is really more sustainable; you need the balance sheet for the material and the energy.
This is a crucial and meaningful indicator. If LCA is considered, this indicator isn't necessary.
Very important! More upcycling than downcycling.
Very important! Should be top priority.
Very important! But in reality, not every building can be constructed entirely from secondary materials. Another point is that in the future, the amount of secondary materials available on the market will not always be consistent.
Very important, but actually not so easy.
Clear & relevant; client/cost-dependent implementation; awareness is growing.
clear | Practice: growing | Implementation: cost/client-dependent | Note: awareness increasing
Clear & relevant; consider material substitution (e.g., concrete → clay).
Reuse should be explicitly mentioned.
when evaluating material use, it is important to consider also the purpose of the building. Moreover, at national level, for entrepreneurs, recycling is a cost rather than a saving, because of the national legislation which does not adequately support recycling. Often entrepreneurs do not know how to manage waste or how to recycle it.
Not all recycled materials are healthy - Toxicity risks should be addressed within the indicator. Use of healthier products. Health as one of the criteria?
Certification and safety of by-products?
The proximity principle (use of local or regional resources) supports both sustainability and local economy.
Aesthetic quality and design integrity of reused materials should also be recognized, not just their quantity. Use of vernacular materials, for example...

RATIONALIZATION OF FEEDBACK

A. **Need to ensure that circular choices are truly sustainable**: different comments point out that the use of secondary, waste, or renewable materials is not automatically more sustainable. In some cases, the energy impact or toxicity may make the option less virtuous. The preference for secondary materials cannot be taken for granted:

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evaluation criteria on health, safety, energy analysis and, where available, indicators such as LCA are needed. The indicator must avoid simplifications that create the risk of greenwashing.

B. **Relevance of the indicator and difficulties in its application**: several stakeholders say that the indicator is very important, but often difficult to implement due to market constraints, availability, or costs. The market for recycled materials is unstable and sometimes expensive. Availability is not guaranteed. Not all projects can adopt secondary materials in a meaningful way.
C. **Importance of reuse, upcycling, and material substitution**: several comments emphasize the importance of prioritizing not only recycled materials, but also direct reuse, recovered components, and upcycling, while avoiding downcycling practices. Reuse and upcycling represent higher forms of circularity than recycling. Substituting conventional materials with natural or bio-based alternatives can also be relevant.
D. **Connection with the local context and the principle of proximity**: some comments emphasize that favoring local materials is a form of circularity that is significant, with environmental and economic benefits. Local sourcing can reduce the impact of transportation, support the local economy, and improve integration with the context.
E. **Need to consider the function of the building**: one comment draws attention to the fact that the choice of materials must remain consistent with the type, purpose, and performance required of the building. Circular solutions must not compromise the performance required by the project: structural safety, durability, usage requirements, regulations.
F. **Regulatory context and legislative barriers**: one comment raises a specific but representative issue: in some jurisdictions, recycling is still seen as a cost. Regulations and administrative processes can hinder circularity, discouraging entrepreneurs.

ACTIONS CONNECTED TO FEEDBACK

A. Add a request to justify the actual sustainability of the choice (health, energy, impacts throughout the life cycle). Include references to the healthiness, certifications, and safety of secondary or waste materials. Invite respondents to report any limitations or cases where the circular choice was not possible or sustainable.
    a. Edited the indicator to read: “Does the project prioritize <u>the sustainable</u> use of…”.
    b. A note has been added requesting explicit reference to health, energy performance, environmental impacts, certifications, and safety aspects of

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secondary materials. The note also asks to report any limitations affecting the use of circular materials.

B. Explicitly acknowledge that the indicator may have varying levels of applicability. Provide for the possibility of justifying non-application for technical, economic, or availability reasons.
    a. In the preliminary phase of the circularity assessment, it is necessary to identify which indicators can genuinely be applied and valued in relation to the project under analysis. At this stage, any exclusion of non-applicable indicators must be justified. Such exclusions may be motivated by technical or economic constraints, or by the lack of availability of the required resources.

C. Explicitly include reuse, upcycling, and vernacular materials. Encourage the documentation of examples of replacing conventional materials with more sustainable solutions (material substitution).
    a. An explanatory note has been added referring to on-site material reuse practices and upcycling. The note also highlights the relevance of material substitution.

D. Add a note inviting consideration of the geographical origin of materials. Promote the use of local, natural, or traditional materials.
    a. This theme does not fall within the scope of secondary material use. The aspect related to local sourcing is addressed separately in the quantitative assessment.

E. Ask to justify the consistency of the materials chosen with the functions and requirements of the project.
    a. A note has been added requesting that the selection of circular materials be shown to align with the technical requirements of the project.

F. Add an optional field allowing users to report significant regulatory or administrative barriers. Do not consider these barriers as penalizing factors in the assessment.
    a. Regulatory constraints that hinder or prevent the implementation of circular practices are also considered acceptable grounds for excluding this indicator from the assessment.

UPDATED INDICATOR

Title: **Prioritization of secondary, reused, and low-impact resources**

Description: Does the building project prioritize the sustainable use[1] of by-products, secondary materials, reused[2] or upcycled components, or virgin renewable resources over conventional raw materials, while ensuring their technical suitability[3] for the project?

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[1] Provide evidence that the chosen materials or solutions are genuinely sustainable, including: health and indoor environmental quality; energy performance and environmental impacts across the life cycle; certifications, safety aspects, and healthiness of secondary or waste-derived materials. Report any limitations or cases where a circular choice was not possible or not sustainable, including regulatory or administrative barriers.

[2] If there are any, include references to on-site material reuse, upcycling practices, use of vernacular and traditional materials, and examples of materials substitution that replace conventional solutions with more sustainable alternatives.

[3] Highlight the choice of circular materials or solutions that are compatible with the project's functional, structural, and safety requirements.

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Has circular performance-based procurement criteria been included in contract specifications?

FEEDBACK

It is a bit difficult; who defines what circular is, and will it also be circular in 50 years?
What is the added value of this indicator? This is not result-oriented.
Important!
This is too non-specific. This indicator should be concretized.
For now, it is very important to emphasize this point, because otherwise it will not be sufficiently considered.
It definitely makes sense!
Clear; in practice partly already a stance; specify criterion and include in contracts.
Clear & relevant; implementable (fix in tender documents); partly questionable for private clients.
Clear & relevant; usability for private clients questionable.
Comprehension: clear | Practice: in principle | Implementation: questionable for private clients | Note: benefit unclear
Clear & highly relevant for new builds; marketing advantage; plan early; strong cross-trade collaboration needed.
Important to be taken into account in contracts. integrate monitoring on soil quality Management of green spaces
when evaluating material use, it is important to consider also the purpose of the building. Moreover, at national level, for entrepreneurs, recycling is a cost rather than a saving, because of the national legislation which does not adequately support recycling. Often entrepreneurs do not know how to manage waste or how to recycle it.

RAZIONALIZATION OF FEEDBACK

A. **Need for clear definitions and more concrete criteria**: many stakeholders point out that the indicator is too generic and lacks clear operational references. It requires greater precision to be applicable: it does not define which circular procurement criteria should be included, nor does it provide parameters for verifying them. The lack of a shared reference to "circularity" generates uncertainty and risks undermining its credibility.

B. **High relevance, especially for new buildings, with a need for early application**: several stakeholders consider the indicator to be very important, even strategic. It has a

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high value because the inclusion of circularity criteria in contract specifications is what enables circular behavior on construction sites and in supply processes. Its relevance increases for new buildings and public contracts, while it may be less applicable or more difficult in the private sector.

C. **Problematic applicability for private clients**: some stakeholders highlight a recurring difficulty: private clients do not readily adopt these criteria. Formal contractual instruments are more common in public works or large-scale projects, whereas in private projects the criteria may be perceived as complex, restrictive, or costly.

D. **Importance of specifying the project objective and the relevance of the type of building**: one comment points out that the relevance of the criteria also depends on the function of the building. The functional type (school, residential, industrial building) can drastically change the nature of the applicable contractual criteria.

E. **National legislative context: obstacles, costs, and lack of knowledge**: one contribution points out that in some countries, recycling or implementing circular practices can be costly or difficult due to regulatory constraints. The regulatory framework can represent a real barrier, not a limitation of the project. The indicator should record these obstacles without penalizing the score.

F. **Possibility of integrating specific aspects (soil, green spaces, monitoring)**: one comment suggests specific additions:
   - **i.** "integrate monitoring on soil quality"
   - **ii.** "management of green spaces"

   These ideas broaden the concept of circular procurement by including ecological aspects, but risk shifting the indicator too far from its original scope. However, these are possible examples to include in the notes, provided they remain optional.

ACTIONS CONNECTED TO FEEDBACK

A. Define what is meant by circular performance-based procurement criteria (durability, maintainability, disassembly potential, minimum share of secondary materials, extended producer responsibility, etc.). Add a note requesting concrete examples of the criteria used. Clearly state the objective of the criterion: to ensure documentable circular performance.
   a. A note has been added, stating the objective of the inclusion of circular procurement criteria: to ensure documentable circular performance.
   b. Circular procurement criteria for construction works (The Circular City Centre – C3, *Circular Public Procurement in Cities*, 2025):

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i. Competencies and past experiences: demand proof of past experience with delivering a circular construction project (such as examples of contracts delivered within a given period of time, references, and the CVs of the relevant personnel);
ii. Material inventories and passports: develop an inventory of reusable materials prior to selective demolition; require a pre-demolition audit to be conducted; require a material passport to be used.
iii. Circular material requirements: incorporate a minimum amount (as a percentage or by weight) of:
    1. recycled materials;
    2. secondary raw materials;
    3. bio-degradable materials;
    4. materials to be recovered for recycling.

    Install (and verify) low-environmental impact construction materials. Use supply chain management to ensure compliance with building assessment and certification systems and to support modelled resource efficiency strategies;
iv. Circular building certifications: requirement to use Level(s), cradle-to-cradle, EPD, LEED, or BREEAM or equivalent certification;
v. Use of life cycle assessment considerations: requirements to reduce the embodied impacts and resource use associated with construction materials. Use life cycle assessment (LCA) and similar tools to quantify the impacts; requirements to evaluate the life cycle impacts of the main building elements;
vi. End-of-use requirements: separate material collection for reuse, recycling and recovery in line with the waste hierarchy in Directive 2008/98/EC; segregate recyclable materials and end-of-life products by material type. The contractors shall provide plans of the building showing the space(s) that have been designated for waste segregation and collection; require a minimum percentage by weight of the non-hazardous waste generated during demolition and strip-out works, and excluding excavations and backfilling, to be prepared for reuse and recycling; comply with existing EPR schemes on construction materials; require that construction and demolition waste be treated in accordance with EU legislation and with the full checklist of the EU Construction and Demolition Waste

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Management Protocol; require that at least 90% for new construction and at least 70% for renovations (by mass in kilograms), excluding backfilling, of the non-hazardous C&D waste generated on construction sites is prepared for reuse or recycling.

C. Add a note acknowledging that the application may vary depending on the client. Allow for the exclusion of the indicator to be justified for contractual or organizational reasons.
    a. A note has been added, specifying that this indicator only applies for public projects. This means that private projects' assessment can exclude the indicator.
D. Request justification of the suitability of the criterion with respect to the type of building.
    a. A note has been added, asking for building type-specific aspects to be highlighted to justify the presence or absence of circular procurement criteria.
E. Add an optional field to describe regulatory, administrative, or market barriers. Clarify that such barriers may justify not applying the indicator.
    a. A note has been added asking to specify the presence of any regulatory, administrative, or market barrier.
F. Include non-binding examples (e.g., soil or green space management criteria) but maintain focus on materials and processes.
    a. A list of circular procurement criteria has been added in response to point A.

UPDATED INDICATOR

Title: **Embedding circularity in contractual and tender procedures**

Description: Have circular performance-based criteria[1] been included in contract specifications[2]?

[1] The purpose of including circular performance-based procurement criteria is to ensure documentable circular performance through contractual obligations.

Non-exhaustive list of applicable criteria (The Circular City Centre – C3, *Circular Public Procurement in Cities*, 2025):

- Competencies and past experiences: demand proof of past experience with delivering a circular construction project (such as examples of contracts delivered within a given period of time, references, and the CVs of the relevant personnel);

G. Material inventories and passports: develop an inventory of reusable materials prior to selective demolition; require a pre-demolition audit to be conducted; require a material passport to be used.
H. Circular material requirements: incorporate a minimum amount (as a percentage or by weight) of:
    i. recycled materials;
    ii. secondary raw materials;

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iii. bio-degradable materials;
iv. materials to be recovered for recycling.

Install (and verify) low-environmental impact construction materials. Use supply chain management to ensure compliance with building assessment and certification systems and to support modelled resource efficiency strategies;

- Circular building certifications: requirement to use Level(s), cradle-to-cradle, EPD, LEED, or BREEAM or equivalent certification;
- Use of life cycle assessment considerations: requirements to reduce the embodied impacts and resource use associated with construction materials. Use life cycle assessment (LCA) and similar tools to quantify the impacts; requirements to evaluate the life cycle impacts of the main building elements;
- End-of-use requirements: separate material collection for reuse, recycling and recovery in line with the waste hierarchy in Directive 2008/98/EC; segregate recyclable materials and end-of-life products by material type. The contractors shall provide plans of the building showing the space(s) that have been designated for waste segregation and collection; require a minimum percentage by weight of the non-hazardous waste generated during demolition and strip-out works, and excluding excavations and backfilling, to be prepared for reuse and recycling; comply with existing EPR schemes on construction materials; require that construction and demolition waste be treated in accordance with EU legislation and with the full checklist of the EU Construction and Demolition Waste Management Protocol; require that at least 90% for new construction and at least 70% for renovations (by mass in kilograms), excluding backfilling, of the non-hazardous C&D waste generated on construction sites is prepared for reuse or recycling.

[2] This indicator applies primarily to public projects. Private-sector projects may justifiably exclude it. Respondents should explain whether the selected procurement criteria are appropriate to the building's intended function, uses, and technical requirements. Any relevant regulatory, administrative, or market barriers hindering the adoption of circular procurement practices may be reported. Such barriers may justify the non-application of the indicator.

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To what extent does the project rely on renewable or recovered energy sources across the different phases of the building's life cycle?

FEEDBACK

"Promoting" is misleading, if we mean the implementation of NZE measures in a building project. If so, "Implementing" would be more appropriate. Clarify if the approach here (and elsewhere) is performance-based (= different levels to reach) or prescriptive.
It should be a parent topic for the state government.
This is a superior topic that shouldn't be an indicator.
It should be a parent topic for the state government. It is eye washing.
Very important! But it should be the considered the unadorned energy consumption that is necessary to produce a product or a building. (e.g., which energy mix was used to produce solar panels)
This is a superior topic. For example, the CO_2 emission of transporting play a crucial role, whether these emissions can be reduced significantly depends on the development of the vehicle sector- in particular the shift toward electric or hydrogen-powered trucks.
Is a good point, but in the construction phase it would be difficult.
Clear & relevant; feasible in principle, but diverse energies/actors → clarify how it operates.
Not clearly placed; often standard in operation; less known/relevant in planning phase.
Needs clarification/segmentation; currently too brief; all relevant, but multi-trade implementation is hard; requires shared understanding; note limits of influence.
Comprehension: unclear/too brief | Practice: relevant | Implementation: hard (many trades) | Note: split/clarify; shared understanding
Harder to understand; seen as less relevant by some; important yet complex to implement (CO_2 claims vs. real impact).
The French regulations are already sufficiently comprehensive on this subject. This indicator does not appear to be relevant.

RAZIONALIZATION OF FEEDBACK

A. **Conceptual ambiguity and the need to clarify the approach (performance-based vs. prescriptive)**: several responses indicate that the indicator is too concise and conceptually ambiguous. It is unclear whether the indicator measures:
   i. the simple use of renewable/recovered sources;
   ii. or the level of performance achieved;
   iii. nor whether it is a descriptive or evaluative requirement.

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This ambiguity reduces practical applicability and generates divergent interpretations among evaluators.

B. **Indicator perceived as an “overarching theme” rather than a single indicator**: most stakeholders believe that the theme is too broad or structural to be treated as an indicator. The use of renewable energy is seen as: a high-level public policy, already regulated; or as an expected standard, rather than a distinctive feature of the project. This leads some to consider the indicator redundant or uninformative.
C. **Variability of relevance between life cycle stages**: several comments point out that the indicator is more relevant in some stages (use) and less so in others (construction, planning). Control over energy sources is more direct in the operational stage and is limited or indirect in the construction and procurement stages. Without this distinction, the indicator risks being perceived as unrealistic.
D. **Complexity of implementation and multiplicity of actors involved**: much feedback converges on the operational difficulty of the indicator. Energy involves numerous actors, complex supply chains and decisions that often lie beyond the direct control of the designer. This makes it difficult to attribute responsibility and results.
E. **Inclusion of “embodied” energy and upstream energy mix**: some stakeholders suggest considering not only operational energy, but also energy embodied in materials and processes. The real impact of renewable sources also depends on the upstream energy mix and industrial and logistical processes. Ignoring these aspects can lead to a partial assessment.
F. **Dependence on national regulatory context**: some feedback indicates that regulations are already very advanced in certain countries. In highly regulated contexts, the indicator may appear redundant or not very discriminating.

ACTIONS CONNECTED TO FEEDBACK

A. Specify that the indicator assesses the degree of integration, not merely the presence of renewable sources. Introduce a brief explanatory note on how the indicator works throughout the different stages of the life cycle.
    a. The indicator is based on a descriptive approach, and its assessment is not linked to a direct measurement demonstrating the achievement of a specific performance level. It aims to evaluate the integration of a sustainable approach within the building project, with specific reference to the incorporation of renewable and sustainable energy sources.

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   b. The indicator refers to design-stage choices aimed at optimizing the building's energy demand during its operational phase. In particular, it seeks to highlight energy supply strategies based on sustainable sources.

B. Clarify in the notes that the indicator does not evaluate general energy policy but rather the choices and specific scope of action of the project.
   a. A note has been added specifying that the purpose of the indicator is to assess project-specific design choices, rather than the broader legislative framework or general energy policy orientation.

C. Segment the indicator by life-cycle stages in the explanatory notes. Highlight that the level of project control varies depending on the stage. Allow for differentiated or justified responses for each stage.
   a. Comments related to this aspect (project life-cycle phases) have already been addressed under point A(b). The description of the indicator has therefore been revised by removing the reference to the building project life cycle.

D. Include a note that explicitly acknowledges the limits of the project's influence. Request that only aspects that can be controlled or influenced be documented. Promote an assessment based on available evidence, not on generic statements.
   a. A note has been added specifying that acceptable grounds for excluding this indicator from the assessment set include the project's limited sphere of influence. Acceptable reasons also include the lack of available data sources demonstrating targeted choices aimed at improving the building's energy sustainability.

F. Include a note indicating when the indicator is covered by mandatory regulatory requirements. Clarify that regulatory compliance can constitute a baseline, without penalizing the assessment.
   a. A note has been added allowing respondents to indicate whether the subject of the indicator is already covered by mandatory regulatory requirements, clarifying that compliance with such requirements does not result in a penalty in the assessment.

UPDATED INDICATOR

Title: **Adoption of renewable energy strategies in the project**

Description[1]: Does the building project include design choices[2] that contribute to covering the energy demand through sustainable and renewable energy sources?[3]

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[1] The indicator is based on a descriptive approach, and its assessment is not linked to a direct measurement demonstrating the achievement of a specific performance level.

[2] The indicator refers to design-stage choices (rather than the broader legislative framework or general energy policy orientation) aimed at optimizing the building's energy demand during its operational phase. In particular, it seeks to highlight energy supply strategies based on sustainable sources.

[3] Some decisions related to energy supply are not under the direct control of the project, since it may be constrained by external factors that limit its ability to introduce more sustainable energy choices. Some examples include: buildings connected to a centralized energy network without the possibility of choosing the energy mix; renovation projects where the integration of renewable sources is not technically feasible; limitations imposed by the urban, infrastructural, or contractual context; lack of expertise, data, or decision-making power on the part of the project team. So, acceptable grounds for excluding this indicator from the assessment set include the project's limited sphere of influence. Acceptable reasons also include the lack of available data sources demonstrating targeted choices aimed at improving the building's energy sustainability. Respondents can also indicate whether the subject of the indicator is already covered by mandatory regulatory requirements; compliance with such requirements does not result in a penalty in the assessment.

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To what extent does the project promote the prevention, reuse, and valorisation of C&D waste instead of disposal?

FEEDBACK

Consider thematic areas, project phases, and value chain actors; for example, the topic of waste management may be relevant across all phases of the project. Nonetheless, other topics/dimensions can be translated differently depending on the stakeholder involved or the project stage. Clarify the distinction between tracking and traceability in material traceability systems was emphasized. Concerns were also raised regarding the separation between waste management and sustainable circular design, pointing out that waste management should be an integral part of circular design from the earliest stages. In this perspective, it was proposed to consider waste valorisation not only in terms of disposal, but also as an opportunity for business and reuse, in line with the principles of the circular economy.
Suggested updating the terminology from waste management to “reuse management” or “new life loop”, as the goal of circularity is to eliminate the concept of waste and frame materials as having “another purpose” or “a new function".
Could be an indicator. Important is a realistic view.
Is related to LCA and the digital product passport.
The wording is not entirely correct. The question should be: how can we generate a higher circularity rate? In fact, the circularity rate of mineral waste in Austria is already 98%. Wood from deconstructed buildings also has a low incineration rate, as it is largely reused in particle boards.
That is not so easy because recycling and reuse work well for pure materials, but composite materials are very difficult to reuse or recycle.
Clear & relevant; straightforward in new builds; upfront design reflects in future deconstruction/refurbishment.
Clear & relevant; project set up for it; implementable—the building is assessed by these principles.
Clear; momentum visible; re-/continued use increasingly considered; time & budget constrain-costs are the cross-cutting opponent.
Comprehension: clear | Practice: increasing | Implementation: limited by time/budget | Note: reuse/continued use; costs constrain
Clear & relevant; building as material resource; identify reusable components; feasible—requires know-how
The waste should not be included in the reuse process.
It’s the main area of intervention, especially for SMEs within the sector, since often they do not have the possibility to intervene in other phases (such as design).

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RAZIONALIZATION OF FEEDBACK

A. **Need for a more systemic framework (project phases, actors, value chain)**: the issue does not only concern the end-of-life or construction phase, but spans the entire building project cycle (design, construction, use, decommissioning) and involves various actors (designers, contractors, demolition companies, recyclers, SMEs). Clearly separating waste management and circular design risks reducing the indicator to a 'downstream' practice, whereas prevention and recovery should be incorporated at the design stage.

B. **Terminological evolution: from the concept of "waste" to that of resource**: some stakeholders believe that the term "waste" is conceptually at odds with the principles of circularity. Valorization should be seen as the creation of new opportunities (reuse, business, new life cycles), not just as an alternative to disposal.

C. **Clarity on the indicator's objective and implicit metric**: in some contexts, recycling rates are already very high, making it meaningless to evaluate "reduction in disposal" alone. The focus therefore shifts to improving the quality of circularity (prevention, high-value reuse, design for disassembly), rather than average system performance.

D. **Technical limitations: composite materials and feasibility of reuse/recycling**: not all materials are equally suitable for reuse or recycling. Composite materials pose real technical limitations, which should not penalize the project if adequately justified.

E. **High operational relevance, especially for new buildings and SMEs**: the indicator is perceived as very concrete and relevant, especially in new buildings (design for deconstruction) and for SMEs, which often have more influence on materials management than on energy or system choices. However, time, costs, and skills are limiting factors.

F. **Connection with digital tools and LCA**: waste prevention and recovery is closely linked to tools such as LCA, material inventories, and digital product passports, which support traceability and informed decisions.

ACTIONS CONNECTED TO FEEDBACK

A. Clarify that the indicator considers prevention, reuse, and recovery strategies throughout the various stages of the project, with differentiated roles for the actors involved. Specify that waste management is intended as an integral part of circular design, not as a separate or exclusively operational activity.
   a. A note has been added clarifying that waste prevention and valorization (i.e., the "non-classification" of materials as waste) refers to different life-cycle stages of

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the building project, from design choices (as part of "circular design") to construction phase activities. Attention is also requested to the different actors involved and their respective roles.

B. Clarify the terminology, specifying that "C&D waste" also refers to potentially reusable materials and components, considered as resources. Reinforce the concept of recovery as reuse, repurposing, upcycling, or reintroduction into new production cycles.
    a. The indicator description has been updated. A note has been added specifying that the term "waste" also includes material resources that could potentially be classified as such but, through conscious project decisions, are diverted from disposal (reuse, repurposing, upcycling, reintroduction into new production cycles).
C. Clarify that the indicator does not assess average national performance, but rather specific project choices to increase the quality of circularity (prevention, direct reuse, value recovery). Specify that the indicator is descriptive and not intended to calculate a quantitative reuse/recovery rate.
    a. A note has been added explaining that the indicator aims to descriptively assess the incorporation of the circular economy principle of Resource Stewardship and does not refer solely to recycling activities.
D. Allow for the reporting of technical limitations related to the nature of the materials (e.g., composites). Allow for the justification of the non-application of certain reuse/recovery strategies for technical reasons.
    a. A note has been added explaining that a (partially) negative assessment of the indicator can be justified based on technical limitations arising from the composite nature of materials generated by construction activities.
E. Introduce the possibility of reporting time, budget, or know-how constraints without these automatically resulting in penalties.
    a. A note has been added specifying that it is possible to report time, budget, or know-how constraints related to the implementation of actions for the recovery/reuse of material resources that would otherwise be classified as waste.
F. Invite respondents to indicate whether and how the indicator is supported by tools such as LCA, material inventories, or digital passports, without making them mandatory.
    a. A note has been added specifying that it is possible to refer to LCA and/or material inventories to obtain the necessary information to support the assessment of the indicator.

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UPDATED INDICATOR

Title: **Circular management of construction and demolition waste**

Description: Does the building project allow for the prevention[1] of construction and demolition waste[2] through reuse and other forms of valorisation of the residues[3] from construction activities?

[1] Waste prevention and valorisation (i.e., the "non-classification" of materials as waste) refers to different life-cycle stages of the building project, from design choices (as part of "circular design") to construction phase activities. Respondents should also identify the roles of different actors involved during the project life cycle, that help in integrating circular practices for waste management.

[2] The term "waste" does not only refer to the materials that are classified as such: it also includes material resources that could potentially be classified as such but, through conscious project decisions, are diverted from disposal with actions of reuse, repurposing, upcycling, reintroduction into new production cycles. The indicator aims to descriptively assess the incorporation of the circular economy principle of Resource Stewardship and does not refer solely to recycling activities.

[3] A (partially) negative assessment of the indicator can be justified based on technical limitations arising from the composite nature of materials generated by construction activities. Respondents should report time, budget, or know-how constraints related to the implementation of actions for the recovery/reuse of material resources that would otherwise be classified as waste. It is possible to refer to LCA and/or material inventories to obtain the necessary information to support the assessment of the indicator.

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