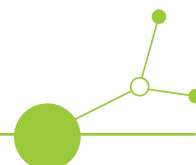


D.1.2.6 - ReBuilt education and training programme for circular and digital construction



Daniella Mehanni, TUW

Dr. Ildiko Merta, TUW

Dr. Dragica Marinič, ZAG

Dr. Alenka Mauko Pranjić, ZAG

Ajda Pirš Zidar, SGZ

Saša Fluger, POR

Krisztina Rimanyi, VAS County

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Table of Content

Summary	2
1. Introduction	2
1.1 Industry & SMEs	5
Description of the training programme	5
Conclusions and future outlook	8
1.2 Government & Public Servants	11
Description of the training programme	11
Conclusions and future outlook	14
1.3 Architects and Investors	17
Description of the training programme	17
Conclusions and future outlook	18
1.4 University & Vocational	20
Description of training program	20
Conclusions and future outlook	22
1.5 Train-the-trainer approach	23
Description of the programme	23
Conclusions and future outlook	25
2. Conclusion	27



Summary

The ReBuilt education/training program aims to raise “T-shaped” experts for circular and digital construction. Hence persons who are broad in knowledge and specialised in one particular area. In order to tailor the programs to the individual requirements of different stakeholders, four target groups were defined and drafted by experts within the consortium. We also added the target group trainers. The stakeholders addressed in the “Fit for Circular and Digital Construction” training programs are:

- Industry & SMEs
- Governments & public servants
- University & vocational students
- Architects & Investors
- Trainers - train-the-trainer

This deliverable (D1.2.6) developed in Activity 1.2 aims to provide tailor-made programs for these 4 stakeholder groups. The concepts for those programs were created in Deliverables D 1.2.1 - 1.2.4 and refined after corresponding workshops had been carried out and feedback was collected (D.1.2.5). In addition, a further focus on train-the-trainer is included. The tailor-made program will be tested in Activity 1.3 between Periods 3 and 6.

1. Introduction

Deliverable D.1.2.6 - “ReBuilt education and training programme for circular and digital construction”- serves as a guideline for lifelong learning initiatives tailored to the needs of different stakeholder groups. The basis for this was set in Deliverables D.1.2.1, D.1.2.2, D.1.2.3, D.1.2.4, and D.1.2.5. This Deliverable aims to harmonise the preceding documents.

The primary objective of the training programs is to equip key actors within the construction value chain with the knowledge and skills necessary to boost circular and digital business practices, thereby positively impacting the transition to green practices in the construction sector in Central Europe. After successful participation in the suitable training program, participants will have a deeper understanding of the principles of circular and digital construction, the use of secondary raw materials and state-of-the-art technologies in the sector, as well as the associated challenges and possibilities. Depending on the target stakeholder group further, the relevant legislative frameworks including, but not limited to, end-of-waste criteria and Green Public Procurement are incorporated. Further topics include life cycle assessments and Environmental Product Declaration.

To minimise the ecological footprint of the construction industry and decarbonise the building industry, **a comprehensive understanding of the environmental impacts is required for future professionals.** The European Centre for the Development of Vocational Training (CEDEFOP) foresees a decline in employment in vocational professions due to a high number of retirements in the upcoming years, amongst other reasons [1]. Due to the COVID-19 pandemic and the energy crisis, as well as higher material costs due to the Russia-Ukraine war, the number of employees has reached its lowest point since the financial crisis. Also, many surveys indicate a reluctance of young trainees towards positions in the construction sector. At the same time, analyses indicate that 4,5 million open positions will need to be occupied until 2030, making the urge to attract future professionals even higher [1]. These factors need to be taken into account when implementing new training programmes. Education programmes in



the field of circular and digital construction could potentially attract more university and vocational students to engage in barrier-breaking technological solutions and implementations.

The importance of education to transform the building sector into a decarbonised sector has been emphasised in many highly impactful documentation by public stakeholders such as the 2022 Global Status Report for Buildings and Construction released by the UN [2]. The Analytical Report on “Improving the Human Capital Basis”, published in 2020 by the European Construction Sector Observatory, supports the importance and emphasises that green skills around energy efficiency, digitalisation, and the use of new materials and designs will be required. The report highlights the importance of training vocational students in **close collaborations with the industry** to gain more hands-on experience and specify construction professionals' skills. It was also outlined that **train-the-trainer** should be promoted and made widely available as this updates and improves the quality of outdated training programmes which do not consider sustainable education elements. [3].

To develop high quality training programmes, the training input must be in line with the most recent legislative requirements on a national and European level. In Deliverables 1.1.4, relevant policies, strategies and legislations have been identified and emphasised, such as the EU Circular Economy Action Plan [4], the EU Waste Framework Directive 2018/851/EC [5], the Construction 2020 Strategy [6], as well as the EU Construction and Demolition Waste Protocol and Guidelines [7], or the Communication on Resource Efficiency Opportunities in the Building Sector [8]. The recognition of key actions emphasised in these guidelines is crucial to **identify gaps in the current education system** on circular and digital building. An essential skill gap was identified in the field of digitalisation due to a general lack of implementations of digital technologies. Regarding the establishment of resource-efficient practices, the potential of Building Information Modelling (BIM) was ranked high [9], [10].

Thus, based on legislative developments, market needs, and education gaps identified in several highly relevant analytical reports on the EU level, the educational potentials and needs have been identified as follows:

- **Digitalisation:**
 - Building Information Modelling (BIM)
 - Digital Additive Manufacturing Technique (e.g., 3D printing)
- **Circular Economy and Sustainable Materials in Construction**
 - Urban Mining
 - Nature Based and/or Circular Solutions, e.g., bio-based building materials
 - Decarbonising the production of building materials
- **Green Building**
 - Renewable Energy Sources
 - Building and Energy Efficiency in Construction
- **Legislation and Economy**
 - Sustainable Development Goals (SDG)
 - Circular Economy Business Models
 - Waste Framework Directive - e.g., end-of-waste criteria, waste hierarchies, extended producer responsibility, ...

Several Projects on education and implementation of sustainability in the construction sector have been completed or are currently ongoing. These include, but are not limited to, CEDEFOP (<https://www.cedefop.europa.eu/en>), BUILD UP Skills (<https://build-up.ec.europa.eu/en/bup-skills>), and Construction Blueprint (<https://constructionblueprint.eu/de/home-de/>).

It is important to include pupils/students to sensitise them to sustainability and the environmental impact of the largest emitters, such as the construction sector. The Rebuilt project aims to enable lifelong learning



for professionals and professionals-to-be. Figure 1 depicts a number of options that shall promote the anchoring of circular and digital construction practices in educational programmes.

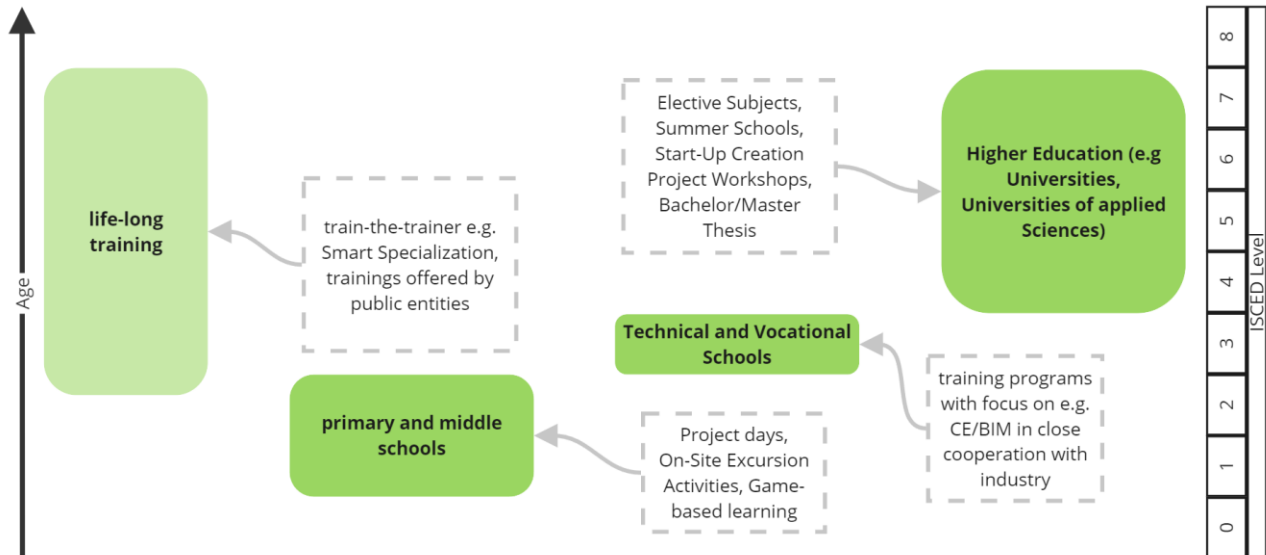


Figure 1: Overview of possible ways of inclusions of sustainability-topics in different levels of education

Within ReBuilt, five different modules have been developed that shall aid in transforming linear business models and knowledge into circular knowledge and digital expertise. The project consortium developed tailored training programmes for each stakeholder group based on identified needs. The following sections will delve into the developed programs that stakeholders can use to enable knowledge transfer.



1.1 Industry & SMEs

Description of the training programme

Implementing the training programme for **industry stakeholders** will encompass several engaging formats to facilitate interactive learning, practical application, and knowledge exchange.

- **Workshops:** Workshops will be conducted in small groups and led by field experts. They will offer interactive sessions featuring presentations, group discussions, case studies, and hands-on activities. Participants will engage in exercises such as developing circular design strategies for hypothetical projects or exploring digitalisation (BIM and digital material/product passports) to optimise resource utilisation.
- **Interactive Discussions/Panel Sessions:** these sessions will bring together experts and participants for structured conversations on specific circular and digital construction topics. Moderated discussions will address regulatory frameworks, technological innovations, and socioeconomic impacts, fostering exploration and knowledge sharing among attendees.
- **Practical Demonstrations:** Through site visits or recorded presentations, demonstrations will showcase tools, technologies, and processes relevant to circular and digital construction. Participants will have hands-on opportunities to interact with demonstrated tools and technologies, gaining practical experience in sustainable construction practices.
- **Site Visits:** tours to waste processing facilities, manufacturing plants, and construction sites will provide firsthand exposure to circular and digital construction practices. Participants will observe how principles are applied across the project lifecycle and engage with stakeholders to understand implementation challenges and solutions.

Short tests, surveys, and participant reflections will continuously monitor the quality and suitability of training formats. Feedback will inform adjustments to training modules to address identified needs and enhance learning outcomes.

These formats were selected to provide a holistic knowledge transfer through experiential learning and peer-to-peer interaction, aligning with the principle that true learning occurs when knowledge is implemented. Workshops and hands-on activities promote practical application and skill development, while practical demonstrations and site visits illustrate concepts in real-world contexts. Interactive discussions and panel sessions encourage critical thinking and knowledge exchange, fostering a community of practice around circular and digital construction principles.

The training programme aims to empower industry stakeholders with the knowledge and skills needed to drive the adoption of circular and digital practices in Central Europe's construction sector by leveraging diverse learning formats.

General: The training program on closing material loops and digitalisation in the construction sector for industry and SME stakeholders is designed in a hybrid format, combining workshops, e-learning modules, expert panels, lectures, site visits, and practical demonstrations.

This format provides flexibility, engaging participants with hands-on experiences while allowing self-paced learning for theoretical concepts. The blend of in-person workshops and online modules ensures a comprehensive understanding of circular economy principles and their digital applications in construction. By including expert panels and live sessions, participants gain practical insights from industry leaders, which fosters a collaborative learning environment.

The **main stakeholders** of the training programme



The program specifically targets construction companies and SMEs, waste management and recycling firms, and building materials suppliers, business support organisations. These stakeholders are primarily decision-makers, project managers, sustainability officers, and site engineers, all actively involved in circular economy practices.

The circular and digital construction training program within the ReBuilt project is designed for multiple target groups:

1. Enterprises and SMEs

- Construction companies: Focus on integrating circular and digital practices, such as sustainable materials, waste management regulations, and digital tools (BIM, digital twins).
- Manufacturers and Suppliers of Construction Products: Training on sustainable sourcing, building material certification, and digital product passports.

Industrial by-product owners and companies that create waste during productions: Learn about environmental regulations, recycling processes, and digitalisation of value chains.

- Raw materials sector/waste collectors and recyclers: Topics include cascade recycling, circular economy principles, and digital process management tools.

2. Business support organisations (such as chambers of commerce, hubs, etc.)

3. Infrastructure and public service providers: large enterprises (e.g., road maintenance and railway asset managers) will gain expertise in green procurement, innovation, and digital tools to manage regulations, standardisation, and environmental assessments.

4. Other Target Groups

- Architects, Designers, and Investors: Specialized training in circular design, use of renewable materials, modular construction, and digital tools like BIM.
- Regulators and inspectors: Focus on streamlining approval processes for sustainable projects and deepening their understanding of relevant regulations.
- Educational and research institutions: to better collaborate with the industry and SMEs with benefits to drive innovation in circular and digital construction.

The training programme, including workshops, practical demonstrations, and continuous adaptation, will support the circular economy, sustainable development, innovation, and adoption of circular economy principles in Central Europe's construction sector.

Each target group will benefit from tailored training programmes that address their specific needs and roles in advancing circular and digital construction practices. The training aims to empower stakeholders with the knowledge and skills necessary to drive sustainable innovation and adoption of circular economy principles across the construction sector. The training programme seeks to create a network of informed and engaged stakeholders committed to advancing sustainable construction practices in Central Europe through interactive workshops, practical demonstrations, visit sites and ongoing monitoring.

In general, the following topics will be addressed within the training programme:

Circular economy principles in the construction sector; circular materials in construction; digital technologies in circular construction; circular economy legislation; End-of-Waste Criteria; green public procurement, Environmental Product Declarations (EVD), Life Cycle Assessment (LCA); innovative business models; good practices across (Central) Europe.



The programme also covers regulatory frameworks, waste management, material recovery and policy compliance, providing a comprehensive picture of how circular economy practices can be implemented in the construction sector.

The topics and core modules of the training programme for industry and SMEs

Module 1: Introduction

- Overview of relevant strategies, policies, and legislative acts at different governmental levels (EU, national, regional, local).
- Presentation of gaps, benefits, and opportunities at local, regional, national, and international levels.

Module 2: Basics of Circular Construction

- Business modelling and lean canvas approaches.
- Role of digital tools and services in circular construction.
- Sustainability considerations and marketing strategies.
- Examples of good practices in sustainable materials sourcing and management.
- Design-for-deconstruction principles.

Module 3: Attestation and Verification of Circular Construction and Technologies

- Compliance with Construction Product Regulation and national construction legislation.
- Waste Framework Directive requirements.
- National environmental legislation and criteria for End-of-Waste determination.
- Reuse of products and harmonized technical specifications.

Module 4: Digitalisation in Construction and Spillover Sectors

- Building Information Modelling (BIM) and digital twins.
- Digital products passports and digital logbooks.
- Automation and digital value chains.
- Robotization and Industry 4.0 applications in construction.

Module 5: Sustainable Assessment and Planning of Construction Works

- Environmental assessments and risk identification.
- Life Cycle Assessment (LCA) and Life Cycle Costing (LCC).
- Social Life Cycle Assessment (S-LCA) considerations.
- Environmental verification and certification frameworks (e.g., carbon capturing, sustainable certification frameworks in Central Europe).
- EU sustainable taxonomy and sustainable reporting.
- Environmental technology verification to prevent greenwashing.

Module 6: Good Practices, Practical Demonstrations, and Training

- Practical demonstrations of circular and digital construction techniques.
- In-laboratory and in-situ training sessions.



Methodology

Implementing the training programme for industry stakeholders will encompass several engaging formats to facilitate interactive learning, practical application, and knowledge exchange, e.g., interactive workshops and discussions, practical visits and in-situ demonstration of good practices. The program adopts a blended learning approach, mixing theoretical and practical learning to maximise understanding and skill application. Experiential learning is emphasised through workshops, where participants can work on real-life scenarios and challenges. Peer-to-peer learning and networking opportunities are encouraged, and mentorship is provided for individual support.

Duration: Typically, it is a one (1)–to three (3)-day event, allowing for in-depth exploration and engagement with various topics and activities. ALI hybrid, one (1) time a week (2-3 hours). The timing /how many times a week/ of the training will be agreed upon with the participants.

Objectives:

- **Education:** provide participants with a comprehensive understanding of circular economy principles and digital technologies in construction.
- **Skill Development:** equip attendees with practical skills and tools for integrating circularity and digitalisation into their projects and practices.
- **Networking:** facilitate connections and collaborations among professionals from diverse backgrounds to foster knowledge exchange and innovation.

Outcomes:

Expected learning outcomes include enhanced knowledge of circular economy principles, practical skills in applying digital tools, strategic implementation abilities for circular practices, and establishing a network of peers and experts for ongoing learning and support:

- Participants gain a deeper understanding of circular and digital construction concepts, tools, and strategies applicable to their work.
- They develop practical skills and insights to integrate circularity and digitalisation effectively into their professional practices.
- Participants engage in collaborative networking, fostering interdisciplinary dialogue and innovation within the construction industry.
- Participants leave the workshop inspired and empowered to drive positive change towards more circular, sustainable, resilient built environments - circular and digital construction.

Conclusions and future outlook

The program's strengths lie in its mixed format, which should receive positive feedback for its flexibility and relevance, and its comprehensive content, which balances theoretical understanding with practical application. Networking opportunities are another significant benefit, facilitating collaboration and fostering participant partnerships.

The expected learning outcomes of a program for circular and digital construction in the construction sector are carefully designed to empower participants with the necessary knowledge, skills, and competencies to drive sustainable innovation and transformation within the Central European construction industry.

These outcomes are tailored to meet specific program objectives and priorities, addressing the target audience's needs. Here are the expected learning outcomes:



Understanding of Circular Economy Principles	Gain a comprehensive understanding of circular economy principles and their relevance to the construction sector, including resource efficiency, material reuse, and waste reduction concepts.
Ability to Apply Circular Design Strategies	Develop the ability to apply circular design strategies in construction projects, including designing for disassembly, selecting sustainable materials, and incorporating modular construction techniques.
Knowledge of Digital Technologies and Tools	Acquire knowledge of digital construction technologies and tools, such as BIM, digital platforms, digital product passports, digital logbooks, parametric design software, digital fabrication techniques, and smart building technologies.
Proficiency in Digital Modelling and Simulation	Gain proficiency in digital modelling and simulation techniques, including 3D modelling, virtual reality (VR), or augmented reality (AR) visualisation to optimise building performance and resource efficiency.
Proficiency in Sustainability Assessment	Develop skills in sustainability assessment, including understanding environmental labelling, verification, and environmental management systems. Learn to specify materials with circularity in mind.
Awareness of Regulatory Requirements and Compliance	Increase awareness of regulatory requirements and compliance considerations related to sustainable construction practices, including building codes, environmental regulations, waste management, and secondary raw materials.
Competence in Project Management and Collaboration	Enhance project management and collaboration competence using digital tools, effective communication strategies, and interdisciplinary collaboration methods.
Understanding of Economic and Social Implications	Gain knowledge and insight into the economic and social implications of digital and circular construction practices, including cost-effectiveness, social equity considerations, and long-term value creation.
Critical Thinking and Problem-Solving Skills	Enhance critical thinking and problem-solving skills by analysing complex sustainability challenges, recognising potential environmental and health hazards in reclaimed materials, addressing durability issues, and applying innovative solutions.
Commitment to Continuous Improvement and Innovation	Develop a commitment to continuous improvement and innovation in the sustainable construction sector, embracing new technologies, methodologies, and best practices to advance sustainability goals.

Continuous feedback mechanisms allow for improvements and content customisation based on participant needs, ensuring issues are addressed promptly.

The program is well-structured to offer a comprehensive learning experience; we will also follow the novelty in the construction sector.



Future Outlook: The future of the program looks promising. Its scalable design allows for expansion to other regions and sectors, with the ability to tailor content to meet specific industry needs and local regulations. Regular content updates will ensure ongoing relevance as technologies and policies evolve. Recognised certification will boost its value, encourage participation, and ensure industry recognition. By emphasizing practical applications, flexible learning formats, and continuous feedback, the program aims to equip professionals with the skills needed to drive the construction industry's shift toward a more circular and digitalised economy.



1.2 Government & Public Servants

Description of the training programme

The training programme will be delivered as a half day online event, including lectures, case studies, discussions, interactive activities etc. Presentations will be made available for the participants after the event. This format has been chosen as conducting the training programme for government officials and public servants online enhances accessibility (participants are able to access training programme from anywhere with an internet connection, eliminating geographical barriers), cost-effectiveness (eliminates the need for travel, accommodation, and venue expenses), and can accommodate a large number of participants simultaneously, also allowing for international participation.

The **main stakeholders** of the training programme are:

All levels of government play a pivotal role in shaping the construction industry's route towards sustainability and digitalisation. As key stakeholders, they are responsible for driving systemic change and creating an enabling environment for sustainable and digitally enabled construction practices. This may be done by enacting policies, regulations, and initiatives that promote circular economy principles and use digital technologies for more efficient and resilient infrastructure development. By attending the training programme, the participants will be sufficiently equipped to develop more effective policies that promote sustainable practices, to identify gaps in current legislation and update existing regulations and standards. Participants will also gain insights into emerging trends, technological advancements, and global best practices that can inform long-term strategic planning efforts.

The training program aims to engage a diverse range of government officials and public servants within governments involved in various aspects of construction regulation, planning, procurement, and policymaking to ensure a comprehensive understanding and effective implementation of sustainable and digitally enabled construction practices.

Several categories of government officials could benefit from attending the circular and digital construction training programme:

- Public servants responsible for construction/waste management/water management investments: Training provides them with knowledge about sustainable construction practices, including materials, technologies, and design principles. This allows them to make informed decisions when allocating funds for construction/waste management/water management projects, ensuring investments align with sustainability goals, helps them identify potential risks associated with traditional construction methods. In addition, the training gives them knowledge, how to maximize the return on investment (ROI) for projects by incorporating sustainable elements, and capacity to and align investments with regulatory requirements and stakeholder expectations.
- Public servants responsible for urban planning: Urban planners are responsible for designing and managing the development of urban areas. Their understanding of sustainable construction practices and digital technologies is crucial for ensuring that urban development projects are environmentally friendly, resilient, and aligned with long-term sustainability goals.
- Public servants responsible for (green) public procurement: Procurement officers hold responsibility of sourcing and acquiring goods and services on behalf of government agencies, including various sectors such as healthcare, research institutions, educational establishments such as schools and universities, among others. Training in green public procurement (GPP) policies and environmental product declarations (EPDs) can help them make informed decisions that prioritize environmentally sustainable construction materials and technologies.



- **Policy Advisors:** Policy advisors provide strategic guidance and support to government officials on policy development and implementation. Their participation in the training programme can help ensure that policies related to construction and infrastructure reflect the latest advancements in sustainability and digitalization.
- **Public servants responsible for issuing construction permits/ Public servants responsible for issuing environmental permits:** Training provides public servants with the information and tools necessary to make informed decisions when issuing construction/environmental permits. It provides insights into the environmental impacts of construction activities and how circular and digital construction practices can mitigate these impacts. They can assess proposed projects based on criteria such as using recycled materials, energy-efficient design, and waste management practices. By attending training, public servants can stay updated on relevant laws, policies, and best practices to ensure that construction projects meet environmental requirements and minimise negative impacts on ecosystems and natural resources.
- **Elected Representatives:** Elected officials, such as mayors, council members, and legislators, have a responsibility to represent the interests of their voters and shape policies that promote the public good. Training in circular and digital construction can help them understand the importance of sustainable development and advocate for policies that support it.
- **The training is also beneficial for building regulators to enhance their ability to assess and regulate building projects for environmental performance and efficiency, environmental regulators to help them better understand the environmental impacts of construction activities and how to mitigate them through sustainable practices and technology adoption, and other public servants interested in the topic to help them incorporate sustainable design principles and innovative technologies into infrastructure projects, improving efficiency and resilience.**
- **All participants should have a basic understanding of construction principles and environmental sustainability concepts.**

In general, the following topics will be addressed within the training programme:

Circular Materials in Construction, Digital Technologies in Circular Construction, Circular Economy Legislation, End-of-. Waste Criteria, Green Public Procurement, Environmental Product Declarations, Life Cycle Assessment (LCA) Principles, Good Practices Across Europe

The training programme for government and public servants can be summarised into the following modules:

Module 1: Circular and Digital Economy in Construction

Introduction to Circular Economy Principles in Construction

Circular Materials in Construction

Digital Technologies in Circular Construction

Interactive Quizzes: Assessing understanding of circular materials and technologies

Module 2: Legislation and Regulatory Framework

Overview of Circular Economy Legislation at the European Union level

End-of-Waste Criteria: Definition, application, and implications for construction materials

Green Public Procurement (GPP): Policies and criteria for incorporating sustainability into public procurement processes



Online Discussions: Identifying barriers and opportunities for promoting circular construction

Optional: Case Studies: Successful implementation of GPP in construction projects

Module 3: Environmental Product Declaration (EPD)

Understanding Environmental Product Declarations: Purpose, content, and benefits

Life Cycle Assessment (LCA) Principles: Assessing the environmental impact of construction materials and products

Optional: Interactive Workshops: Creating and interpreting EPDs for construction materials and products

OR Interactive Webinars: Q&A sessions with experts on EPDs and LCA

Module 4: Good Practices Across Europe

Case Studies: Innovative projects demonstrating the use of circular materials and technologies in construction

Case Studies from Different Countries: Exemplary measures and activities showcasing circular and digital construction practices

Collaborative Activities: Group discussions and brainstorming sessions to identify transferable best practices and potential implementation strategies in local contexts

Optional: Virtual Study Tour: Video tour of innovative construction project CINDERELA - Dogošë.

Conclusion:

At the end of the event a Q&A session will be held, where participants will be able to ask questions and discuss their thoughts and ideas on the topics discussed. The workshops will be held by experts within the field of the given topics.

The **instructional methods** are tailored to suit online format of the training programme and incorporate a variety of instructional methods to effectively engage government officials and public servants, promote active learning, and facilitate knowledge transfer and application in the context of circular and digital construction practices. Modules include a combination of:

- lectures providing a theoretical content and practical examples,
- case studies,
- discussions,
- interactive activities, and
- collaborative activities.

Participants will have access to digital learning materials and online resources, to supplement their learning experience

Trainings will be implemented within the activity 1.3 throughout 2 half-day on-line transnational events, as will be agreed within the consortium.



Within the developed training programme, the following learning outcomes are planned:

- Participants will gain a deeper understanding of circular economy principles in construction and will be able to identify and evaluate suitable circular materials and technologies for construction projects, understanding their environmental and economic benefits;
- Participants will gain an understanding of the legislative frameworks, inc. end-of-waste criteria and GPP; gain an understanding of the legislative and regulatory frameworks governing circular construction; understand the concept of end-of-waste criteria and Green public procurement, enabling them to navigate and implement policies and practices that promote sustainability in construction projects;
- Participants will familiarise with the concept of life cycle assessment (LCA), and obtain the knowledge and skills to create, interpret, and integrate environmental product declarations (EPDs) into construction projects, enhancing decision-making processes and promoting transparency in environmental performance;
- Participants will gain insights into circular practices by studying exemplary case studies and best practices across Europe, acquire insights into the critical success factors and be able to implement effective strategies to advance circular and digital construction initiatives in their respective contexts.

Firstly, the training programme will teach the trainers (Trainers-in-training) the core content they will be responsible for teaching in the future. This includes not only the subject matter but also the best practices, that will be shown especially in the Module 4. Trainers-in-training will be provided with the presentation slides that they will be able to use and adapt when performing as teachers. Moreover, Trainers-in-training will be participating at the training programme, and will be able to observe first-hand the facilitation techniques used for facilitating the discussion etc.

Conclusions and future outlook

Strengths of the training program are the topics that the training is covering. The stakeholders that participated at the consultation workshop that was held on 13.9.2024 were agreeing with the topics that were proposed in the concept note and did not suggest any other major topic. The strength of the training programme can also be seen in its relevance, taking into consideration that participants of the consultation workshop mostly believe that employees in their organisations does not have necessary knowledge and experience in circular and digital construction, and that such knowledge would be beneficial for them.

The feedback indicated at the stakeholder consultation workshop can and has been incorporated into the training programme, if nature of the feedback permits.

Below, the suggestions from the consultation workshop will be listed in first column, whereas the second column will show ways how the feedback was incorporated into the training programme.

Suggestions from the consultation workshop	How the suggestions were incorporated into the training programme
Offering also the opportunity for peer-to-peer discussions	We believe that the concept of the training programme already includes opportunities for group discussions (see how suggestion number 3 will be incorporated). Moreover, Module 3 proposes Interactive Webinars: Q&A sessions with experts on EPDs and LCA and Module 4 proposes Collaborative Activities: Group discussions and brainstorming



	sessions to identify transferable best practices and potential implementation strategies in local contexts. Implementing those discussions will allow the participants with opportunities to conversations and exchanges of knowledge, experiences, and ideas between individuals who are on the same levels, while fostering collaboration, critical thinking, and sharing of diverse perspectives.
Covering the topic of urban planning	Urban planning is a wide topic on its own as is not a subject to this training. To incorporate the feedback, we will emphasise the importance of urban planning and its relation to circular and digital construction in the introductory part of Module 1. “Urban planners are responsible for designing and managing the development of urban areas. Their understanding of sustainable construction practices and digital technologies is crucial for ensuring that urban development projects are environmentally friendly, resilient, and aligned with long-term sustainability goals.”
The training programme should allow slot for a moderated discussion on challenges and conclusions	We believe that this is already provided for by part of the 2nd module “Identifying barriers and opportunities for promoting circular construction”, which was so far proposed as one of the options of 2nd module, and now becoming a non-selective part of the module. Moreover, the concept note on the training programme already provided timeslot for Conclusion - at the end of the event a Q&A session will be held, where participants will be able to ask their questions and discuss their thoughts and ideas on the topics discussed.
Creation of a network of training	We believe that the comment refers to the process of setting up a structured system or collaboration among different organizations, institutions, or individuals to provide training programs. This network could enable the sharing of resources, expertise, and best practices, allowing for more coordinated and effective training efforts across various locations or sectors, with the aim of facilitating knowledge exchange, improving training accessibility, and ensuring consistency in the skills or information being taught. By nature, this can not be included in the training programme itself, but we will encourage the participants of the training to stay tuned and follow the ReBuilt website to obtain more information on the training opportunities and other relevant information.



At the conclusion of each training session, we will be asking for feedback from participants. We are committed to continuous improvement of our programme to reflect the latest trends, materials, technologies and best practices in circular and digital construction.

By empowering governments and public servants with the skills and knowledge on circular economy practices in construction in order to drive sustainable change, we believe that our training programme will play a vital role in shaping the future of the circular and digital construction industry and advancing global sustainability goals. We believe that the proposed topics, minorly adjusted after the consultation workshop, are exactly what is needed for governments and public servants to excel within their respective roles.

The future outlook of our training programme is promising and builds on collaboration (between the project partners on one hand and training participants on the other) and innovation. We will aim to expand the reach of our training programme to reach a wide audience of governments and public servants.



1.3 Architects and Investors

Description of the training programme

The training programme will be delivered as a half-day online event, including lectures, case studies, discussions, interactive activities, etc. Presentations will be made available for the participants after the event. An online format for the training has been chosen due to the variety of architects and investors working in almost every city, town and village. With an online education training programme, they can be reached simultaneously and spare the travel.

The main stakeholders of the training programme are:

- architects and engineers willing to embed the circular economy principles in their work;
- professionals with work experience in the fields of architecture, landscape architecture, engineering and construction methods;
- investors, who want to expand their horizon and add circular construction in their portfolio;
- businessmen, who want to learn to plot and implement steps for developing a sustainable business model.

The main topics of the training programme are:

- Theoretical Basis of the Circular Economy;
- Circular Built Environment Business Models;
- Barriers and Benefits of implementation;
- Code of Ethics & Professional Standards;
- Legislation about the circular and digital construction industry and their possible codification;
- Environmental Product Declaration (EPD) and Life Cycle Assessment (LCA) Principles;
- End-of-Waste criteria;
- Circular and Digital Construction - Case studies across Europe.

The training programme for architects and investors can be summarized into the following modules:

Module 1: Theoretical Basis of the Circular Economy

Introduction:

- Today's challenges
- The growing global challenge of scarce resources
- Resource efficiency and general principles of the circular economy
- Material flows, input diversity

Circular Built Environment Business Models:

- Linear versus circular business models
- Introduction of circular business models: circular inputs, sharing economy concept, product use extension, product-as-a-service, resource recovery



Barriers and Benefits of implementation

- Barriers: awareness, technical, economic and market, implementation, support and promotion, social
- Benefits: protecting the environment, reducing raw material dependence, creating jobs and saving consumers' money

Module 2: Circular & Digital construction

Regulatory framework

- Legislation
- Code of Ethics & Professional Standards
- Professional guidelines - EPD, LCA, end-of-waste

From blueprint to building

- Impact of material selection
- Material specification, public procurement, and handling processes
- Upholding circular and digital measures during the lifecycle of the project

Module 3: Circular and Digital Construction - Case studies across Europe

Presentation of innovative projects demonstrating the use of circular materials and technologies in construction

The methodology of the training programme involves a combination of lectures, interactive learning techniques, practical case studies, discussions, interactive activities etc. aimed at fostering engagement and knowledge retention among participants.

At the end of the event a Q&A session will be held, where participants will be able to ask their questions and discuss their thoughts and ideas on the topics discussed.

The training programme will be implemented as agreed within the consortium, within Activity 1.3 throughout 2 half-day on-line transnational events, between Period 3 and 6.

Upon completion of the training programme, participants will gain a deeper understanding of circular economy principles in construction, circular materials and technologies, their challenges and gaps. They will gain a deeper understanding of the regulatory framework, including end-of-waste criteria and GPP, LCA and EPDs, and also gain insights into circular practices through exemplary case studies of best practices across Europe.

Conclusions and future outlook

The most important element of the training programme is the timeliness and relevance of the topic. The participants of the stakeholder workshop on the 11th of September agreed that architects and investors need training during their professional careers to stay up-to-date with current and future trends.

The two suggestions made during the workshop can easily be covered during the training, without changing the concept, and incorporated into the curriculum:

1. More focus on sustainability during the training; and
2. Use of clear, simple information



Similar to the feedback workshop on the training programme itself, a Q&A session is held at the end of each event to allow participants to ask questions and discuss their thoughts and ideas on the topics covered. These can be asked live, posted via chat, or emailed later.

Future outlook of the programme:

By empowering architects and investors with the skills and knowledge on circular economy practices in construction in order to drive sustainable change, we believe that our training programme will play a vital role in shaping the future of the circular and digital construction industry and advancing global sustainability goals.

“Tailor-made programme concept note for architects and investors” serves as the basis for the training programme “Fit for Circular and Digital Construction” which will be implemented within the activity 1.3 throughout 2 half-day on-line transnational events. In addition to that, the topics will be incorporated in the MOOC (Massive On-line Open Course) that will be developed within the activity 1.4.

The future outlook of our training programme is promising and builds on collaboration (between the project partners on one hand and training participants on the other) and innovation. We will aim to expand the reach of our training programme to reach a wide audience of architects and investors; through feedback from participants, we are committed to continuous improvement of our programme to reflect the latest trends, materials, technologies and best practices in circular and digital construction.



1.4 University & Vocational

Description of training program

One relevant lever is to raise awareness of circular and digital construction practices by promoting **collaboration between experts and University students**. For this reason, in the framework of ReBuilt, a format will be tested in which experts from different fields will be proactively included in lectures.

This training programme is intended to have 5 modules that revolve around circular and digital construction practices in research and industry. Students will gain insights into the current state-of-the-art around legislations and regulatory framework; novel research approaches around circular and digital practices, low carbon technologies in construction, geopolymers and secondary raw materials and circular and digital construction in the application. In the following section an overview is presented including exemplary contents that can be addressed within the modules and that have been tested by the Munich University of Applied Sciences (HM).

At HM, a joint lecture titled „**Use of low-CO₂ binders in construction and recycled concrete**“ took place. It is an online and an in-person attendance lecture open for German and also international students and researchers. The speakers are from different international Universities and research institutes. Students will engage in various fields of expertise and international speakers. The idea revolves around shedding light on different challenges, backgrounds, and solutions faced along the whole lifecycle of buildings. This course especially covers two main topics: CO₂-reduced binder systems in concrete and the use of recycled aggregate materials. The students will receive a certificate of participation as acknowledgement. All lessons were recorded and it is possible to watch the presentation later on or maybe in a following lecture on a platform to save the knowledge and for lifelong learning programmes. The recordings will be available to the public to enable broad knowledge transfer.

The **specific stakeholders** included are University Students enrolled in Bachelor, Master and PhD programmes. Also, the exchange between students and industry, researchers, architects/designers and/or public entities will be promoted.

The training programme intended for **vocational students** will be based on the so-called shadowing approach. The vocational students will benefit from shadowing/accompanying experts hands-on in their daily working routine. Shadowing is a training and learning method where an individual (the "shadow") closely observes the day-to-day activities and tasks of an experienced professional (the "mentor") in their work environment. This approach enables students to gain hands-on experience and enhance understanding of job roles.

Defintion of modules

The topics addressed within the lecture are the following:

Module 1: Legislation and Regulatory Framework

Objective: Basics and legislation about use of recycled aggregate in recycled concrete in different countries

Exemplary Content: Recycled aggregate and concrete in Germany, Brazil and European countries

Module 2: Novel Research Approaches towards Circular and Digital Practices



Objective: Insights into novel research topics around circular and digital practices

Exemplary Content: Recycling of Chloride Containing Aggregates,
Microbial Induced Calcium Carbonate Precipitation on Recycled Aggregates,
Towards greener construction: Exploring Sustainable Practices in 3D Printing,
3D Printing with Recycled Sand

Module 3: Towards Low Carbon Technologies in Construction

Objective: Enabling knowledge around the production of low carbon concrete

Exemplary Content: Carbonation of recycled aggregate (Austria),
Geotechnical Applications (Slovenia),
Introduction about low CO₂ binders in Germany
Introduction about low CO₂ binders in Slovakia

Module 4: Geopolymers and Secondary Raw Materials

Objective: Use of secondary raw materials and geopolymers

Exemplary Content: New research presentations about the following topics from Brazil:

Geopolymers, Tools of nanotechnology to reduce CO₂ emissions of construction

New research presentations about the following topics from European countries:

Ladle slag as SCM and the hydraulic activity ashes from different combustion processes (Slovenia), fly ashes in concrete, package density as CO₂ reducing method, Recycled Sand as Supplementary Cementitious Material (Germany)

Module 5: Circular and Digital Construction in Application

Objective: presentation of current state-of-the-art in the industry

Exemplary Content: 3D printing in an industrial scale, practical insights including a guest lecture

This format enables broad collaboration among Central European stakeholders by providing insights into different legislation systems and research topics. Further, experts with applied knowledge from industry and research and development will be included.

Upon completion of this programme, participants should be able to:

- Demonstrate understanding of various countries' legislation and regulatory frameworks for recycled concrete use.
- Explain and evaluate novel research approaches in circular and digital practices relevant to sustainable construction.
- Discuss the production and benefits of low-carbon concrete technologies in construction.
- Analyse the applications of secondary raw materials and geopolymers in construction, focusing on their sustainability impacts.
- Assess the practical application of circular and digital construction practices in the industry.



Conclusions and future outlook

The training program developed in collaboration with Munich University of Applied Sciences (HM) successfully promotes awareness of circular and digital construction practices. By including experts from diverse international backgrounds, the program offers students exposure to different perspectives on critical topics, such as using CO₂-reduced binder systems and recycled aggregate materials. Including recorded lectures for lifelong learning ensures that shared knowledge can reach a wider audience, enhancing its impact and promoting continuous professional development. Based on the feedback obtained a 5th module was added, which shall promote the closeness and collaboration between university students and industrial experts.

In addition to university students, the vocational training component based on the shadowing approach allows students to gain valuable hands-on experience by accompanying industry professionals in their day-to-day routines. This real-world exposure helps vocational students bridge the gap between theory and practice, providing them with a comprehensive understanding of industry dynamics. Such an approach encourages skills development and cultivates familiarity with job roles that are essential for effective integration into the workforce.

Overall, the program sets a solid foundation for the growth of knowledge around circular and digital construction, and with continued efforts in expanding collaboration, increasing industry participation, and refining training approaches, it can significantly contribute to a more sustainable future in construction.



1.5 Train-the-trainer approach

Description of the programme

A train-the-trainer module is crucial because it ensures that trainers are well-versed in the subject matter and equipped with the pedagogical skills necessary to communicate complex concepts to a diverse audience effectively. In the context of circular economy and digitalisation in construction, these topics involve both advanced technical knowledge and a nuanced understanding of industry practices, making effective knowledge transfer particularly challenging. By focusing on developing trainers' abilities to use hands-on tools, moderate discussions, and engage different stakeholders, the train-the-trainer module empowers them to adapt content to various learning needs and contexts. This ultimately leads to a more consistent and impactful dissemination of knowledge throughout the industry, supporting the broader adoption of circular and digital practices. Such a module also fosters a multiplier effect, where a small group of well-prepared trainers can significantly expand the reach and impact of training initiatives, driving systemic change in the construction sector.

The developed training programme will equip trainers with a broad skillset ranging from coaching competencies, communication strategies to engage with various stakeholders, in-depth knowledge of material recovery and reuse processes, legislation, digital tools, sustainability and impact assessment. Lastly, life-long training shall be enabled by instilling a culture of continuous improvement in trainers.

Definition of modules

The modules within the training programme for the stakeholder-group trainers are defined as follows:

Module 1: Introduction to Circular Economy and Digitalization in Construction

- **Objective:** to familiarize trainers with the basic concepts of the circular economy and digitalization in construction, which will enable effective knowledge transfer to training participants.
- **Content:**
 - Circular economy definitions and principles in the construction sector, including waste reduction, reuse, and recycling.
 - The role of digital technologies such as Building Information Modelling (BIM), the Internet of Things (IoT), and digital twins in supporting circular systems.
- **Training method:** case studies presenting successful circular economy practices in construction and examples of how digital tools facilitate these changes.

Module 2: Development of Coaching Competencies

- **Objective:** to equip trainers with the necessary pedagogical and technical skills to deliver effective training.
- **Content:**
 - Communication strategies for engaging various stakeholders (e.g., architects, engineers, construction workers, B&DW collectors).
 - Hands-on workshop techniques, including simulations using BIM and other digital tools.
 - Ways to moderate group discussions on practical challenges related to implementing the circular economy and digitalization.
- **Training method:** role-playing exercises where trainers practice delivering content to diverse audiences, adapting the complexity based on their backgrounds.



Module 3: In-depth Knowledge of Material Recovery and Reuse Processes

- **Objective:** to provide trainers with a comprehensive understanding of material recovery processes, reuse strategies, and their integration with digital technologies.
- **Content:**
 - Overview of commonly recovered materials in construction (e.g., concrete, steel, timber) and challenges related to quality and safety assurance.
 - Use of digital platforms to track material recovery, assess material lifecycles, and implement certification systems such as Environmental Product Declarations (EPDs).
 - Tools and techniques to assess the performance of recovered materials (e.g. structural integrity testing, chemical analysis).
- **Training method:** interactive sessions using digital tools that track the lifecycle of construction materials, from demolition to reuse.

Module 4: Digital Tools for Increasing Circularity in Construction

- **Objective:** to introduce trainers to advanced digital tools and their application in circular construction projects.
- **Content:**
 - In-depth training on BIM, emphasizing the ability to design buildings with material recovery in mind.
 - Introduction to digital material passports and how they facilitate the tracking and reuse of materials.
 - The use of IoT and AI to optimize resource use and predict material degradation.
- **Training method:** hands-on sessions with BIM software and demonstrations of IoT devices applied in construction projects to support material loop closure.

Module 5: Circular Economy Legislation and Standards in Construction

- **Objective:** to familiarize trainers with the regulatory landscape and standards supporting circular construction practices.
- **Content:**
 - Overview of global, European, and local policies that promote circular construction, such as the EU Green Deal and the Waste Framework Directive.
 - Guidelines for implementing material recovery and reuse processes in accordance with safety and environmental standards.
 - Certification processes for construction projects compliant with circular economy principles (e.g. LEED, BREEAM).
- **Training method:** group discussions on how to deal with regulatory challenges, supplemented by role-play exercises including mock compliance audits.

Module 6: Sustainability and Impact Assessment

- **Objective:** To teach trainers how to assess the environmental, economic, and social impacts of circular construction.
- **Content:**
 - Life Cycle Assessment (LCA) methodologies for evaluating the sustainability of materials and construction processes.
 - Quantitative and qualitative impact assessment tools for circular projects.
 - Case studies demonstrating how digitalization improves sustainability outcomes in construction projects.
- **Training method:** case-based learning that covers the application of LCA tools in circular construction projects.

Module 7: Engaging Stakeholders in Circular and Digital Construction



- **Objective:** Teach trainers how to engage stakeholders across the construction value chain (e.g., clients, contractors, suppliers) in circular and digital processes.
- **Content:**
 - Strategies for communicating the benefits of circularity and digitalization to different stakeholders.
 - Collaborative digital platforms that enhance transparency and coordination across the supply chain.
 - Techniques for overcoming resistance to change in traditional construction practices.
- **Training method:** Workshops where trainers facilitate stakeholder engagement exercises, simulating real-life interactions.

Module 8: Monitoring and Continuous Improvement

- **Objective:** to instill a culture of continuous improvement in trainers, focusing on monitoring progress and refining circular and digital processes.
- **Content:**
 - Key Performance Indicators (KPIs) to track the effectiveness of circular economy practices and digital tool implementation.
 - Techniques for gathering feedback from trainees and stakeholders to improve training content.
 - Adaptation of new technologies and methods in line with evolving industry trends and regulations.
- **Training method:** Peer-to-peer feedback sessions and use of digital monitoring tools to assess project progress.

II. Evaluation and Certification

- **Objective:** to certify trainers based on their ability to effectively deliver content and understand the principles of circular construction and digitalization.
- **Content:**
 - Trainers will undergo both theoretical and practical assessments, including conducting a full training session and demonstrating proficiency in using digital tools.
- **Training method:** Trainers will receive feedback from peers and evaluators, and a certificate will be awarded upon successful completion of the training.

The program follows an participatory learning methodology:

- **Case-based Learning:** Real-world examples to illustrate concepts and facilitate learning.
- **Role-playing and Simulations:** To develop communication skills and practice engaging diverse stakeholders.
- **Hands-on Workshops:** Practical application of digital tools like BIM, IoT, and LCA in construction.
- **Interactive Group Discussions:** Promoting critical thinking and collaborative problem-solving.
- **Continuous Feedback:** Peer-to-peer and expert feedback will help trainers improve their delivery and content understanding

Conclusions and future outlook

By the end of the program, trainers are expected to:

- Understand the fundamental concepts of the circular economy and digitalization in construction.
- Effectively use digital tools (BIM, IoT) for promoting circularity.



- Develop coaching and communication skills for engaging diverse stakeholders.
- Implement material recovery processes with a strong focus on quality and safety.
- Navigate and apply circular economy regulations effectively.
- Engage stakeholders and facilitate group discussions on circular economy practices.
- Monitor and continuously improve training and project outcomes based on KPIs and feedback.



2. Conclusion

Deliverable D.1.2.6 is essential for testing and establishing transnational programmes for knowledge creation and capacity building. The ReBuilt education/training programme focuses on developing "T-shaped" experts for circular and digital construction—individuals with broad knowledge but specialised skills in a particular area. With the training programmes we will include five (5) target stakeholder groups: Industry & SMEs, Governments & public servants, University & vocational students, Architects & Investors, and Trainers (train-the-trainer). The tailored learning programmes will help target groups adapt to circular and digital knowledge and practices and develop new circular business models.

This document (D1.2.6) outlines programmes with different modules on circular and digital construction, such as circular economy, secondary raw materials, new technologies, green and sustainable materials, life cycle assessments, environmental product declarations, etc. With the training, the stakeholders will reduce knowledge and skill gaps in the circular economy in construction, as well as digital technologies like BIM, digital material/ product passports, and digital platforms, as well as resource-efficient practices.

At the same time, the training programmes will provide comprehensive information about various EU legislative frameworks, which are crucial for understanding the circular construction industry's regulations. The programmes respond to industry needs for professionals with green skills in circular and digitalised construction in Central Europe.

The ReBuilt project plays a pivotal role in presenting lifelong learning to professionals. By performing the trainings and introducing the essential circular and digital knowledge and skills, we will help professionals shift from linear to circular and digital business models. These programmes aim to bridge knowledge gaps and ensure that future professionals are equipped to meet the construction industry's social, environmental and technological challenges. This emphasis on continuous professional development in circular and digitalised construction underscores the project's long-term impact and sustainability.