Circularity in the built environment

A Reading Guide

ECESP Leadership Group Circular Construction & Infrastructure, March 26th 2025

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Introduction

The past 5 years we have seen significant advancements in adopting circular principles within the construction and infrastructure sectors. The focus has shifted towards minimizing waste, maximizing material efficiency, and integrating sustainable practices at every stage of the building lifecycle. Key trends include the rise of modular construction, increased use of recycled and reused materials, and the development of policies that support circular economy initiatives.

This reading guide is designed to help architects, building companies, real estate developers, material suppliers, policymakers and other stakeholders navigate the wealth of information available on circular principles in the built environment. By curating key publications, guides, and tools, the leadership group on Circular Built Environment aims to provide a comprehensive starting point for stakeholders to integrate circular practices into their organizations. The guide is structured around key themes, followed by a detailed list of the publications for further reading. This approach ensures that readers can quickly grasp the essential concepts and then delve deeper into specific topics of interest.

In addition to providing a comprehensive overview of key publications, this guide highlights the significance of the R strategies—Refuse, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, and Recycle—as a foundational framework for the circular economy. These strategies offer a systematic approach to minimizing waste and maximizing resource efficiency, which are essential principles for achieving sustainability in the built environment. By understanding and implementing the R strategies, stakeholders can make informed decisions that contribute to a more resilient and regenerative construction sector.

Integrating circular principles into day-to-day working processes is not easy. That is why Circular Flanders has created an ambition chart, a detailed framework to determine priorities and circular strategies for design and construction. It helps cities and regions, as well as private project developers, to engage in discussions with project stakeholders to make circular choices and select appropriate actions. And since a common language is also crucial to work together on circular construction, the Dutch initiative 'The new normal' aims to establish a shared standard and language for circular construction. Circular construction is expressed in nine indicators, with corresponding measurement and assessment methods. Thanks to this shared language, parties involved in the building process can make agreements on their performance in circularity.

STRATEGIES FOR DESIGN AND CONSTRUCTION

Responsible use of raw materials and resources > Avoid premature demolition > Keep materials in the cycle

A	B	C	D	E
minimise total **AMOUNT** of materials	minimise **ENVIRONMENTAL IMPACT** of materials	extend the **USEFUL LIFE** of buildings	maximise the **REUSABILITY** of elements	maximise the **REUSABILITY OR RECYCLABILITY** of materials
A1 **question needs for new construction** and/or fulfil them differently	**B1** gain insight into the environmental impact of the building (**materials & energy**) & optimise via TOTEM	**C1** design with potential for **future functions** (functional adaptability)	**D1** detailing with consideration for easy dismantling **(reversibility)**	**E1** choose elements that can be dismantled into pure **raw materials**
A2 preserve the value of **existing heritage**	**B2** focus on **reusing elements/materials** & assess environmental impact via TOTEM	**C2** design for **adaptability:** flexibility, versatility, “support-infill-principle ”	**D2** design with consideration for **modularity, prefabrication, standardisation**	**E2** keep **harmful/toxic substances** out
A3 **share spaces** with third parties	**B3** invest in materials with **high recycled content** & assess environmental impact via TOTEM	**C3** design with consideration for **future extension**/ ”in-fill”	**D3** consider **compatibility & interchangeability** when choosing construction elements	**E3** choose (raw) materials that are **biodegradable** or can be disposed of responsibly
A4 **share technical equipment** with third parties	**B4** focus on **bio-based structural elements/ materials** & assess environmental impact via TOTEM	**C4** design for future maintenance, upgrading & repair: include independent & accessible **functional layers**	**D4** choose elements with contractual agreements **regarding take-back schemes**	**E4** choose (raw) materials with **already existing, closed loops**
A5 make spaces **multifunctional**	**B5** avoid irresponsible management of **natural resources** (forest cover, arable farming, quarries, etc.)	**C5** choose **robust & high-quality** materials	**D5** identify **existing valuable parts** during renovation/ dismantling	**E5** choose elements/ materials with a **take-back guarantee and/or recycling guarantee**
A6 **dematerialisation at the structural level:** design lightweight structures	**B6** minimis e **energy needs**	**C6** Building stock regularly **maintained** & optimally **managed**	**D6** **identify & record elements/ components** of the new building	**E6** **identify (raw) materials** in existing elements/ components
A7 **dematerialisation at the material level:** design with raw materials as finishing (without additional layers)	**B7** use **renewable energy sources**	**C7** contractually encourage the **extension of useful life**	**D7** **preserve elements that have cultural value (e.g. heritage)** in subsequent building cycles	**E7** identify **elements, materials & raw materials** during renovation and/or dismantling
A8 **dematerialisation at the technical level:** design smart-tech solutions	**B8** **meet remaining energy needs** as efficiently as possible			**E8** **tap into second-hand markets or platforms** for selective demolition and/or disassembly

Circular Design Principles

The Circular Built Environment Playbook offers practical guidelines for implementing circular practices, including design strategies and material selection. Encouraging the adoption of these principles in architectural education and professional training programs is crucial for widespread implementation. DGNB provides a definition and brief introduction to circular building in its publication Focus on: circular building. Holland Circular Hotspot offers complete overviews on circular buildings and circular infrastructure, including different design strategies. The public waste agency of Flanders published a guidebook on future proof design for the construction sector. Another guide, Zirkuläres Bauen erfolgreich umsetzen, aimed at decision-makers, construction managers and planners, provides an introduction to the topic as well as information on the relevant key aspects and levers to enable circular construction. The section below provides a deep dive into one of these principles:

Design for Disassembly and Reuse

One of the fundamental principles for the built environment is designing buildings for disassembly and reuse. This approach not only extends the lifecycle of materials but also reduces waste and environmental impact. Insights from the Whitepaper on Circular Construction emphasize modular building components that can be easily reused or repurposed. Design for Disassembly in the built environment delves into strategies for creating buildings that facilitate future changes and dismantlement, promoting material recovery and reducing waste. In The Netherlands, Lente-akkoord published a new catalogue on disassembly detailing (in Dutch).

Case studies include Mobble and other modular construction projects that demonstrate the feasibility and highlight the benefits of designing for disassembly.

Materials and Resource Efficiency

Efficient use of materials and resources is a cornerstone of the circular economy in the built environment. By assessing lifecycle impacts, prioritizing sufficiency, and embracing innovative materials and methods, stakeholders can significantly reduce environmental footprints while maintaining economic value.

Life cycle assessment (LCA)

The Circular Buildings: Constructing a Sustainable Future publication discusses the role of lifecycle assessment in achieving sustainability goals. By evaluating the environmental impact of materials from production to disposal, stakeholders can make informed decisions that enhance material efficiency and reduce waste.

Sufficiency

The first circular strategy and an effective measure for material efficiency is sufficiency. Sufficiency focuses on optimising the use of existing buildings to create a built environment that is attractive, affordable, and aligned with the actual space and accessibility needs of occupants, all while respecting planetary boundaries. Four publications were launched on this topic: Sufficiency in the building sector (EU Commission report), the factsheet on sufficiency in the built environment of the European Environmental Bureau (EEB), the paper 'Prioritising Existing Buildings for people and climate (BPIE) and the UNEP/Global ABC sufficiency hub publication all identify sufficiency measures that reduce the need for unnecessary new construction by maximising the use of existing buildings.

Circular Materials

An example presented in this paper is the Biosintrum. Innovations in recycled materials, such as using reclaimed wood and recycled concrete, are highlighted as effective ways to reduce the environmental footprint of construction projects. The recap of the Interreg Europe Policy Learning Platform event on Promoting sustainable materials and circularity in construction offers an overview of more good practices within Europe. In Circubuild's podcast (Dutch) experts discuss the application and benefits of biobased materials in construction.

Urban Mining and Reuse of materials

Urban mining is an essential part of a circular construction economy: by carrying out selective demolition of buildings, recovering as many valuable materials and products as possible from the demolition site or via a sorting centre and preparing them for recycling and reuse, material loops are closed and value is maintained. Barriers and possible strategies are summarized in Circular Flanders' project learnings on urban mining. Circuit's (Interreg) report describes good practices and recommendations on urban mining. The Urban Mining Manual (Platform CB'23) provides methods for inventorying and harvesting materials from existing buildings. The Urban Mining Index measures the reuse and recyclability potential of materials in buildings to promote resource efficiency and circular construction.

Buildwise, in collaboration with Tracimat and VITO, has created a study and created a database at the request of OVAM: VISUM, describing pathways for recycling non-stony construction materials. For each waste stream, information is gathered to help the relevant actors in the chain in getting it to its destination: recognising it in the building, logistics, intermediate storage, recycling, new application, etc.., all these data dynamically offered on multiple platforms, and it will be kept up to date over time.

The webinar series (in French) of INEC, Toulouse Métropole and France urbaine provides exemplary approaches on how to reuse construction resources, based on the lessons learned from the LIFE Waste2Build project.

Standardization and Digitalisation

To make the transition to a circular economy in the construction sector feasible, promoting standardization is crucial.

International standards on circular economy

Standards are crucial for the circular economy as they provide consistent guidelines that ensure quality and reliability across industries and borders. ISO TC 323 on circular economy has taken a holistic perspective launching the development of related standards. They help organizations manage resources more sustainably, reduce waste, and improve product lifecycle management. Additionally, ISO standards foster consumer trust in recycled and upcycled products, promoting broader adoption of circular practices regardless of the economic sector. They provide a comprehensive set of reference standard for supporting the shift towards circular business practices and business models, fully applicable to the building and construction sector.

The four ISO standards on circular economy published so far are:

1. ISO 59004:2024 - Vocabulary, principles, and guidance for implementing circular economy practices.
2. ISO 59010:2024 - Guidelines for the transition of business models and value networks.
3. ISO 59020:2024 - Measurement and evaluation of circularity.
4. ISO 59040:2025 - Product circularity data sheet.

Frameworks for Measuring Circularity

The report Circular technologies in construction explores 4 strategic areas that could benefit from standardization: a) frameworks and indicators to measure circularity, b) quality assurance of reused and recycled material, end-of-waste criteria, c) design for circularity, adaptability and disassembly, and d) building. DGNB provides a Circularity Index and Quality Standard to support decision-making in construction projects and promote the transition to a circular economy.

Digital product passports

The whitepaper Digital product passport for construction products delves into the concept of DPP's, emphasizing their role in enhancing data transparency and circularity within the construction industry. It discusses pilot projects and best practices, offering practical guidance for implementation. The WBCSD's report dedicates a chapter to DPP's in the construction industry, detailing strategic areas, opportunities and barriers.

DPPs and Building Information Modelling (BIM) are complementary tools that significantly enhance data transparency and circularity within the construction industry. By integrating DPPs with BIM, stakeholders can access comprehensive, real-time information about construction products throughout their lifecycle. In the publication Digital Technologies and Material Passports for Circularity in Buildings: An In-Depth Analysis of Current Practices and Emerging Trends (p692) the significant potential of digital technologies is highlighted, including BIM and digital product passports, to support circular economy applications throughout the building lifecycle. The research 'QR Code-Based Material Passports for Component Reuse Across Life Cycle' explores the digital and physical applications of QR code-based material passports to track building elements through their life cycle.

Digital Tools

While Life Cycle Assessment (LCA) remains the main approach for evaluating environmental impacts, the study From LCA to circular design: A comparative study of digital tools for the built environment highlights other methods and tools that can help assess circular design strategies, such as computational methods to design with reused elements and circularity indicators. The paper identifies both the strengths and limitations of these digital tools.

Examples of tools in use:

- This Concular tool aims to 'transform the real estate and construction industry towards a circular, sustainable way of doing business' through an AI-driven platform that matches buyers' demand for construction material with suppliers' circular materials.
- Globechain aims to promote circular economy in the architecture and construction sector. Users can exchange resources, building materials, furniture and second-hand building components, as well as ideas for reuse in architecture, construction and crafts.
- DGNB provides the DGNB Building Resource Passport for documentation of building resources.

Policy and Regulation

Regulatory Frameworks

The Circular Economy Action Plan (EU Commission) outlines policies to support circularity in construction. "Creating a roadmap towards sustainability" aims to guide decision-making and assess the implementation of the CEAP for both new and existing buildings.

The long-awaited new Construction Products regulation enters into force on 7 January 2025. EBC and Small Business Standards have developed an SME guide to navigate the changes. The guide simplifies complex requirements and offers practical tools to support SME manufacturers and users. It explains key changes in the regulation, such as elements to support sustainability of construction products and the introduction of the Digital Product Passport. It also provides step-by-step advice on compliance, from identifying technical specifications to preparing essential documentation. Tailored for SMEs, the guide is an essential resource for navigating the revised rules and ensuring products meet EU standards. In November 2024, INEC published the guide Deploying the circular economy: Construction (in French) to help players understand the regulations on circular construction and make their worksites more circular. It aims both to clarify the constantly evolving regulations and to go further by sharing best practices and successful feedback.

The World Green Building Coalition developed an EU Building Policy Tracker, which takes stock of what progress has been made by the European Commission to facilitate the full decarbonisation of the EU's built environment by 2050.

Policy recommendations:

Policy frameworks can be a barrier or an enabler for the reuse of construction products. Nordic sustainable construction explores the opportunities in their Report: Policies Enabling the Reuse of Construction Products in the Nordics. In their report "Towards a Circular Economy in the Built Environment Overcoming market, finance and ownership challenges", the Circular Building Coalition explores systemic challenges to accelerating the circular transition in the construction sector in Europe, and what can be done to overcome them.

In C3's Guide to circularity in the built environment, city administrations are advised on how to take a leading role to promote the shift to more circular construction. Circular Flanders and VVSG created a guidance for local governments highlighting the benefits to commit to circularity in their building and renovation projects. It offers strategies to use less materials or use them more efficiently(responsible material use), to overall create adaptable, sustainable buildings for the future.

The report "Circular Construction: From Dream to Political Practice in the EU" outlines several key policy recommendations to advance circular construction practices. It emphasizes the need for regulatory frameworks that support the reuse and recycling of construction materials, promoting eco-design principles to ensure buildings are designed for disassembly and material recovery. The need for financial incentives is highlighted to encourage the adoption of circular practices, such as tax reductions or subsidies for using recycled materials. This report also highlights the importance of public procurement policies that prioritize circular construction projects, and educational initiatives to raise awareness and build skills in the sector.

Public Procurement

Case studies from the Final Report on Green Deal Circular Construction further highlight the importance of public procurement policies prioritizing circular projects. In the learning hub of circular procurement.be an overview of specific criteria and cases are available to use in tenders on construction and on infrastructure.

Economic and Enviromental Benefits

The Brochure on Circular Buildings and the Building Prosperity: The Circular Economy in the Built Environment both highlight the economic and environmental benefits of circular buildings. Reduced environmental impact, cost savings, and economic growth are some of the key advantages. Promoting public awareness and developing financial incentives for companies that adopt circular practices are recommended actions. The Whitepaper on Circularity in the Built Environment offers strategies for a sustainable transition in the built environment, highlighting how reimagined circular design, technology and business models can unlock environmental and economic value. Four circular building pathways towards 2050 investigates social and carbon reduction scenarios based on 4 pathways: build nothing, build efficiently, build with the right materials and build for long-term use. The benefits of circular economy on climate targets via the introduction of the M-level, has been the topic of a research done by the CE Center. Through the use of lower impact building materials, the carbon emissions and total environmental impact of new construction and extensive renovation of residential homes can be lower than current practices. The total reduction in greenhouse gas emissions through the introduction of the M-level for construction and renovation for the Flemish non-ETS sector is estimated at approximately 146 kilotons of CO2-eq. per year; the gain in terms of environmental impacts is estimated at approximately 9,000 points per year.

Best practices

The Final Report on Green Deal Circular Construction provides valuable insights from successful case studies. These examples demonstrate the practical application of circular principles and highlight the benefits of collaboration between stakeholders. Sharing best practices and developing standardized methods are key recommendations from this report. The researchers that observed these experiences bundled their insights in guidebooks on urban mining, circular construction, circular procurement and a matrix for cities. More case studies and best practices from around the world can be found on the Ellen MacArthur website but also on the ECESP website and on the website of Circular Flanders.

In several publications case studies emphasize the importance of policy support and cross-sector partnerships between government, industry, and academia to drive the circular economy forward. Knowledge-sharing, education and training are essential to accelerate the transition. TU Delft offers open online courses on Circular Construction while Nordic Sustainable Construction has a dedicated webpage with educational material for teachers at vocational schools in 7 languages. ETH Zurich provides a continuing education program on the use of earth, bio-based, and reused building materials, aimed at professionals in the construction industry who are interested in sustainable construction practices in their CAS ETH in Regenerative Materials. The MOOC ETH in Regenerative Materials and Construction is a free, open-access online course that introduces the basics of regenerative sustainability in construction, targeting architects, engineers, builders, material producers, and city officers with an interest in sustainable construction techniques and materials.

Publications and Resources

Overview of the publications

- Impacts of Circular Economy on climate targets: M-level in construction and renovation (CE Center, 2025)
- Sufficiency in the building sector – For the whole life carbon roadmap – Final report (European Commission: Directorate-General for Environment, 2024)
- Sufficiency in the built environment: a fact sheet (European Environmental Bureau, 2024)
- Circular Construction: from dream to political practice in EU (Green Transition Denmark, December 2024)
- Brochure on Circular Buildings (Circular Cities and Regions Initiative, August 2024)
- VISUM, describing pathways for recycling non-stony construction materials (OVAM, 2024)
- Prioritising existing buildings for people and climate (BPIE, 2024)
- UNEP/Global ABC sufficiency hub publication
- Local circular construction: starting with circularity in your municipal construction and renovation projects (Circular Flanders & VVSG, 2024)
- Building Prosperity: The Circular Economy in the Built Environment (Ellen MacArthur Foundation, July 2024)
- Catalogue on disassembly detailing (Lente Akkoord, 2024)
- Four circular building pathways towards 2050 (Circular Buildings Coalition, 2024)
- From LCA to circular design: A comparative study of digital tools for the built environment (European Circular Economy Stakeholder Platform, 2024)
- Circular technologies in construction: Putting science into standards (Joint Research Centre 2024)
- SME guide on the new construction products regulation (Small Business Standards (SBS) and the European Builders Confederation (EB) 2024)
- Deploying the circular economy: Construction (Institut National de l'Economie Circulaire, 2024)
- Whitepaper: Digital product passport for construction products (Bauen digital Schwiez, 2024)
- Promoting sustainable materials and circularity in construction (Interreg Europe Policy Learning Platform, 2024)

Overview of the publications

- Guide to circularity in the built environment (C3 - European Investment Bank, 2024)
- Zirkuläres Bauen erfolgreich umsetzen (Baden-Württemberg, 2024)
- Digital Technologies and Material Passports for Circularity in Buildings: An In-Depth Analysis of Current Practices and Emerging Trends (Czech Technical University in Prague, 2024)
- The Circular Built Environment Playbook (World Green Building Council, 2023)
- Final Report on Green Deal Circular Construction (Vlaanderen Circulair, 2023)
- Guidebook on future proof design (OVAM, 2023)
- Creating a roadmap towards sustainability (Circular Building Coalition, 2023)
- Report: Policies Enabling the Reuse of Construction Products in the Nordics (Nordic sustainable construction, 2023)
- Towards a Circular Economy in the Built Environment Overcoming market, finance and ownership challenges (Circular Buildings Coalition, 2023)
- Circularity in the built environment: Maximizing CO2 abatement and business opportunities (World Economic Forum, 2023)
- Achieving a circular economy: using data-sharing tools, like the Digital Product Passport (WBCSD's, 2023)
- QR Code-Based Material Passports for Component Reuse Across Life Cycle (ETH Zurich, 2023)
- Circular buildings - Constructing a sustainable future (Holland Circular Hotspot, 2022-
- Circular infrastructure: the road towards a sustainable future (Holland Circular Hotspot, 2022).
- Circular Buildings: Constructing a Sustainable Future (European Circular Economy Stakeholder Platform, 2022)
- Whitepaper on Circular Construction (Vlaanderen Circulair, 2022)
- Circular Buildings: Constructing a Sustainable Future (Holland Circular Hotspot, 2022)
- Increasing the reuse & recycling of building materials (CIRCuIT Project, 2022.).
- Urban mining pilot projects: Management summary (Vlaanderen Circulair, 2020)
- Design for Disassembly in the built environment (Lifecycle Building Center, 2005)
- Zirkuläres Planen und Bauen mit Fokus auf die Wiederverwendung von Bauprodukten. Handlungsempfehlung für die öffentliche Hand (Concular 2024)
- Transformation zu einer zirkulären Bauwirtschaft als Beitrag zu einer nachhaltigen Entwicklung (KNBau 2024)

Courses

- MOOC: Circular Economy for a sustainable built environment, TU Delft
- Skills 4 Reuse, Nordic Sustainable Construction webpage.
- CAS in Regenerative Materials, ETH Zurich
- Built environment case studies, Ellen MacArthur website.

Courses

- MOOC in Regenerative Materials and Construction
- Learning hub Circular Construction + cases and Learning hub Circular Procurement, Circular Flanders websites

Podcasts and Webinars

- https://www.circubuild.be/nl/podcasts/experts-ter-zake-over-de-toepassing-van-biogebaseerde-bouwmaterialen-in-belgie/ (in Dutch)
- https://aedes.nl/verduurzaming/hoe-maak-je-100-jaar-oude-woningen-toekomstproof?utm_campaign=alerts&utm_medium=email&utm_source=alerts (in Dutch)
- Circular approaches to affordable Housing Conclusion
- Webinar series on the reuse of construction resources (INEC, Toulouse Métropole and France Urbaine)

Tools

- The ambition chart on circular construction for local authorities offers a detailed framework to determine priorities and circular strategies for design and construction and helps to choose strategies and matching actions that local governments can implement accordingly.
- The Circular Buildings Toolkit has taken the principles of the circular economy and translated them into a prioritised set of strategies and actions relevant for real estate projects. Alongside circular building guidance are real-life examples of how building design and operation can utilise the principles of the circular economy.
- Re-sign (Italy) aims to promote circular economy in the architecture and construction sector. Users can exchange resources, building materials, and second-hand building components, as well as ideas for reuse in architecture, construction and crafts.
- This Concular tool aims to 'transform the real estate and construction industry towards a circular, sustainable way of doing business' through an AI-driven platform that matches buyers' demand for construction material with suppliers' circular materials:
- Globechain aims to promote circular economy in the architecture and construction sector. Users can exchange resources, building materials, furniture and second-hand building components, as well as ideas for reuse in architecture, construction and crafts.
- Madaster is an online registry that documents all materials and products used in real estate and infrastructure, creating material passports to facilitate circular construction by providing insights into dismantlability, embodied
- Urban Mine Platform
- EU Building Policy Tracker - World Green Building Council

Closing Remarks

The transition to a circular built environment is gaining momentum, driven by innovative practices and supportive policies. As we move into 2025, stakeholders in the construction sector should focus on scaling up successful circular initiatives, fostering collaboration, and continuing to innovate. By embracing circular principles, we can create a more sustainable and resilient built environment for future generations.

Our ECESP Leadership group on Circular Built Environment could focus on following aspects, but all ideas are welcome.

- **Policy development**: follow possible initiatives that advocate stronger regulations that mandate circular practices in construction.
- **Market innovation**: communicate on possible investments/subsidies for new technologies and materials that support circularity.
- **Education and training**: enhance and share open educational programs to include circular economy principles in construction-related curricula.
- **Collaboration**: foster partnerships between government, industry, and academia to drive the circular economy forward.

By taking these steps, we can show that the built environment contributes positively to our planet's health and sustainability. If you are interested in joining our Leadership Group contact the secretariat of ECESP and they will bring you in contact with us.