

Built by Nature

Circularity Conceptual Framework:
Advancing low-emission construction materials
through Timber Use in the Czech Republic

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March 2025

The authors would like to thank Built by Nature and the European Climate Foundation for supporting this project. The interpretation of data, sources used, as well as the conclusions and recommendations presented in this document are the sole responsibility of the authors.

With support by:



Built by Nature

Co-financed:



European Climate Foundation (ECF)
Buildings Programme

Project Boosting Mass Timber Construction in Czechia

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About us

[Institute of Circular Economy](#) (INCIEN) is a non-governmental, non-profit organization that has been promoting the circular economy since 2015. INCIEN was founded in response to the unsustainable rate at which natural resources are currently being used, offering circular economy as a practical solution. Our research team conducts studies that provide valuable know-how tailored to the Czech context. Under another key pillar, Consulting, we have conducted hundreds of consultations across both the public and private sectors, helping to monitor and optimize the development and implementation of circular practices. We are committed to moving the Czech economy toward a circular future.

[Built by Nature](#) (BbN) is an international network and philanthropic organization committed to accelerating the shift toward sustainable construction through increased use of timber and other renewable bio-based materials, founded in 2021. The organization supports innovative design and building approaches that contribute to the regeneration of natural systems and the creation of healthier living environments. BbN connects frontrunners in timber construction, creates spaces for sharing best practices, and inspires climate-positive projects, including multi-storey timber buildings. Through its grant-making and collaborative efforts, BbN aims to mainstream timber as a key material for sustainable building across the globe.

As part of the BbN-supported project "Advancing Mass Timber Construction in the Czech Republic," our goal is to support the development of multi-storey timber buildings in the Czech construction sector, with a focus on residential buildings—currently representing less than 1% of this segment in the country. Our approach is inspired by the successful Dutch model of voluntary Green Deals. This type of agreement is a collaborative initiative that brings together a wide range of stakeholders—from public institutions and local governments to the private sector, investors, academia, and civil society organizations. The agreement sets clear goals, defines specific actions and timelines, and outlines the roles and commitments of each participant. We aim to create and pilot a similar agreement in the Czech Republic, engaging at least 10 key industry stakeholders and one ministry. The objective is to support the development of multi-storey residential buildings using timber and other low-emission materials in a way that fits the Czech context. Through this pilot implementation, we seek to position mass timber construction and other sustainable construction systems as an attractive, sustainable, and mainstream solution in the Czech building sector.

The project "Advancing Mass Timber Construction in the Czech Republic" was originally focused exclusively on supporting multi-storey buildings made of timber. However, during its implementation, and in agreement with representatives of BbN, the scope

was expanded to include other low-emission construction materials. This document will nevertheless focus primarily on timber, even though the final agreement will also encompass a broader range of sustainable materials.

Introduction

The global construction sector is a major source of energy demand, waste material, and greenhouse gas (GHG) emissions. Approximately 37% of all GHG emissions arise from the lifecycle of buildings.¹ This outsized climate impact reflects both the carbon intensive practices needed to build these structures (embodied emissions) and the need to heat, light, and maintain their basic functions (operational emissions).² Materials like concrete and steel, common in current construction practices, add significantly to the carbon footprint of the built environment. Moreover, with the shift to renewable energy and increased energy efficiency of buildings, embodied emissions from the material cycle will likely contribute the dominant share of total building sector emissions within the next decade - indeed, this is already the case for some new high energy efficient modern buildings.

In recent years, timber construction has emerged as a key pathway to drive down emissions from the construction industry and create a more sustainable built environment. Timber construction has been a common practice for single family homes across the globe, particularly in North America and Scandinavia. Advances in structural wood materials like cross laminated timber (CLT) and innovative modular design practices are opening up new pathways for timber based high-rise structures. Compared to their steel and concrete counterparts, timber structures offer numerous environmental benefits. A recent Swedish study of CLT based high rises found a 50% reduction in GHG emissions compared to traditional designs. In addition to their direct emissions benefits, timber structures also store significant amounts of carbon.³ Close to 50% of the mass of timber is made up of carbon alone.⁴ Through utilizing timber in construction, this carbon is sequestered safely away for the lifespan of the building and potentially much longer.⁵

However, as the timber construction sector expands and new uses for natural fiber materials are found, demand for roundwood and forestry residues threatens to reach an unsustainable level. If current trends hold, the European Union (EU) expects to see a 33% increase in roundwood harvests by 2050.⁶ This increase in demand is predicted to be accompanied by a further decrease in the EU forest carbon sink from -290 Mt CO₂/yr in 2020 to as low as -92 Mt CO₂/yr by 2050. Counterintuitively, less intensive forestry practices that leave forestry residues to decompose and return

¹ Building materials and the climate: constructing a new future - UNEP (2023)

² Circularity concepts in wood construction - UNECE (2023)

³ Comparative carbon-footprint analysis of residential buildings with different structural materials - Department of Building Technology, Linnaeus University, Växjö, Sweden (2022)

⁴ How sustainable timber buildings can help fight the climate crisis - ECOS (2023)

⁵ Timber and carbon sequestration - Will Hawkins, MEng, PhD (2021)

⁶ Simulating future wood consumption and the impacts on Europe's forest sink to 2070 - Publications Office of the European Union (2024)

to the ecosystem result in worse outcomes for the carbon sequestration potential of EU forests. This trend is due to the increased area of land needed to be logged in order to meet demand for timber biofuel. When viewed in this light, it becomes clear that no known change in forestry practices can counteract the negative effects of growing wood demand. Instead, demand for virgin wood sources must be managed within sustainable limits through a number of channels. Key amongst these: A circular model for wood use in the economy.

The circular wood bioeconomy revolves around the principle of cascading use. In a cascading use model, wood products are kept in the value chain after they serve their primary purpose through reuse in other projects, recycling into similar or lesser value wood-based products, and final incineration for energy production. Wood's versatility as a material for a circular economy lies in its ability to cascade through uses in both technical and biological cycles of reuse.⁷ Timber starts in the biosphere as a living resource. Once felled, timber moves into the technical side of the circular economy. On the technical side, timber is processed into products like lumber and CLT that can be maintained, reused, refurbished, and eventually recycled into lower value goods. However, unlike materials like glass and concrete, once wood reaches the end of its useful life as a product, it can be burned to capture the last of its useful energy before returning to the biosphere as ash and CO₂ ready to become live timber once again. Thus, the timber industry can become a completely circular one of growth, extraction, processing, reuse, combustion, and an eventual return to the biosphere.

The construction sector is a critical sector for this circular use of timber. Many construction materials like lumber, mass timber, and particle board have high value and high potential for reuse and recycling into other wood products. Thus, their lifespans can stretch into decades or even centuries.⁸ Incorporating circular principles into the industry has great potential to close the loop not only in construction, but also in many adjacent wood-based value chains that currently rely on limited virgin roundwood supplies.

Circular practices in the timber construction industry are already well recognized as the future of a sustainable built environment. Increasingly, new projects are implementing measures of sustainability and carbon emissions into their considerations in the design phase. Tools like life cycle analysis (LCA) and whole life embodied carbon (WLEC) assessments can quantify the impact new structures will have on the climate and potential pathways for circularity. The long-term carbon sequestration potential of wood structures is also becoming a more prominent consideration for new circular designs.

Construction practices like prefabrication and modular designs have emerged as viable strategies for reducing cost and waste materials compared to traditional construction methods. These techniques focus on creating standardized building

⁷ The butterfly diagram: visualising the circular economy - Ellen MacArthur Foundation (2021)

⁸ Circularity concepts in wood construction - UNECE (2023)

modules ranging in scope from simple exterior panels to fully furnished rooms and structural elements. These modules are constructed off site in factories before being shipped to the build location and assembled. This method minimizes waste material whilst offering opportunities for deconstruction and recycling at the end of the structure's life cycles. For example, recent projects by the HDO Groep in Leiden highlight the potential of prefabricated modular timber structures to meet housing shortages facing many EU cities.⁹

Digital design and material tracking tools will play a vital role in this shift towards prefabrication and modular timber construction.¹⁰ The adoption of building information modeling (BIM)—a data-rich system of digitised architectural renderings, system functions, and material information—is shifting design and planning processes in the construction industry to digital platforms.¹¹ By incorporating LCA information into these systems, new structures can be designed in an integrated manner with sustainability and a minimized carbon footprint front of mind. Products like Autodesk's Revit already include LCA compatible add-ons that can connect BIM files to their corresponding LCA data.¹² However, these tools require large amounts of additional data that are time consuming to procure and add significantly to project complexity. Material passports are another emerging tool in the arsenal of architecture and construction professionals. These passports keep track of data on embodied carbon, certifications, sourcing, deconstruction potential, and much more for construction materials. This data can improve the accuracy of LCA models and increase the circular reuse potential of buildings when they reach the end of their lifespan.¹³ Streamlining the integration of LCA data into BIM platforms and the adoption of material passports will be key steps towards a circular future for the construction industry.

New industries and supply chains are expanding to make use of recycled wood from construction. Products like particle boards are well suited to utilize recycled wood. For example, Italy has already reached 100% recovered wood inputs in particle board production.¹⁴ Moving down the ladder of cascading uses, new wood-based adhesives, foams, glycols, and bioplastics are entering the market, providing sustainably sourced alternatives to their petroleum based equivalents.

There is no shortage of success stories in the timber construction economy. Many countries like the United States, Canada, Japan, and Sweden already have entrenched timber home construction traditions.¹⁵ A key next step for these

⁹ HDO Groep Builds 75 Relocatable Homes in Leiden: A Case Study in Sustainable Construction - Madaster (2025)

¹⁰ New Workflows for Digital Timber - in book Digital Wood Design (pp.93-134) (2019)

¹¹ A Digital Evolution, Majority Using BIM - Hubexo North UK

¹² A BIM-based tool for embodied carbon assessment using a Construction Classification System - Sara Parece, Ricardo Resende, Vasco Rato (2024)

¹³ What are Material Passports and what are the benefits of using them? - UKGBC (2024)

¹⁴ Circularity concepts in wood construction - UNECE (2023)

¹⁵ Circularity concepts in wood construction - UNECE (2023)

frontrunners is to create a circular framework for reuse of the plentiful used wood supplies they possess. In Canada, this process is already underway with players such as the salvage and deconstruction company Unbuilders. Countries with traditionally less wood-based building practices are also joining the push for timber construction. The Austrian Wood Initiative has already seen progress with the creation of a national timber policy, financial incentives for wood use, and increased investment into education and innovation in the timber bioeconomy. Czechia has also joined the trend with the adoption of a new Raw Material Policy for Wood and updating fire safety norms to facilitate the permitting of timber structure buildings up to a height of 22.5 metres. Despite these modest advances, policies promoting timber construction and the greater use of timber are yet to be fully implemented.

This paper aims to provide a framework for a circular timber construction ecosystem and outline the benefits circularity brings to the construction industry. It will serve primarily as an overview of existing frameworks from around the world and the successes and challenges of these initiatives. There is no one size fits all approach to an industry as reliant on local material availability and ecological conditions as timber. However, by exploring a range of solutions and ideas in the sector, this paper offers a framework for future initiatives and regulations in the circular timber bioeconomy. This framework is accompanied by a National Research Brief developed as part of the initiative on the state of timber and bio-based construction in Czechia. Together, these documents are intended as supporting materials for the *Partnership for the construction of standardized apartment buildings using low-emission materials*.

Principles of Circular Economy

The circular timber bioeconomy is already a well defined and researched area of study. However, large hurdles remain to be overcome before these research results and pilot initiatives reach an impactful scale in the industry. To understand these challenges it is necessary to outline the circular economic model in well defined categories.

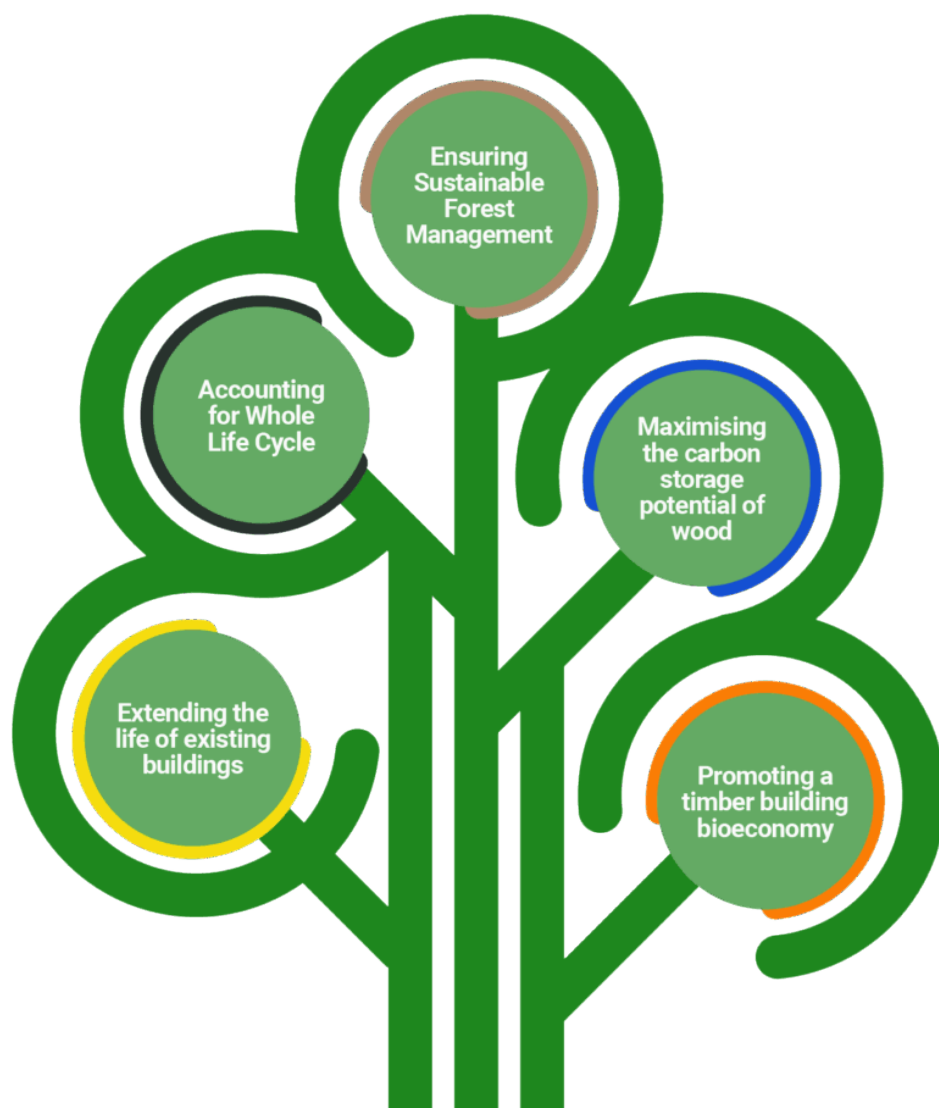


Diagram 1: Principles for Responsible Timber Construction, created by BbN.¹⁶

¹⁶ Principles for Responsible Timber Construction (Built by Nature).

This chapter is structured around five key principles of circular timber construction, drawing on the BbN *Principles for Responsible Timber Construction* (PRTC) and the emerging Czech *Partnership for the construction of standardized apartment buildings using low-emission materials* commitments and its three core circularity parameters (design for circularity, waste as a resource, digitalization). The objective is to provide a clear and systematic overview of the practices and technologies that enable a shift from a linear to a circular model. While ambitious, the principles and parameters can be located in the present and their results will be key to targeting a carbon-neutral future for the Czech Republic.

Extending the life of existing buildings

Aligned with BbN Principle **“Extending the life of existing buildings”** and the project’s **“Waste as a resource”** parameter

PRTC #1: *“The potential for existing structures to be repurposed, renovated, and/or extended using timber, biobased, secondary and other low-carbon materials is prioritised over demolition.”*

In one of the first principles for reducing the climate impact of construction, the best building is one that is already built. Europe has a plethora of existing structures at its disposal. Improving the energy efficiency and extending the lifespan of these structures has the potential to greatly reduce the need for new construction, cutting emissions from construction by up to 68Mt CO₂ by 2050.¹⁷ The EU’s Renovation Wave¹⁸, a strategy to modernize older buildings for greater energy efficiency and lifespan, is already having positive impacts on the sector and the longevity of aging structures. Additionally, aligning economic incentives with greater housing efficiency opens possibilities to free up more homes to combat the cost of living crisis hitting the continent. Estimates suggest a full ⅓ of EU houses are underoccupied with unused bedrooms and space to comfortably accommodate more residents.¹⁹

Building on this momentum, there are a number of case studies from across Europe demonstrating how the “build nothing new” principle, also outlined by the Circular Buildings Coalition²⁰, can be successfully applied in practice. For instance, the Square Garden project in Stockholm transformed a former office property into a mixed-use development of 440 residential units and commercial spaces by retaining the original frame, retrofitting it with modern installations, and reusing interior elements such as plaster walls and light fixtures.²¹ Similarly, Amsterdam’s Circular City House prioritized expanding an existing site over demolition, integrating recycled materials and flexible

¹⁷ Webinar #1: Four Circular Buildings Pathways Towards 2050 - Circular Buildings Coalition (2025)

¹⁸ Renovation Wave - European Commission

¹⁹ Towards a circular economy in the built environment - Circular Buildings Coalition (2023)

²⁰ Four circular building pathways towards 2050 - Circular Buildings Coalition (April 2024)

²¹ Square Garden (Kista, Stockholm)

design to allow for future adaptation.²² Both projects show how extending the life of existing structures not only reduces embodied carbon but also delivers high-quality, modern spaces while minimizing resource use and waste.

Accounting for Whole Life Cycle

Aligned with BbN Principle **“Accounting for Whole Life Cycle”** and the project’s **“Digitalization”** parameter

PRTC #2: “New timber buildings and renovations are designed and constructed to be safe and resilient, in ways that minimise Whole Life Cycle impacts, optimising operational efficiency and minimising embodied carbon emissions and other environmental impacts from materials. Carbon is accounted for transparently, clearly differentiating between biogenic and fossil carbon.”

Recent developments in modular construction have been in large part possible thanks to the emergence of precision design software. In a field where misalignments, mere centimeters in size, can render modules useless and precipitate major modifications and delays to the construction process, digital design tools have changed the game. BIM software allows architects and engineers to map out an entire building complete with structural elements, plumbing, wiring, and much more. Using BIM software allows architects, structural engineers, prefabrication plants, and contractors to have access to a shared set of building plans.

While these BIM tools are widely deployed internationally²³, their potential in embodied emissions tracking through life cycle assessments (LCAs) is still largely underutilized. Existing LCA tools for BIM software like Autodesk Revit’s Tally and Oneclick compare a bill of quantities (BoQ) for the design to databases of the carbon impacts of a wide variety of materials. However, to properly function these tools require highly detailed information about the building and the specified materials.²⁴ Projects generally reach this stage of development late on in the design phase, well after key decisions about the structure and general design philosophy of the building have been made. Thus, embodied emissions can become a secondary consideration amongst a whole host of tradeoffs being weighed in the design process. At the same time, some architects and engineers are integrating embodied carbon assessments at the earliest stages of planning. This early focus directly shapes decisions on structural systems, grid layouts, material choices, and servicing strategies—well before a BIM model reaches advanced development. Tools such as Carbon Designer 3D by One Click LCA exemplify this approach.²⁵

²² Circular City House (Amsterdam)

²³ A Digital Evolution, Majority Using BIM - Hubexo North UK

²⁴ A BIM-based tool for embodied carbon assessment using a Construction Classification System - Sara Parece, Ricardo Resende and Vasco Rato (2024)

²⁵ Carbon Designer 3D by One Click LCA

Despite these challenges, work is underway to streamline BIM-LCA interconnectivity and make carbon assessments easier to carry out throughout the design process. Systems like SECClasS are attempting to bridge the gap between BIM software and LCAs by creating a standardized language for BIM objects and LCA data.²⁶ Future LCA software should incorporate these advances to create tools that can be applied throughout all stages of the design process, giving architects and engineers rough LCA estimates early on to guide their design decisions. In the timber construction industry, streamlined LCA tools will allow architects to easily compare timber materials with their traditional reinforced concrete (RC) counterparts in all stages of the design process, providing a clearer picture of the embodied carbon benefits of wood and allowing for iterative improvements on novel timber design strategies.

Beyond embodied emissions, digital tools are opening up new opportunities for resource tracking and long term reuse for construction materials. Material passports in particular have emerged as key tools to track the life cycle and reuse of construction materials.²⁷ These passports act as repositories of information, allowing participants throughout the design, manufacturing, construction, and deconstruction phases to view key data on the origin, physical characteristics, certifications, embodied carbon, and end of life options for a given building element.²⁸ Crucially, these passports can include guidance on circular reuse paths for timber construction elements. As material passports are more widely adopted, newly produced materials can include these reuse pathways, allowing deconstruction firms to quickly and easily identify high value reuse cases for salvaged materials in the future.

Ensuring Sustainable Forest Management

Aligned with BbN Principle **“Ensuring Sustainable Forest Management”** and the project’s **“Design for circularity”** and **“Waste as a resource”** parameter

PRTC #3: “Wood-based construction materials are sourced from forests managed according to best practices in sustainable forest management which as ‘a dynamic and evolving concept, aims to maintain and enhance the economic, social and environmental values of all types of forests, for the benefit of present and future generations’ [UN definition of SFM].”

Despite the great potential of timber as a material, sourcing sustainably harvested roundwood remains a key challenge for the industry. Traditional methods of forestry in the EU rely heavily on even-age monoculture forests and clearcutting.²⁹ While efficient in the short term, these practices and the overall lack of diversity in EU forests

²⁶ SECClasS (Sustainability Enhanced Construction Classification System)

²⁷ What are Material Passports and what are the benefits of using them? - UKGBC (2024)

²⁸ Project Circular DigiBuild - Disruptive technologies, circular economy and the building industry in the Danube area (2025)

²⁹ Bringing EU forestry closer to nature - ECOS (2025)

are detrimental to biodiversity, soil health, and ecosystem functions in the long run.³⁰ Modern forestry practices are bucking these trends. In recent decades foresters have begun to pivot away from these harmful practices towards sustainable forest management (SFM). SFM's practices aim to balance the economic, environmental, social, and aesthetic value of forests through a dynamic system of management. Key principles in SFM include the diversification of tree species, selective cutting—a practice where trees are felled in small groups as opposed to clearcutting, leaving consistent forest cover—and the return of forest residues like stumps and branches to the ecosystem through decomposition and regrowth.³¹ This newfound attention on forest health in the EU has resulted in a 9% increase in forested area across the region since 1990.³²

To continue building out the sustainable timber bioeconomy a common language for forestry practices is needed. Independent certification schemes like FSC and PEFC already exist to verify the sourcing of timber materials. An EU-wide system is still in the works, with EU Guidelines on Closer-To-Nature Forest Management (CNF) serving merely as suggestions for industry best practices. Systems in the past have been plagued by over-reliance on ineffective carbon offset programs and inconsistent implementation.³³ Integrating consistent certification criteria on a continental level will be the next major step in creating a more sustainable, circular model for timber material.

The most sustainable solution to sourcing timber comes in the form of salvaged wood. Even the most ambitious SFM practices cannot completely combat the negative effects of the ever-growing demand for wood and fiber based products. The EU, facing a 33% increase in demand for roundwood by 2050³⁴, needs to adopt circular models of reuse and recycling to keep wood in the value-chain over a longer period, easing the strain on virgin roundwood supplies.

³⁰ Green Deal: New guidelines for sustainable forest management and payment schemes for forest ecosystem services - European Commission (2023)

³¹ The IMPACTT Project: Bridging the gap between construction and forestry - ASPB (2022)

³² State of Europe's forests - UNECE (2020)

³³ Bringing EU forestry closer to nature - ECOS (2025)

³⁴ Simulating future wood consumption and the impacts on Europe's forest sink to 2070 - Publications Office of the European Union (2024)

Designing for circularity

Aligned with BbN Principle “**Maximising the carbon storage potential of wood**” and the project’s “**Design for circularity**” parameter

PRTC #4: “*Wood is used efficiently, and its carbon storage potential is maximised by prioritising and incentivising its use for durable products such as construction where appropriate. Circularity of wood use for buildings is promoted, including design for disassembly to facilitate re-use and subsequent cascading of timber components in successive buildings to maximise the material’s lifespan.*”

While renovation and reuse offer clear environmental benefits, there remain cases where entirely new structures are required. To enable circular futures for these ground-up projects, a rethink of materials is needed. Existing industry norms place heavy emphasis on reinforced concrete and steel structures. These materials have carbon-intensive production processes and sequester little to no carbon. For context, precast concrete, steel reinforced concrete, and precast concrete beams have approximate embodied carbon footprints of 0.15 to 0.25 kgCO₂e/kg and structural steel as much as 1.21 kgCO₂e/kg.³⁵ In comparison, if sequestered biogenic carbon is included, timber construction materials like softwood lumber, LVL, glulam, and CLT have negative embodied carbon emissions in the range of -0.90 to -1.29 kgCO₂e/kg.

The design and modeling stage of construction presents one of the most vital steps in the chain of circularity. Through structures designed with carbon negative components, flexibility, longevity, and deconstruction in mind, the construction industry can shift itself towards a path of circularity and climate neutrality.

Prefabrication is a production style well suited to tackle this challenge.

The prefabrication process starts in a factory where the required materials are delivered and fabricated in a controlled environment with minimal excess material being consumed. Once complete, the constituent panels and modules are transported to the construction site for assembly. This process reduces construction waste by 80%, shortens build times, and benefits from an estimated 40% increase in productivity, all thanks to the increased specialization of the participants involved.^{36,37} By treating construction like other manufactured goods in a production line, the whole industry has the potential to be optimized for efficiency, both in economic and environmental terms. These gains will only grow larger with increased digitalisation of the supply chain.

On the architectural side, prefabrication techniques rely on panelised or modular designs that can be assembled from a set of constituent parts, akin to constructing

³⁵ Circularity concepts in wood construction - UNECE (2023)

³⁶ Circularity concepts in wood construction - UNECE (2023)

³⁷ Design of a modular timber building system - Eindhoven University of Technology (2022)

with Lego. These units range in size from single panels (as in panelised construction) to entire rooms and houses (modular designs). They can vary in complexity from simple structural elements up to fully furnished sections complete with lighting, plumbing, and even basic interior furnishings.³⁸

From a circularity standpoint, modularity is a key enabler for deconstruction and reuse in the end of life phase. Unlike many traditional structures, modular buildings can be deconstructed relatively easily by reversing the process in which they were built. These modules, once removed from the main structure, can be refurbished and reused in other structures or broken down and recycled into similar or lower value materials. In the case of timber construction, whilst a whole module may not be reusable, many timber structural elements can still be salvageable, and other wood components primed for recycling into particle board or fiber-based products.

Examples of modular timber structures have already hit the market across the globe, including the following examples from Europe. In Leiden, modular timber designs were used to construct 75 homes for displaced Ukrainian refugees.³⁹ End-of-life outcomes and deconstruction capabilities were central to the design, ensuring materials from the project enter cycles of reuse once the building has served its primary purpose. A Temporary Museum of Modern Art in Warsaw applied modular timber structures designed for disassembly, enabling reuse and recyclability while incorporating fiber-cement reinforcements.⁴⁰ In Serbia, the Kolarević company producing CLT panels has created a modular design system allowing for adaptable and expandable wood houses. This development has come in step with reinvigorated interest in timber housing in the past two decades in Serbia. The panels produced by Kolarević have shown numerous benefits including lowered construction costs and an 80% decrease in build time.⁴¹ An elementary school in Petrovice, Prague, demonstrates how prefabricated timber construction can deliver quick, adaptable expansion while prioritizing bio-based materials with high recycling potential.⁴²

³⁸ [Circularity concepts in wood construction - UNECE \(2023\)](#)

³⁹ [HDO Groep Builds 75 Relocatable Homes in Leiden: A Case Study in Sustainable Construction - Madaster \(2025\)](#)

⁴⁰ [Temporary museum of modern art \(Warsaw\)](#)

⁴¹ [Circularity concepts in wood construction - UNECE \(2023\)](#)

⁴² [Modular elementary school \(Petrovice, Prague\)](#)

Maximising the carbon storage potential of wood

Aligned with BbN Principle “**Maximising the carbon storage potential of wood**” and the project’s “**Waste as a resource**” parameter

PRTC #4: “Wood is used efficiently, and its carbon storage potential is maximised by prioritising and incentivising its use for durable products such as construction where appropriate. Circularity of wood use for buildings is promoted, including design for disassembly to facilitate re-use and subsequent cascading of timber components in successive buildings to maximise the material’s lifespan.”

The end of life phase of timber construction is critical to maximising the carbon sequestration potential of wood. Currently, the global construction industry is making inefficient use of waste timber from construction. Multiple cycles of reuse and recycling allow wood-based construction materials to stay in the technical side of use far longer than the lifespan of one building. Repurposed wood has the potential to maintain value and sequester carbon for decades, even centuries after its initial use phase ends with vastly lower energy consumption (11-13x less) and climate change potential compared to standard methods of demolition and reconstruction with virgin wood sources.⁴³ In the US in 2018, 75% of wood construction and demolition waste (CDW) was landfilled whilst only 5% was recycled. In the EU the outlook is better with 49% of all reported wood waste having been recycled, 48% combusted and only 3% reported as landfilled in 2018. Currently, Japan is a leader in circular wood use with over 80% of wood waste being recycled.⁴⁴

These figures underscore the need to not only improve waste management but also rethink how timber is designed, used, and recovered throughout its life cycle. Despite advances in wood recycling in the EU and Japan, there remain immense opportunities for higher value utilization of wood waste and circularity in the sector. The 9R Framework⁴⁵ lays out the relative value of circular material management practices. Starting at refusal of production for redundant products (as seen in the current underutilization of EU housing), it descends the levels of value through rethinking product design for efficiency, reduction in consumption, reuse, repair, refurbishment, remanufacturing, repurposing, recycling, and finally recovery in the form of incineration.⁴⁶ Current waste treatment practices are heavily focused on the lowest two levels of waste utilization, recycling and energy recovery. By looking towards higher value treatment practices like reuse, repair, refurbishment and remanufacturing, the timber construction industry has the potential to prolong the lifespan of its timber elements and preserve greater material value in old timber buildings.

⁴³ [Circularity concepts in wood construction - UNECE \(2023\)](#)

⁴⁴ [Circularity concepts in wood construction - UNECE \(2023\)](#)

⁴⁵ [9R Framework by Julian Kirchherr](#)

⁴⁶ [9R Framework - CE Grow Circular](#)

While these principles of material circularity can apply to a variety of construction materials, timber has a unique role as both a biological and technical resource. As illustrated by the Ellen MacArthur Foundation,⁴⁷ wood begins life as a biological resource in the form of live timber. After being felled and extracted it crosses over to the technical side of material management. Here, wood is cut, processed, and built into products from buildings to furniture. Applying principles of cascading use, timber can be reused, refurbished, and remanufactured into other high value timber products. Even after an inevitable decline in resource quality with age, timber can be recycled into lower value materials like particle boards, fiber products like paper, and even wood based resins. Once timber has cycled through this process numerous times and exhausted all recycling possibilities, it can be burned for energy production. Here, the CO₂ trapped within is released back to the atmosphere on the biological side of the cycle where it can become plant matter once again, restarting the cycle. Importantly, unlike non-renewable resources like glass, steel, and concrete, wood is a completely regenerative material.

Quantifying the current potential of wood reuse, a study of salvaged wood from the German construction sector found that 26% of timber materials were in good condition for reuse. With more emphasis on deconstruction in the design phase, this figure has the potential to rise significantly in the future. From an economic perspective, deconstruction and reuse have been shown to make prudent financial sense. A recent case study for the deconstruction of a timber home in the US found that the value of materials obtained was double that of labor costs.⁴⁸ A variety of sustainable deconstruction companies from Lovett Deconstruction⁴⁹ in Portland to Deconstruct in the UK⁵⁰ have shown the viability of deconstruction as a business.

The reuse of these salvaged materials in construction represents the pinnacle of the circular timber bioeconomy. Whilst many reuse pathways already exist for wood, construction materials require high quality inputs and generally represent some of the highest value materials in the entire timber industry. The residues from these structures will then cascade down into other particle and fiber based industries, circularizing not just the timber industry but also related wood-based value chains.

⁴⁷ The butterfly diagram: visualising the circular economy - Ellen MacArthur Foundation (2021)

⁴⁸ Circularity concepts in wood construction - UNECE (2023)

⁴⁹ LOVETT Deconstruction and salvage shop

⁵⁰ Deconstruct UK

Social benefits and promoting a timber building bioeconomy

Aligned with BbN Principle **“Promoting a timber building bioeconomy”**

PRTC #5: *“Information, education and training is provided for stakeholders across the ‘forest to frame’ value chain on the benefits and practices of responsible timber use in construction. Innovation, research and development is supported and encouraged to enable a timber construction economy and wood culture to thrive.”*

Timber construction offers significant social benefits, extending beyond its ecological and economic advantages. Research indicates that wood is generally perceived as a very pleasant material, leading people to prefer environments that incorporate it. This positive perception is particularly evident with wood in its natural form, contributing to a stronger relaxing effect and a more pleasant experience from both psychological and physiological perspectives. Surveys show that people associate wood with feelings of coziness, warmth, and pleasantness, making its presence create a more intimate and inviting environment.⁵¹ While the exact reasons for these perceptions are still being explored, some scientists attribute them to the material’s visual properties, such as its color temperature. Additionally, modern timber constructions are designed to be resistant to pests and mold, preventing degradation of the wooden structural elements.

Wood also represents a vital cultural symbol. For thousands of years many communities in forested areas of the globe have utilized wood extensively for building. From the stave churches of Norway to the ancient temple complexes of Japan, timber construction has played a lasting role in the architectural traditions of its respective practitioners. In the Czech Republic, wood has played a vital role in construction for centuries⁵², seeing widespread use in timber-based cottages and the ceilings of many homes. Refocusing the construction sector on timber materials presents a unique opportunity to reconnect with the architectural traditions of old. Thus, circularity becomes a means to, not only environmental health, but also social and cultural wellbeing.

⁵¹ What do we actually know about the benefits of wood in human health? - Erich Kazui Shigue and Akemi Ino (2021)

⁵² Wood species utilization for timber constructions in the Czech lands over the period 1400–1900 - T. Kolář, P. Dobrovolný, P. Szabó, T. Mikita, T. Kyncl, J. Kyncl, I. Sochová, M. Rybníček (2021)

Conclusion

The transition to a circular timber construction industry will be vital to combatting climate change and creating a more resilient built environment.

The industry's current practices focused on concrete and steel structures have contributed to close to 10% of current global GHG emissions from construction activities.⁵³ Scaling up timber construction practices will reduce the carbon intensity of the industry, decreasing embodied emissions from the built environment whilst providing a sizable carbon sink of CO₂ stored in timber materials. However, supplying the sheer volume of wood needed for the industry, combined with other fiber based products, will put great strain on existing forests.⁵⁴ A circular cascading use model is needed to extend timber's lifespan and reduce pressure on limited virgin wood resources.

This framework is built on the basis from BbN's Principles for Responsible Timber Construction⁵⁵, following the cascading principle of the circular timber economy from existing structures all the way to end-of-life scenarios for those yet to be built. Starting small, the current EU renovation wave is already yielding improved operational efficiency for a variety of older structures. Already built, these structures require fewer resources and less energy to be brought up to date compared to structures built from scratch. Moving upwards in complexity, new circular timber structures require a rethink of the design and materials procurement phases of construction. No longer rooted in the emissions intensive practices of the past, new circular timber structures should take full advantage of modern wood materials (CLT, glulam), prefabrication, and millimeter accurate digital design software to achieve substantial reductions in materials waste, embodied emissions, and construction costs, all whilst providing ample opportunities for deconstruction and circular reuse in the future. To mitigate the harmful effects of deforestation, sustainable forest management practices should regulate all new timber used in construction, backed up by common certification schemes guaranteeing the quality and origin of virgin roundwood. In the end-of-life phase, timber building panels and modules can be disassembled and assessed for reuse potential, before finding their way into new structures, lower value timber materials, fiber based products, and other closed loop recycling streams. In combination, these practices have the potential to transform the Czech construction industry, reducing construction industry emissions, improving quality of life for citizens, and making the Czech Republic a frontrunner in the circular timber bioeconomy.

⁵³ [Building materials and the climate: constructing a new future - UNEP \(2023\)](#)

⁵⁴ [Simulating future wood consumption and the impacts on Europe's forest sink to 2070 - Publications Office of the European Union \(2024\)](#)

⁵⁵ [Built by Nature's Principles for Responsible Timber Construction](#)

In the current Czech context there remain significant barriers to the adoption of circular timber construction practices. The contemporary industry relies heavily upon brick and reinforced concrete constructions. In 2024, out of 11,406 new units built in multi-dwelling structures, a mere 69 were wood based constructions. Amongst single family homes the trend improves slightly to 13% of dwellings constructed out of wood, the vast majority of which featuring light frame construction.⁵⁶ Despite the relatively minimal share in multi-dwelling structures to date, the future of timber construction in the Czech Republic is promising. Over half of all multi-dwelling structures produced in the country in 2024 used prefabricated components, demonstrating the interest in the technique and potential for prefabricated timber structures in the future. Moreover, as of August 1st, 2025 the maximum height of timber structures has been raised from 12m to 22.5m.⁵⁷ This change has greatly expanded the potential use cases for timber structures, allowing larger residential and commercial projects to go ahead. A recently completed timber residential development in Prague (Arcus City by UBM Development) has already demonstrated the feasibility of timber construction on a large scale for the Czech market.⁵⁸ The EU climate goal of net zero by 2050 should further encourage investment and innovation in the Czech circular timber construction sector.⁵⁹ More information on the current state of the sector can be found in INCIEN's National Research Brief on Timber Construction.

Both this document and the National Research Brief are designed to support the creation of the *Partnership for the construction of standardized apartment buildings using low-emission materials*. The partnership will be one of many aimed at tackling the challenges facing the Czech transition to a circular economy by engaging stakeholders in industry to create specific, targeted solutions to the barriers facing circular business models and low-carbon solutions. Borrowing concepts from Green Deals in place in the Netherlands, these voluntary Partnerships are designed to be voluntary collaborative agreements between companies who want sustainable solutions to the practical barriers facing their industries. Recognising the decarbonisation potential for the Czech construction industry, the *Partnership for the construction of standardized apartment buildings using low-emission materials* will be focused on circular timber and other low-emission construction practices and materials.

The work done by the partners of the *Partnership for the construction of standardized apartment buildings using low-emission materials* will become an important contribution to transforming the Czech built environment into one based on regenerative materials, efficient production practices, and cascading use across multiple cycles. Facing rising global temperatures, resource shortages, and expanding EU emissions regulations, the need for circular economy practices grows with each

⁵⁶ Completed buildings by Construction Materials - Český statistický úřad (2025)

⁵⁷ Nové stavební normy otevírají cestu moderním dřevostavbám. Přinesou mimo jiné udržitelnější a rychlejší výstavbu - Ministry of Regional Development (2025)

⁵⁸ Arcus City splňuje všechny vaše požadavky! - Arcus City

⁵⁹ 2050 long-term strategy - European Commission

passing day. Early adopters of the principles of circular timber construction have the opportunity to guide the industry as it looks to decarbonise, setting an example for the Czech building industry and wider EU construction landscape. With the adoption of these principles, the Czech Republic has the potential to become a leader in the sustainable transition to circular timber buildings on a continental scale.

Abbreviations

BbN	Built by Nature
BIM	Building information modeling
BoQ	Bill of quantities
CDW	Construction and demolition waste
CE	Circular Economy
CLT	Cross laminated timber
CNF Management	Closer-To-Nature Forest Management
CO ²	Carbon dioxide
ECOS	Environmental Coalition on Standards
EU	European Union
FSC	Forest Stewardship Council
GHG	Greenhouse gas
INCIEN	Institute of Circular Economy (in Czech, Institut cirkulární ekonomiky)
kgCO ₂ e/kg	Kilograms of carbon dioxide equivalent per kilogram
LCA	Life cycle assessment
LML	Laminated Veneer Lumber
Mt CO ₂ /yr	Megatonnes (1 million metric tonnes) of carbon dioxide per year
PEFC	Programme for the Endorsement of Forest Certification
PRTC	Principles for Responsible Timber Construction
RC	Reinforced concrete
SECClasS	Sustainability Enhanced Construction Classification System
SFM	Sustainable forest management
UKGBC	United Kingdom Green Building Council
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
WLEC	Whole life embodied carbon
z. ú.	Registered institute

