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# Policy guidelines
# Low carbon construction in cities

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REDUCING CONSTRUCTION'S CARBON FOOTPRINT WITH SUSTAINABLE WOOD PRODUCTS

UNITED NATIONS
Geneva, 2024

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## ABSTRACT

This policy brief offers policymakers and decision-makers a comprehensive overview of how sustainably grown and sourced wood can significantly reduce the carbon footprint of urban built environments.

By highlighting the carbon and technical advantages of wood as a low-carbon building material, the policy brief encourages stakeholders and provides guidance on how to promote the increased use of wood from sustainable sources as a key building material in low-carbon urban construction across the UNECE region and beyond.

# BACKGROUND AND PROCESS

This study was prepared as part of the UNECE project, "Strengthening cooperation and national capacities in selected UNECE countries for sustainable forest management".

The publication aims to provide a comprehensive overview of boreal forests, highlighting their significance and challenges, and contribute to ongoing efforts to promote sustainable forest management and protect the valuable resources of boreal ecosystems. The study aims to:

- Raise awareness of the importance of boreal forests among high-level decision-makers and the general public.
- Offer a comprehensive overview of the ecological, economic, and social significance of boreal forests.
- Identify key challenges and opportunities for sustainable forest management in boreal regions.
- Inform policy development and decision-making related to boreal forest conservation and management.

The study is based on an extensive review of existing literature and data on boreal forests and country-specific national overviews prepared by six UNECE countries with boreal forests for this project. The national overviews of boreal forests in Canada, Finland, Norway, the Russian Federation, Sweden, and the United States of America can be found on the UNECE website.

Whenever possible, the data presented follow the formats, terms, and definitions of international data collection processes, including the FAO Global Forest Resources Assessment and the Joint Forest Sector Questionnaire. However, due to the variety of data sources and differences in reference areas, methodological coherence may vary among the presented information. This should be considered when interpreting potential differences, particularly among national data, which may result from the applied formats.

Given the lack of a universally agreed definition, national understandings of the extent of boreal forests may differ, potentially impacting the comparability of data among reporting countries in this publication.

While national information and research on this vast biome are relatively abundant with recent findings, there is a shortage of data directly attributed to the boreal biome and forests. This is primarily due to the absence of desegregated data distinguishing boreal forests from other forests, particularly regarding social and economic aspects.

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# EXECUTIVE SUMMARY

This policy brief provides policy makers and decision makers with an in-depth analysis of how sustainably sourced wood can significantly reduce the carbon footprint of cities by replacing high-emission construction materials such as concrete and steel. It emphasizes the importance of wood in achieving low-carbon construction goals while addressing environmental, economic, and policy aspects.

Key findings of the policy brief indicate that urbanization significantly contributes to increased carbon emissions from energy consumption, building materials, and inefficient infrastructure. The substantial carbon footprint associated with cement and steel production, estimated at 2.2 $GtCO_2$-eq annually, underscores the urgent need for alternative, low-carbon materials such as wood.

The policy brief highlights the numerous advantages of wood in construction, as it has a negative carbon footprint storing more carbon than it emits ("cradle-to-gate"). Also modern wood structures perform better in terms of durability, seismic resistance, and energy efficiency. providing superior insulation and reducing energy demand for heating and cooling. The lightweight properties of wood make it suitable for innovative construction including vertical extensions, repurposing existing structures, and building in areas with limited load-bearing capacity.

Wood-based construction elements and materials can facilitate circular economy approaches, enabling reusability and recycling.

The policy brief outlines a range of policy options to further enhance the use of wood as a key low carbon construction material and include:

- **Legislation**: Update building codes to favour materials with low embodied emissions, address fire safety concerns, and focus on lifecycle performance.
- **Incentives**: Promote green public procurement, facilitate access to green mortgages, and consider trust funds to mitigate financial risks in innovative construction projects.
- **Education and Innovation**: Invest in education, research and development, and standardization of modular wood construction to enhance efficiency and adoption.
- **Measurement and Data**: Develop a comprehensive database on the progress on the current use of low-carbon construction materials to inform policymaking and assess trends.

The policy brief emphasizes the urgent need to prioritize minimizing new construction regardless of the building material used and maximize the reuse of existing buildings. Only should alternative materials, such as sustainable wood, be considered as replacements for high-emission materials.

Only when the reuse of existing structures is not feasible should sustainable alternatives like wood be considered to substitute high-emission materials. Modular and standardized building practices for building in wood have a significant potential to enhance scalability and sustainability. Decision-makers should develop effective end-of-life strategies for wood used in construction.

The policy brief concludes that sustainably grown and sourced wood offers a compelling solution for transforming urban construction. By leveraging its low-carbon potential and applying supportive policies, cities can accelerate resilient, low-carbon urban development while stimulating economic growth and innovation.

# 1. Introduction

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Urbanization is one of the global demographic "megatrends"; the share of the world population in urban areas is projected to increase from 55% today to 68% in 2050 (UN, 2019). This concentration will also trigger significant increases in energy use and economic output. Cities are hotspots of the global carbon cycle, with considerable fossil fuel carbon dioxide ($CO_2$) emissions from electricity consumption, ground transportation, residential and commercial buildings (global Carbon Atlas, 2023).

The Intergovernmental Panel on Climate Change (IPCC) estimated in 2021 that global greenhouse gas (GHG) emissions from buildings amounted to the equivalent of 21% of the global GHG emissions in 2018. Of this, 57% are indirect emissions from the offsite generation of electricity and heat, 24% are direct emissions produced onsite and 18% are embodied emissions from the production of cement and steel used in buildings.

Globally, cement and steel used in buildings emitted 2.2 $GtCO_2$-eq, more than twice the amount reported for the aviation sector (1.04 $GtCO_2$- eq) in 2018. Over the period 1990-2019, global $CO_2$ emissions from buildings increased by 50% (IPCC, 2022).

Building-specific drivers of those increasing GHG emissions include the larger floor area per capita, driven by the rising size of dwellings while the size of households kept decreasing, especially in developed countries. In addition, the inefficiency of newly constructed buildings, particularly in developing countries, and the low renovation rates in developed countries when existing buildings are renovated exacerbate the problem (IPCC, 2022).

Cities can achieve net-zero status if their carbon emissions are reduced within and outside of their administrative boundaries through supply chains, which will have beneficial cascading effects across other sectors (IPCC, 2022).

Cities of the future could become major carbon storehouses and remain economic powerhouses if they take advantage of highly energy efficient building materials with a low carbon footprint, such as wood.

Today, more than 75% of the population in UNECE member States live in urban areas and rapid urban expansion is less of a driver for construction needs. A major part of 2050's building stock in the UNECE region already exists today. Most low carbon or carbon neutral construction activities in the UNECE region will focus on urban densification, re-purposing or renovation of existing building stock. UNECE member States are the major producers of sustainable forest products, key innovators in modern wood construction in the world and are best placed in leading the transition to low carbon or carbon neutral construction with wood.

# 2. Carbon emissions and the built environment

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## 2.1. Embodied emissions

Embodied emissions account for 20–50% of an average building's whole-life emissions, and most of them occur before anyone even sets foot in the building. These include emissions from material extraction, manufacturing, transport, construction, maintenance and end of life. Most construction materials used in cities (and their associated emissions) are imported from beyond city boundaries. This aspect is only too often overlooked.

Production of common construction materials, such as concrete and steel cause very high carbon emissions. The production of cement, a key ingredient in concrete, is alone responsible for 8% of all global $CO_2$ emissions. If the cement industry were a country, it would be the world's third-largest carbon emitter.

Switching construction materials, i.e. from concrete and steel to less energy and carbon intensive materials is not the first step to decrease carbon emissions of the built environment in cities. The need for new construction in cities could be significantly reduced if existing and unused or underutilized building stock could be used more efficiently or brought back to use. Some cities developed dedicated tools to:

- Document vacant and underused spaces (e.g. Milan)
- Introduce or increase taxes on unoccupied or unused properties (e.g. Paris and Vancouver).
- Relax regulations for "adaptive reuse" projects that repurpose buildings for new uses (e.g. Los Angeles).

The Ellen MacArthur Foundation estimates that eliminating waste, sharing buildings more, as well as reusing and recycling construction materials, can reduce the emissions from construction materials by 38% by 2050. The C40 Knowledge Hub summarized the priorities in their construction hierarchy (C40 cities, 2023).

These priorities are:

When new materials are required, the rule of minimizing the embedded emissions of construction material needs to be applied equally to any type of future construction, whether it is a new construction or renovation, refurbishment, repurposing or extension of existing building stock.

There is a vast choice of materials available for renovation, refurbishment, or repurposing existing stock with high variations in embedded emissions. Wood consistently features among the low or carbon negative materials. Repair, remodeling and improvement (RMI) are already today a major market for the forest-based industries. The 2023 UNECE/FAO Data Brief on sawn softwood found that about one third of the sawn softwood production in the United States is being used for repair and remodelling mainly of single and multifamily homes.

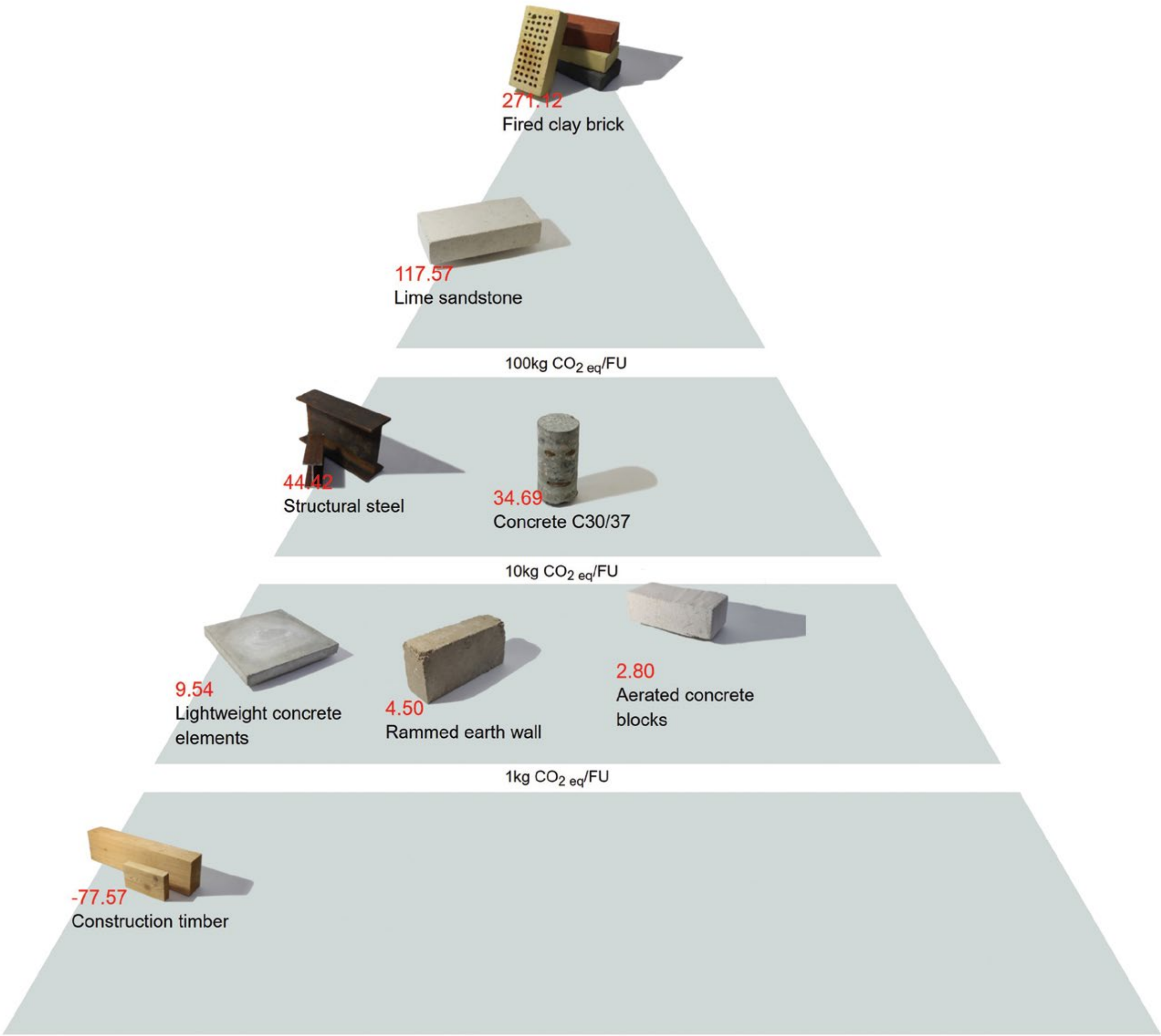
When it comes to materials that can be used as structural elements with defined load-bearing capacities (walls, beams, columns, arches, etc.) the choice of materials and products is rather constrained. The Centre for Industrialized Architecture at the Royal Danish Academy for Architecture, Design, Conservation compared the global warming potential (GWP) of functional units (e.g. 3m load-bearing columns) and found that wood is the only building material for structural application that has a negative carbon footprint (i.e. stores more carbon than is emitted during the processing and lifetime) from material extraction up to production ("cradle-to-gate") (see graph 1)(CINARK, 2023).

The embodied emissions of wood as a structural building element are impressive and wooden buildings can be carbon negative. However, this should not lead to a maximization of carbon stored in a single building since the availability of sustainably produced wood products is not unlimited. Cities need to maximize the substitution of construction materials with high embodied emissions and not the carbon storage per building.

Wooden buildings or buildings with wooden elements must also follow the principle of maximizing their lifetime by re-use, repurpose and recycling. These measures will further delay the release of stored carbon and contribute to maximizing the duration of carbon storage in future cities.

**FIGURE 1**

**Global warming potentials for comparable functional units of load bearing elements elements [kg $CO_2$eq/FU]**




*Notes:* FU: functional unit. 1FU=3 metre load bearing column. Global warming potentials in kilogramme carbon dioxide equivalents per functional unit [kg $CO_2$eq/FU].

*Source:* CINARK – Centre for Industrialised Architecture, The Royal Danish Academy – Architecture, Design, Conservation, www.materialepyramiden.dk.

## 2.2. Sufficiency of buildings

The International Energy Agency (IEA) estimates that a building's operations account for 30% of global final energy consumption and 26% of global energy-related emissions (8% being direct emissions in buildings and 18% indirect emissions from the production of electricity and heat used in buildings).

The Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2022) differentiates between energy sufficiency and energy efficiency: sufficiency is about long-term actions driven by non-technological solutions, which consume less energy in absolute terms; efficiency, in contrast is about continuous short-term marginal technological improvements. Sufficiency policies are a set of measures and daily practices that reduce demand for energy, materials, land and water while delivering human well-being-for-all within planetary boundaries. Sufficiency measures tackle the causes of GHG emissions by limiting the demand for energy and materials over the lifecycle of buildings and appliances.

Much of the UNECE's building stock of 2050 already exists today. Improving the sufficiency of this existing stock is therefore essential in further reducing the cities carbon footprint that arises from heating and cooling these buildings.

**FIGURE 2**

**Global warming potentials for a comparable functional unit of insulation materials [kg $CO_2$eq/FU]**


***Notes:*** FU: functional unit. 1FU=1 square metre $m^2$ of insulation with a u-value 0.15 W/mK. Global warming potentials in kilogramme carbon dioxide equivalents per functional unit [kg $CO_2$eq/FU]. Extruded polystyrene (XPS); polyurethane rigid foam (PUR); polyisocyanurate (PIR); expanded polystyrene (EPS).

***Source:*** CINARK – Centre for Industrialised Architecture, The Royal Danish Academy – Architecture, Design, Conservation, www.materialepyramiden.dk.

This will often require a significant improvement of insulation (e.g. walls, ceilings, roofs, windows, balconies, doors, etc.). The source of heating or cooling or the energy efficiency of heating or cooling devices is beyond the scope of this policy brief.

Good insulation materials minimize the loss of energy from a building. This capacity is expressed by the "u-value " of materials. Untreated wood is a natural champion among structural materials in terms of insulation capacity and people in boreal regions traditionally have built log-wood homes owing to the abundance of this raw material and the natural insulation characteristics. Structural elements of modern wooden construction maintain the low energy conductivity of the raw material.

In contrast, concrete, steel, glass and aluminum have extremely poor insulation capacities. That is why these buildings often require thick additional layers of insulation – most of these insulation materials are currently being derived from fossil-based products or products with significant embodied emissions. Modern wood construction with similar insulation efficiencies can have thinner walls and thus provide up to 10% more interior space with the same exterior dimensions than other construction materials.

Research and development efforts in the past decades led to biobased products with low or negative embodied emissions that fulfil all the functional properties required for insulation materials. Wood-based insulation elements are among these. Such products comply with durability and fire resistance requirements. In addition, when wood products are compared to their fossil-based competitors, they have much lower or negative embodied emissions and can store more carbon than is emitted during their production (see graph 2).

Increased requirements for the accounting of embodied emissions of insulation materials will certainly contribute to further reducing the carbon footprint of cities and will likely boost the demand for organic based insulation materials, including wood.

## 2.3. End of life

Construction and demolition waste is one of the largest waste streams in the UNECE region, representing about one third of all municipal waste. The composition of the waste stream varies greatly depending on the prevailing construction materials used and the recovery rate of these materials.

Landfilling of non-organic construction and demolition waste is still widespread while landfilling of organic components is mostly forbidden or strictly regulated. Wood, like any organic material, is biodegradable and will decompose if not recycled or burnt at the end of its lifecycle. The landfilling of wood products increases the likelihood of increased methane ($CH_4$) production. The IPCC has indicated a global warming potential (GWP) for methane between 84-87 when considering its impact over a 20-year time frame (GWP20) and between 28-36 when considering its impact over a 100-year time frame (GWP100). This means that one tonne of methane can considered to be equivalent to 28 to 36 tonnes of $CO_2$ if looking at its impact over 100 years.

The strength of wood as an organic, renewable construction material can easily turn into its biggest weakness in terms of carbon balance if landfilled and any methane ($CH_4$) emissions must be prevented. Biobased construction materials, such as wood, should be reused, recycled as long as possible and incineration should only be considered as the last possible step.

# 3. Beyond carbon

# 3. Beyond carbon

Modern wood construction has further advantages over competing materials with high embodied emissions that further improve the competitiveness of forest products in construction markets.

## 3.1. Lightweight material (vertical extension)

Wood is a lightweight construction material with a much higher weight to load bearing capacity than steel or steel reinforced concrete. Modern wood construction can be used for multi-floor construction of impressive high-rise buildings. These taller, bigger, larger building attract the media's attention and help to raise public awareness of the technical capacities of building with wood.

The three biggest advantages related to the low weight to load bearing ration of modern wood construction are:

- Reduced dimension of the foundations: The foundation of buildings directly correlates to the weight of the building. A reduced weight of the superstructure will therefore reduce the size of its foundation – which, in most cases, is produced in concrete and steel – and thus further reduces the embodied emissions of the building.
- Reduced urban sprawl: Cities may have areas which cannot be used for constructions owing to limited load-bearing capability of the ground (construction exclusion zones), e.g. because of underground cavities, underground infrastructures, or other reasons. Modern lightweight wood construction allows urban planners to use formerly excluded spaces within the cities' boundaries in their development plans. London's 10 storey Dalton Lane building, made of in cross-laminated timber (CLT) and built above underground road and rail tunnels, is only one example.
- Vertical extension of existing stock: Modern wood construction is perfectly suited for vertical extension of existing buildings and is already widely used for that today. Vertical extension and reduced urban sprawl contribute to a more efficient use of existing infrastructures such as transportation, amenities and utilities.

## 3.2. Seismic resilience

The best earthquake-resistant construction materials have an important quality in common: high ductility. This refers to the material's ability to move and change shape without breaking or losing strength. Traditionally, steel and wood are the best and most common earthquake-resistant materials.

The weight to strength ratio of modern wood construction and its capacity to flex make wood the material of choice for earthquake proof buildings. Shake table tests by WoodWorks (2023) conducted in 2023 indicate that wooden buildings remained damage free even after receiving seismic shocks from two simulated seismic events with 6.7 and 7.7 magnitude on the Richter scale (like the 1994 Northridge earthquake and the 1999 Chi Chi earthquake). It is for this reason that L'Aquila in Italy used wood for rebuilding the communal buildings of the city after the devastating earthquake in 2009 (6.3 magnitude on the Richter scale). The Turkish State Forest Service used wood structures to rebuild 97 thousand square metres of their administrative buildings in the region that was struck by the 2023 Turkey-Syria earthquakes which had magnitudes of 7.8 and 7.6 respectively.

## 3.3. High precision

Modern wood construction is often highly mechanized and is extremely precise. Wood processing and wood construction industries are constantly increasing the vertical range of manufacture of building components. The precision of the production processes combined with the light weight of the material allow for pre-production of all the modules of a timber construction project. Pre-production is becoming more and more the standard.

Off-site pre-production under standard industrial conditions radically improves the working conditions for construction personnel since these workplaces are indoors under controlled climate, highly mechanized and have regular working hours. Most of the skilled workers no longer need to commute to various construction sites but will have one production site. Considering the ageing workforce in many UNECE member States, it is likely that better working conditions will enable these industries to successfully attract skilled workers.

Modern methods of construction (MMC) including modular homes ad off-site prefabrication accelerates the process since many steps of the construction process can be implemented in parallel. A report by Woodworks Canada states that "depending on the project, taking a modular approach can reduce the duration of a construction project by 30% to 50% when it is compared to on-site methods" (WoodWorks, 2024; Modular Building Institute, 2024).

Only a small number of workers are needed to assemble the prefabricated modules. McKinsey estimated in 2019 that "typically, one team of five workers can assemble up to six 3D modules, or 270 square meters of finished floor area, per day. This is significantly faster, and therefore cheaper, than traditional construction".

## 3.4. Reduced financial risk

Construction projects using wood instead of concrete, bricks or steel have often been more expensive than more established construction types. With economies of scale and a wider use of wood as construction material, costs already started to decrease.

Looking beyond the simple metrics of construction cost is therefore important, wood construction projects as an investment will radically change the result of their economic viability. Modern wood constructions with a certain degree of prefabrication can be delivered much quicker to the market, as the high share of prefabricated parts allows for the simultaneous production of various parts of the building. This precision also allows for accelerated inspection and code approval. The time difference can be more than half a year compared to conventional buildings, shortening the lag between investment and lease or sale. This can result is significant savings for the building developer.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# 4. Low carbon construction and forests

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Boosting the use of wood for construction today and in the future will certainly have an impact on supply and demand for wood and ultimately increase prices for raw material and thus influence the balances of wood production and trade of wood and wood products from and to the UNECE region.

## 4.1. Forest in the UNECE – wood supplier and carbon sink

More than 40% of the world's forests (by area) are in the UNECE region. These forests produce 60% of the global wood for material uses (industrial roundwood). Seventy five percent of the world's certified forests are in the UNECE region. These forests have been managed sustainably for decades and the UNECE region is the only region in the world with a continuous increase in forest coverage. At the same time, the UNECE region is an important producer of wood and wood products. Over the period 1990-2020, the forests in the UNECE region increased their growing stock from 187.2 billion $m^3$ in to 205.5 million $m^3$. The most recent UNECE/FAO Forest Sector Outlook Study, 2020-2040 (UNECE, 2021) found that the growing stock will likely continue this trend until 2040 and beyond.

Forests in the UNECE region are owned by 16 million forest owners and are a significant source of income. Forests in the UNECE region can provide additional amounts of sustainably grown wood to a limited extent without decreasing in area or carbon/wood stock. (UNECE, 2021)

The effect of annual storage per hectare (tonnes of $CO_2$ eq/yr.) in forests in the UNECE region without harvesting will decrease in the long term as older trees decrease their growth rate and even emit $CO_2$ in the decay phase. Storing wood carbon in long-lived harvested wood products (HWP) maximizes the overall carbon sink function of wood in the UNECE region (UNECE, 2021).

## 4.2. Increased wood construction's impact on forests in the UNECE region

The availability of the raw material wood is in the short, medium and long term one of the key questions for policy makers, city planners, architects, structural engineers and others using wood for construction.

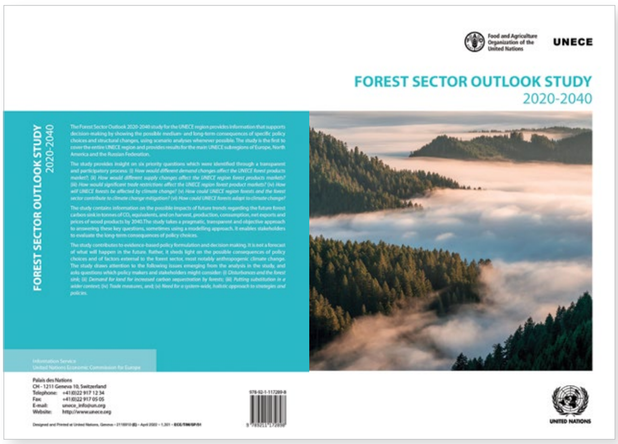
The UNECE/FAO Forest Sector Outlook Study, 2020-2040 found that the forest area as well as the carbon stock in forests in the UNECE region will further increase by 2040. UNECE's member States have tools at hand to monitor sustainable forest management (SFM) regularly and report their trends to the Forest Europe or the Montreal processes every five years. This information is made available to the public on the INForest website (UNECE, 2024).

Forests in the UNECE region have physical limits of how much wood can be removed on a sustainable level each year. Those limits are strictly regulated and assessed on a regular basis by UNECE member States.

The UNECE region is an important exporter of wood and wood products globally. A strong increase in demand in wood for construction in UNECE member States will very likely change global trade patterns and redirect exports to domestic consumption.

Non-structural elements in wood construction, such as insulation boards, fibre boards and particle boards, could also use wood and other cellulose rich resources deriving from space-efficient land management other than forests, such as agroforestry, roadside greenings, infrastructure maintenance, recovered waste streams or wood co-products.

Considering the non-destructive re-use of wood construction elements in new constructions today will help to decrease the demand for fresh wood fibres from forests in the future. Ideally the cities become storehouses of carbon and wood construction elements so that future demand for wood construction modules can be satisfied by both forests and by re-purposing obsolete or un-used buildings in cities.



# 5. Enabling conditions

# 5. Enabling conditions

All the above outlined features and advantages of wood as low embodied emissions material already exist today. However, there are many hurdles that hinder wood construction to fully unlock its potential.

Policy makers, decision takers, planners, public and others involved in making low embodied emissions a reality are required to contribute in various ways. The non-exhaustive list below outlines some of the main tasks.

## 5.1. Legislate a framework

**Identifying key barriers:** The legislative framework plays a key role in enabling the use of construction materials with low embodied emissions. Identifying and mapping these barriers is the first step in enabling low carbon construction at a wide scale and would ideally use a holistic approach involving consultation with the entire sector and value chain.

**At any scale:** Legislative framework conditions related to construction and building requirements are often not created and changed at national level, but rather at local or sub-national. Peer learning from experiences in successfully implemented legislative reforms can reduce the efforts, reduce costs and harmonize the legislative requirements for new materials.

**Fire regulations:** In many cases, wood is explicitly excluded from mid-rise construction because of outdated fire safety concerns which define the maximum building height if a building is constructed with wood. When fire safety requirements permit the use of wood, these may be too strict and lead to increased embodied emissions (e.g. requiring concrete staircases and elevator shafts) or which may drive up the cost (e.g. in case of mandatory sprinkler systems). These may significantly decrease the competitiveness of wood as a construction material.

**Performance driven:** Policies on carbon and energy emissions should be inclusive for all materials and allow for the best mix of materials. This could be achieved by revising and centering regulations around embodied emissions, sufficiency and circularity of all stages in a building's life cycle. Building codes will need to be more performance driven, science based, not exclude any low carbon material and allow for the most efficient mix of materials and construction methods. Legislation can define the key parameters and conditions for life cycle assessments (LCA) and environmental performance features that need to be met by the building. Ideally these requirements would be phased in, with increasingly strict requirements to allow for the long-term planning security of the sector.

**Offsetting of emissions:** Low carbon construction has evolved significantly over the past two decades. New materials and technologies are available to allow for all building types. The offsetting of embodied emissions or emissions from maintaining the building should be minimized or avoided.

**End of life:** It is crucial for the performance of organic construction materials in their life cycle that the legislative framework prevents any possible methane ($CH_4$) emissions at the end of its service. The legal framework needs to ensure that any methane ($CH_4$) that could arise from anaerobic decomposition are fully captured or are completely avoided.

## 5.2. Lead by example

Public procurement policies (PPP) can be a powerful tool in boosting the demand for new materials and construction techniques. Such policies can prescribe the carbon performance of public buildings at any stage of the lifecycle, especially for embodied emissions of materials used, the sufficiency of new or renovated buildings as well as the circularity of the interventions. These public buildings are often open to or are visited by the public (e.g. kindergartens, schools, hospitals and churches) and lead to a lighthouse effect, increasing the outreach and acceptance of these new forms and materials.

## 5.3. Communicate

Communicating the need to decarbonize the built environment to the public is key in creating acceptance among the broad population. Communicating the performance of new building materials and techniques is key to change the public's attitude towards organic construction materials (they rot, they burn, they are not durable, etc.). The establishment and widespread use of these buildings, materials and methods must be demand driven.

## 5.4. Educate, innovate, standardize

Low carbon construction will require new competencies, know-how and capacities and even new job profiles for the specialists involved along the entire construction value chain. These capacities are needed for the successful planning, developing, implementing and finalizing any low carbon construction.

Universities, schools and other institutions who are involved in the education of construction experts such as architects, fire safety experts, structural engineers, urban planners, workers, etc. need to adjust their curricular to include materials with low embodied emissions and their varying technical features. It will be particularly important to offer access to this knowledge and training to practitioners and fully trained experts as training on the job including continuous professional development (CPD). Support will be needed to allow for a quick transition of the entire sector.

Universities and research in close collaboration with practitioners should be given the responsibility to help the sector to:

- innovate (e.g. clever mix of materials, new or more efficient processes)
- improve the circularity aspects of low carbon construction (e.g. improved modularity, improved non-destructive re-use, better use of residues, use of alternative resources, etc.)
- help the sector in standardizing single modules to allow for interchangeable use of various modules and materials in the buildings.

## 5.5. Finance

Home ownership rates and the number of households with a mortgage show large differences across countries of the Organisation for Economic Cooperation and Development (OECD). For most households, purchasing a home is their biggest lifetime investment. In most cases, this purchase comes with their largest financial liability as well, since many households rely on mortgage loans to finance their home. The structure and functioning of mortgage markets can therefore have important consequences for people's access to housing and their financial situation.

The finance sector will only be willing to provide loans or mortgages for projects whose possible risks and probabilities are well understood. This information is based on successes and failures from past experiences. The finance sector does not have the information required for assessing possible risks and probabilities of new constructions with new materials, such as wood construction. The risk aversion of the financial sector and the lack of reliable data on the economic viability and risks of building with low carbon materials often results in less competitive mortgage rates for less well understood materials and methods. This, however, is not compatible with the need for disruptive change in decarbonizing the construction sector. Decision makers could therefore envisage developing a trust fund for the economic risks arising from innovative low carbon construction projects.

Some banks have already aligned mortgage rates with environmental goals such as the reductions in greenhouse gas emissions from the housing stock. Policies can create a favourable environment by:

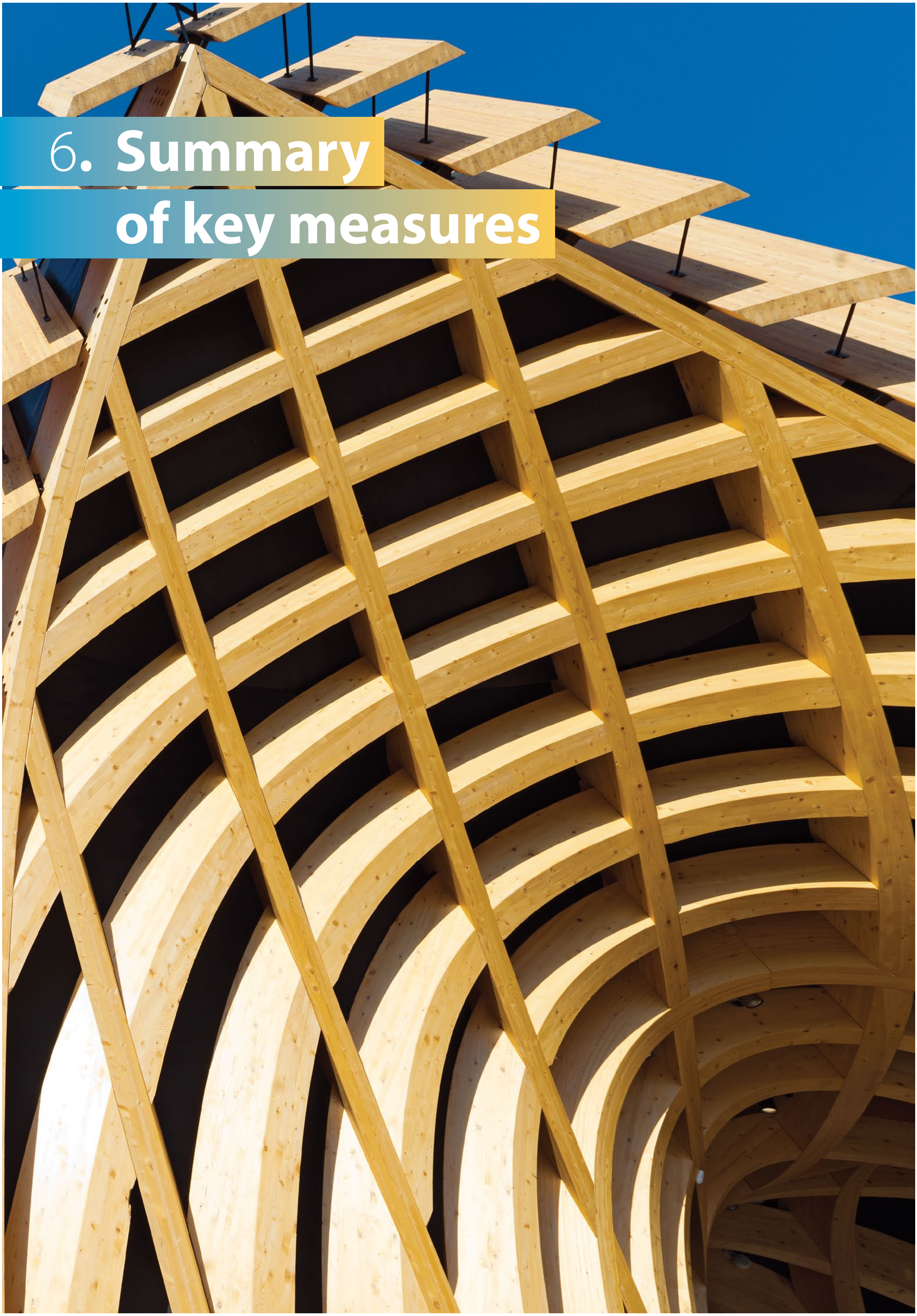
- Establishing international standards for energy-efficient, or "green", mortgages;
- Creating mechanisms to ensure the quality of the energy certification of dwellings;
- Setting supervisory standards for green mortgages to properly reflect their risk (which is typically reduced compared with standard mortgages).

## 5.6. Measure

Data and information in the UNECE region on low carbon construction in general and wood construction is scattered and is not readily available. The availability of this information would facilitate a better understanding of the current situation and future potentials. Better data on low carbon construction are required to enable evidence-based policymaking and decision taking. It would allow for assessing the effectiveness of policy measures and enable policy makers to adjust the legislative framework. Such information would also allow peers to learn from experiences made and to quickly adjust their own policies.

Regular assessments of the quantity of low construction housing permits issued and starts recorded would also allow the forest sector to anticipate the current and future demand for raw material and adjust production accordingly. These data will also allow for developing trends and enable the forest sector to provide feedback about the anticipated availability of raw material.

# 6. Summary of key measures



# **6.** Summary of key measures

The following points summarize key measures that will enable cities to significantly reduce or eliminate the embodied emissions arising from the built environment:

- **Minimize new construction where possible.**
- **Maximize substitution of construction materials with high embodied emissions.**
- **Take into full consideration embodied emissions of materials at all stages of a building's lifecycle.**
- **Maximize global material efficiency.**
- **Maximize sufficiency of any building.**
- **Strive for destruction-free deconstruction at the end of life of buildings or building modules.**
- **Improve global standardization of (wooden) construction elements.**
- **Prevent any methane ($CH_4$) emission at the end of life of organic construction materials.**
- **Allow for a clever mix of materials.**
- **Keep the supply of raw materials as local as possible to maximize the creation of local livelihoods and minimize embodied emissions from transportation.**
- **Innovate.**
- **Educate.**
- **Communicate.**
- **Measure.**

UNECE member States have sufficient forest resources to fully embrace low carbon construction. By becoming early adapters and trailblazers, they will be able to use their experiences and role as global provider of wood products to boost wood construction in other regions and foster revenues. This can help to ensure a multifunction use of forests in the region.

# 7. References

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Policy guidelines
**Low carbon construction in cities**

As urbanization accelerates, cities are significant contributors to global greenhouse gas emissions, particularly from building construction, which is heavily reliant on cement and steel. With global emissions from buildings on the rise, cities can help achieve net-zero emissions by adopting energy-efficient materials like wood. The UNECE region, home to major producers of sustainable forest products, is well-positioned to lead this transition, particularly through urban densification and renovation of existing building stock, rather than new construction.

This policy brief is one of the outcomes of the Swiss funded project on "Forests and Forest Knowledge for Resilient, Low-Carbon Urban and Rural Communities". It outlines how sustainably sourced wood can contribute to reducing the carbon footprint of urban construction. It highlights the carbon and technical advantages of using wood as a low-carbon building material, especially in cities in the UNECE region, and provides guidance for various stakeholders to increase its utilization.

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