Building for the Future

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A Knowledge Product Collection
by Bauhaus Earth

Series 1 — Setting the Frame

How to Fix the Built Environment System

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What to Expect:

The built environment is extremely dysfunctional. The way we currently design, plan, construct, and maintain our buildings and infrastructure has serious – if not existential - consequences for people and the planet (see Knowledge Product 1, Series 1).

As we face the harsh realities of climate change, it is crucial that we take immediate action. This second Knowledge Product in Series 1 “Setting the Frame” highlights seven approaches and ideas for transforming the built environment. Learn about buildings as carbon sinks, the power of nature-based solutions, and why we should revalue traditional building practices.

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Towards a Climate Positive and Inclusive Built Environment

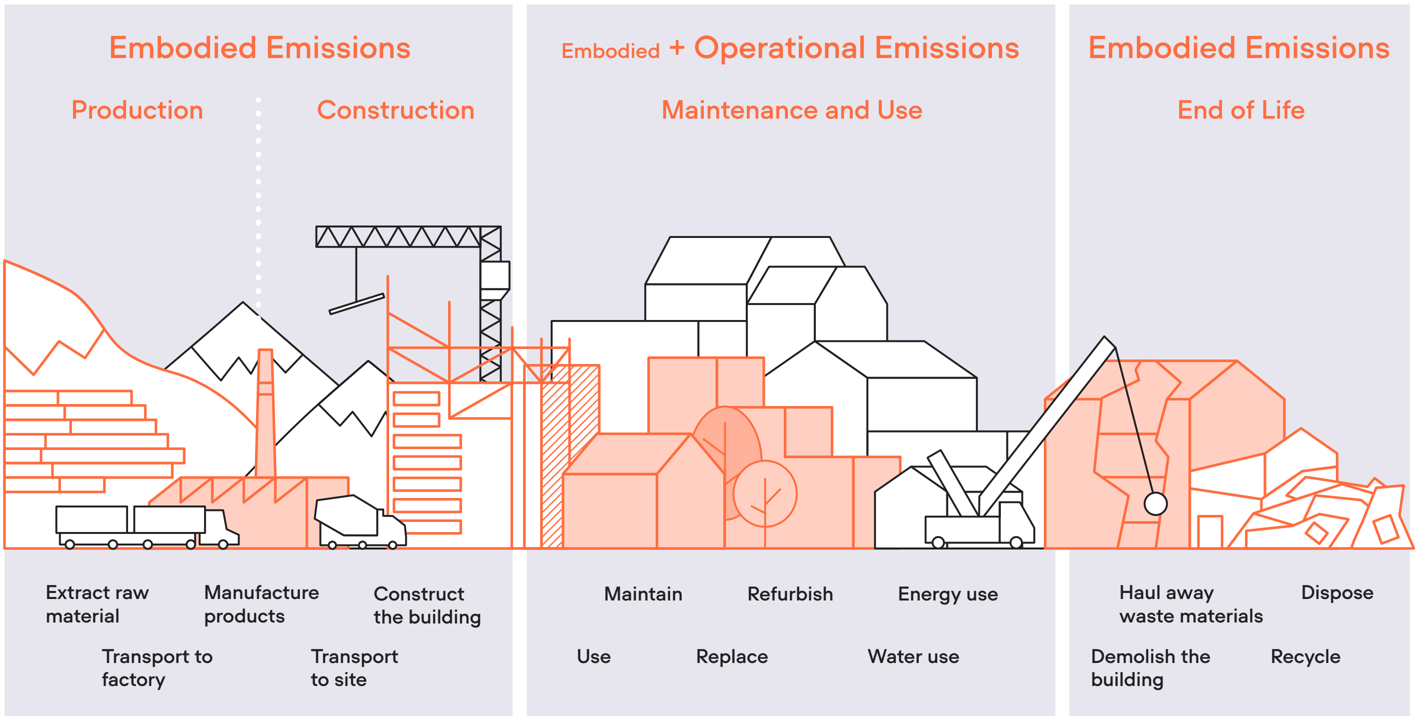
A major repair of the built environment system is needed – a repair that corrects the mistakes of the past while addressing current and future challenges. By transforming the built environment, we can not only unlock untapped potential to mitigate climate change, but also ensure that our human-made surroundings are healthier, more liveable, more equitable and more in harmony with nature. There are many innovative approaches and ideas on how to achieve such a transformation. These solutions need to be harnessed, holistically combined, and scaled up.

Adopt the Perspective of Whole Life Carbon Emissions

The need to decarbonize the built environment is increasingly recognized, but current efforts focus mainly on minimizing 'operational emissions' (28% of global carbon emissions)[1], that is emissions resulting from the use of a building, such as lighting, heating, and cooling. 'Embodied emissions' (11% of global carbon emissions)[1], however, have received little attention. Embodied emissions refer to all non-operational emissions that occur throughout the entire life cycle of a building. This includes emissions released *before* the building is even in use, such as during extraction, production, and transportation of building materials as well as emissions that occur during the construction and demolition process. As new buildings are constructed at a rapid pace, taking into account these "upfront" emissions is critical to meet climate goals in near future[2].

However, embodied emissions also need to be considered when retrofitting buildings for energy efficiency. For example, while the use of conventional insulation layers may reduce operational emissions, high upfront emissions may cancel out any energy savings over the life of the building. One way to capture the *true* carbon footprint of buildings is to apply a Whole Life Carbon (WLC) approach. WLC assessments are an emerging methodology to better estimate the amount of all carbon emissions expected to be emitted over a building's lifecycle and enable informed decision-making. Incorporating this approach into future policies, grant programs, or financial incentives is critical to decarbonize the built environment.

Fig. 1: Life cycle of a building. Graphic based on New Buildings Institute (2023)[3]



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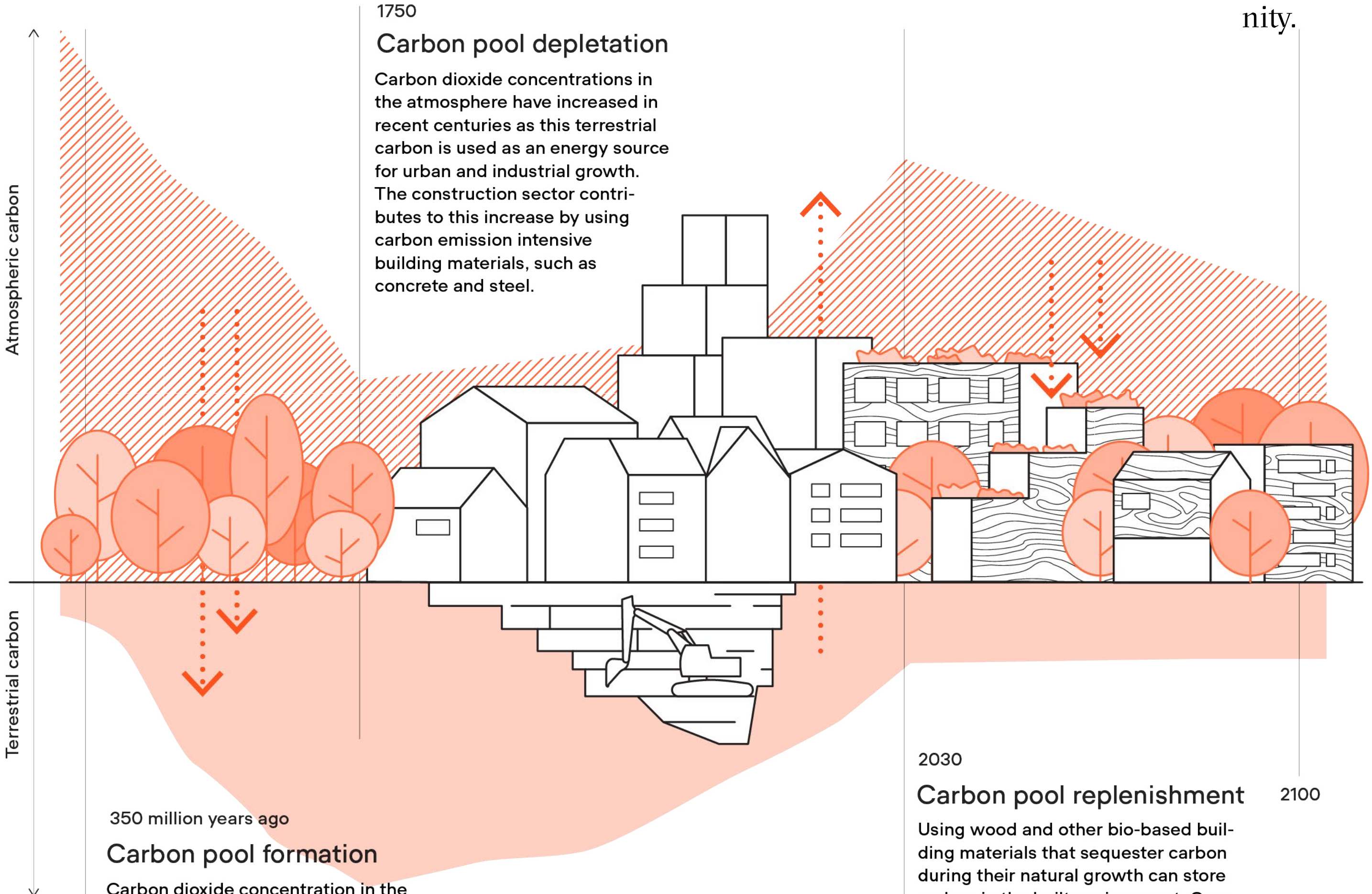
From Carbon Source to Carbon Sink

To limit global warming to well below 2.0°C, it will not be enough to only reduce carbon emissions[4]. Decarbonization efforts need to be combined with ways to actively *remove* CO_2 from the atmosphere – a process, which is known as generating negative emissions. Switching from conventional building materials, such as concrete or steel, to bio-based building materials, such as bamboo, wood, straw, and hemp, offers such an opportunity.

Fig. 2: Changes in atmospheric carbon over time. Graphic based on Churkina et al. (2020)[5]



Carbon sequestration is the process of capturing and storing atmospheric CO_2. Forests transform carbon into biomass through photosynthesis.

Carbon substitution refers to the emissions avoided by using products made from wood or other bio-based materials as they tend to be less carbon-intensive in the production than conventional building materials.

Carbon storage refers to total amount of carbon contained in, for example, a material or building.

Trees and plants sequester carbon from the atmosphere in their growth process. By using bio-based materials, we can store the sequestered carbon in buildings while substituting emissions from the production of conventional building materials. In this way, buildings and cities can be transformed from a carbon source into an artificial carbon sink[5]. If 90% of new buildings were built with wood from sustainably managed forests, more than 100 Gt of CO_2 could be saved by 2100[6], which is currently more than a third of our remaining carbon budget if we are to stay below the critical 1.5°C threshold[7]. The use of bio-based materials in new buildings, retrofits, and renovations should thus be politically incentivized and streamlined through changes in building codes.

Ensuring Sustainable Management and Harvesting of Bio-Based Materials

A bio-based building economy that relies on timber, bamboo, and other agroforestry products must adhere to strict environmental guard rails and sustainable forestry practices. Forests need to be protected, stabilized, and wherever possible expanded to safeguard their vital eco-systemic performance as carbon sinks and biodiversity hubs. Many regions of the world, such as Scandinavia, Eastern Europe, or North America, have sufficient forest resources to meet a significant part of the material demands from various sectors, including construction, while respecting sustainability guard rails. Other regions will need to rely on global supply and more accurate data to drive science-based modelling and simulation for conclusive supply and demand relationships. However, researchers already estimate that nearly 900 million hectares of degraded forests are available

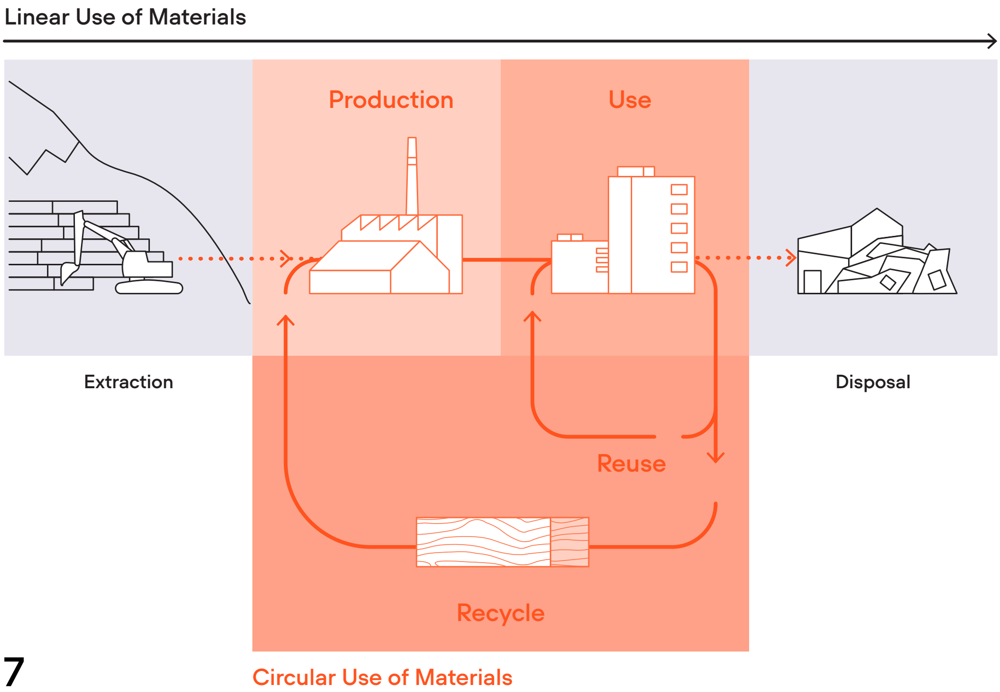
> „The linear use of materials, based on extraction, use, and disposal, must be replaced by **circular practices.**“

for reforestation without compromising the needs of other sectors such as agriculture[8]. If all this land were healthy forests, we could store 25% of the current atmospheric carbon pool[8] and lay the foundations for a transition to bio-based construction.

Optimise Material Use Through Circularity

The increased use of bio-based materials must be accompanied by a fundamental shift in our understanding and appreciation of materials. The linear use of materials, based on extraction, use, and disposal, must be replaced by circular practices aimed at reducing resource consumption and waste production. Transitioning to circular practices in the production of cement, aluminium, steel, plastic, and food alone could eliminate half of the emissions associated with the production of goods – equivalent to reducing current transport emissions to zero[9].

Fig. 3:
Linear versus circular use of materials



However, as a circular economy based on the complete avoidance of resource extraction and waste generation is an unattainable goal for the foreseeable future[10], it is essential to optimize existing material supply chains and to reuse and recycle materials wherever possible. New buildings should be designed for

The 15-minute-city imagines decentralised cities and neighbourhoods where residents can reach all their daily needs and essential urban functions, such as housing, work, commerce, healthcare, education, and entertainment, within 15 minutes by walking or cycling.

disassembly – so that individual components such as walls, beams, or slabs can be easily deconstructed without loss of material and reused in existing or new buildings. The existing building stock should be viewed as a material bank, containing valuable resources that can be reclaimed once the structure reaches its end of life. Material passports provide a novel way of collecting and organizing data on the materials contained in a building and their potential for reuse and recycling.

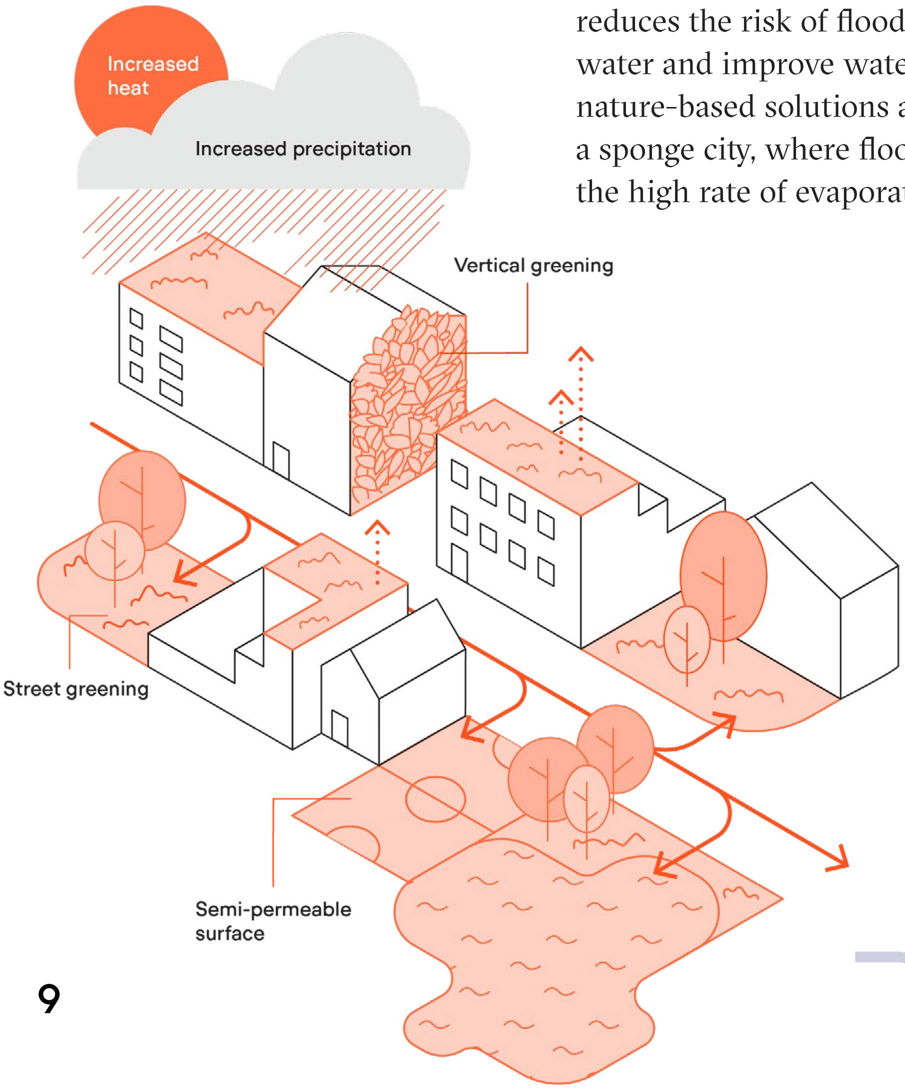
Reduce Resource Consumption Through Compact, Mixed-Use, and Polycentric Urban Development

Researchers and planners agree that a shift away from the ideal of single-family homes towards compact, efficient, and mixed-use developments is an important lever for substantially reducing per capita consumption of materials, land, and energy. Planning concepts such as the 15-minute city or superblocks support such a development while improving quality of life and social cohesion[11]. Similarly, polycentric city regions, which are networks of urban centres on a regional scale, can make more efficient use of resources, allow for shorter transportation and supply routes, and reduce per capita emissions compared to sprawling landscapes[11]. The focus on inner city densification, the conversion of obsolete infrastructure or the development of brownfield sites offer opportunities to promote the compact, polycentric city (region) – within existing structures and without compromising the natural landscape.

Invest in Nature to Make the Built Environment More Resilient and Liveable

In addition to reducing emissions from the built environment, we need to increase its resilience to climate change. Incorporating nature-based solutions, such as green roofs and walls or green spaces in buildings and infrastructure, as well as maintaining and expanding existing green spaces, is an important solution[12]. Nature-based solutions provide numerous health benefits, reduce the vulnerability to extreme weather events, while increasing biodiversity and improving the microclimate. Green roofs and walls regulate the temperature of the building envelope, reducing the need for insulation, improving indoor climate and quality of life, while filtering carbon dioxide and other pollutants from the air. In streetscapes, greening further reduces the risk of flooding through their potential to store water and improve water infiltration. At the urban scale, nature-based solutions are strongly associated with the idea of a sponge city, where flooding is limited by retention areas and the high rate of evaporation cools the temperature[13].

Fig. 4: Incorporating nature-based solutions in the built environment



> "Nature-based solutions provide numerous health benefits, reduce the vulnerability to extreme weather events, while increasing biodiversity and improving the microclimate."

Revalue Traditional Knowledge to Create a Locally Responsive Architecture

"A new architectural language that combines traditional architecture with the desire for modernity is needed in order to increase acceptance and bring about the necessary change in mentality."

In the past, locally available, often bio-based, building materials were used to construct houses and entire settlements, resulting in unique architectures inspired by both the prevailing climate and culture[14]. However, in the course of modernity, much of this valuable knowledge has faded away or even disappeared altogether. Today, traditional construction methods and the use of locally available materials are often falsely associated with primitiveness and poverty or with misconceptions such as the fire safety of wood. Yet bio-based building materials offer a range of benefits. For example, the natural properties of wood help to regulate indoor humidity, improve comfort, and reduce stress. The use of wood in healthcare centres is also known to improve patients' sense of wellbeing and lead to a shorter recovery time[15]. It is important to highlight these advantages and to find a new architectural language that combines traditional architecture with the desire for modernity in order to increase acceptance and bring about the necessary change in mentality.

Promote High-Quality Climate-Friendly Housing for All

The shift to bio-based and other climate-friendly materials offers an opportunity to meet the global demand for decent housing. Building with bio-based materials provides residents a healthy alternative to conventional materials and facilitates a rapid and cost-effective delivery of high-quality housing for all. Bio-based building materials have the advantage that most require less processing and less skilled labour, making them relatively quick and easy to use in construction[16]. Further, materials such as wood and bamboo, can be prefabricated, enabling rapid delivery of housing[17]. Although, political, regulatory, and financial frameworks in many countries often

Universal design aims to make buildings and environments accessible to as many people as possible, regardless of age, disabilities, or other factors. This includes ensuring that housing and infrastructures have barrier-free access, that walkways are wide enough for someone in a wheelchair or with a stroller to manoeuvre comfortably, or that chairs with armrests are provided at regular intervals to assist the elderly.

"Ensuring that everyone has access to decent housing is not just about providing shelter, it also means meeting the fundamental needs of all residents."

pose a hindrance to this change, the dwindling availability of conventional materials is increasing the pressure for alternative solutions. To facilitate this change, true carbon costs and holistic carbon footprints should be used as the basis for pricing materials, structuring procurement, and granting permits.

Ensuring that everyone has access to decent housing is not just about providing shelter, it also means meeting the fundamental needs of all residents. A universal design approach to housing and infrastructure can help address the rising demand for barrier-free and accessible housing caused by an ageing global population. This can also benefit persons with disabilities or those with children. As we move forward, energy retrofitting to reduce emissions and new construction to meet the housing demand will remain inevitable. If executed correctly, however, both provide a chance to meet the evolving needs of our societies.

Outlook to a Regenerative Built Future

By embracing these strategies and ideas, we can pave the way for a future where our built environment is in harmony with nature, supports our communities, and reduces its environmental footprint; a built environment that works for the people and the planet, not against them.

Transforming the built environment offers one of the greatest levers for addressing climate and biodiversity crises while ensuring dignified living conditions for all. Such a transformation requires deep structural changes and a holistic approach that considers issues from materiality to land use to affordability. The vision of the regenerative built environment consolidates such a holistic approach. The Bauhaus Earth Knowledge Collection "Building for the Future" aligns with this vision and attempts to address the various aspects that need to be considered at different scales. The upcoming Knowledge Product 3 of Series 1, "Setting the Frame", presents the principles and values of a regenerative built environment.

KEY TAKEAWAYS

→ To tackle the true carbon footprint of the built environment, we must address operational and embodied carbon equally. In addition to decarbonising the sector, it's important to create negative emissions as well.

→ Switching to bio-based building materials can help transform buildings and cities from carbon sources into carbon sinks. Sustainable land and forest management, along with reforestation and afforestation, is necessary for this transformation.

→ To save resources and reduce waste, we need to optimize our value chains and reinforce circular solutions such as reuse and recycling. We can also design our cities more resource-friendly by making them compact, mixed-use, and polycentric.

→ Greening cities can reduce the impact of climate change and extreme weather conditions on cities, while also improving people's health and well-being.

→ Traditional building techniques hold valuable knowledge for climate-friendly construction. They are designed to suit the local climate and are often built with locally available, bio-based materials.

→ To respond to the global housing crisis, the use of bio-based materials should be scaled up to allow for the rapid construction of decent housing for all.

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About Bauhaus Earth

We envision a future where buildings, cities, and landscapes proactively contribute to climate restoration and have a positive impact on the planet and its inhabitants. Our mission is to transform building and human settlements from a driver of climate and societal crises into creative forces for systemic regeneration.

Only a complete systemic overhaul of our built environment will prevent a global climate catastrophe.

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