

## Policy pointers

**Use of mass timber in urban building construction** offers a major opportunity for developing countries, especially in Africa, to address climate change, meet housing needs and support rural livelihoods.

**Governments can increase market confidence in timber construction** by updating legislation and building codes, providing guidelines to increase energy efficiency, and encouraging the private sector with tax incentives and proof-of-concept public buildings.

**Development actors should invest in smallholder tree growing and affordable certification**, support mass timber processing and manufacturing, and update legislation and building codes for safe and quality timber construction.

**Governments and other development actors can build trust-based multistakeholder coalitions** to encourage positive public perceptions of urban timber construction.

## African timber cities: carbon sinks with development benefits?

Carbon emissions from concrete and steel building construction are a major cause of climate change. The building and construction sector currently accounts for around 39% of global greenhouse gas emissions. Rapid urbanisation in developing countries requires large-scale building, including housing for low-income people. Mass timber is a newly developed category of engineered wood products, laminated from smaller boards into larger structural components. Substituted for concrete and steel, mass timber is a carbon-absorbing, energy-efficient, lower-cost, durable and mendable building material that can help deliver affordable urban housing and rural livelihood opportunities. It is suitable for Africa, where trees grow faster than in temperate climates. Africa can mitigate climate change and achieve other developmental benefits using mass timber in its construction sector. Governments and other development actors can support the transition.

The IPCC report of August 2021 issued a 'code red for humanity' on the urgency of our changing climate and the urgent need to reduce greenhouse gas (GHG) emissions.<sup>1</sup> In 2019, annual GHG emissions were the largest ever, at 59.1 billion tonnes (gigatonnes) of carbon dioxide equivalent (GtCO<sub>2</sub>e), with a significant increase in forest fires.<sup>2</sup> Despite overall emissions reductions during the peak of the COVID-19 pandemic, atmospheric GHG concentrations continued to rise in 2020–21. More than five years after adoption of the Paris Climate Agreement, the 'emissions gap' between where GHG emissions are heading and where they need to be remains very large. By 2030, annual emissions need to be 27% lower than current unconditional Nationally Determined Contributions (NDCs) to limit global warming to 2°C above pre-industrial levels and 57% lower to keep warming within the 1.5°C limit. Countries need to pursue post-pandemic recovery with substantial decarbonisation.<sup>3</sup>

Building construction has been responsible for changes in atmospheric CO<sub>2</sub> for hundreds of years

(see Figure 1). The building and construction sector accounts for approximately 39% of global GHG emissions, 28% of which (11% of total GHG emissions) are associated with construction material — 'embodied carbon'.<sup>4</sup> Continuing with 'business as usual' will drive a considerable emissions increase, with current expectations that global building stock will double by 2050. Limiting global warming to 1.5°C will require a rapid transition towards low-carbon urban construction.

A transition from carbon-emitting mineral-based construction materials to carbon-absorbing regeneration and renewal-based materials is urgently required. Forests and advancements in mass timber construction have much to contribute. Mass timber is a newly developed category of engineered wood products laminated from smaller boards into larger structural components suitable for the construction of low- to mid-rise buildings. Mass timber products include cross-laminated timber (CLT), glued laminated timber (GLT) and mass plywood, all made by layering and pressing together large wood pieces to form panels as rigid

## Mass timber in Africa has high carbon sink potential

and durable as steel. They are more robust, lighter, more attractive, and potentially more fire-resistant than concrete and steel. Among the different types, CLT's technical properties and market trajectory offer the best potential for substitution at scale.

To explore mass timber's potential, this briefing draws on the authors' experience in wooden construction projects in Africa, previous consulting work and recent desk research.

### Mass timber's potential in Africa

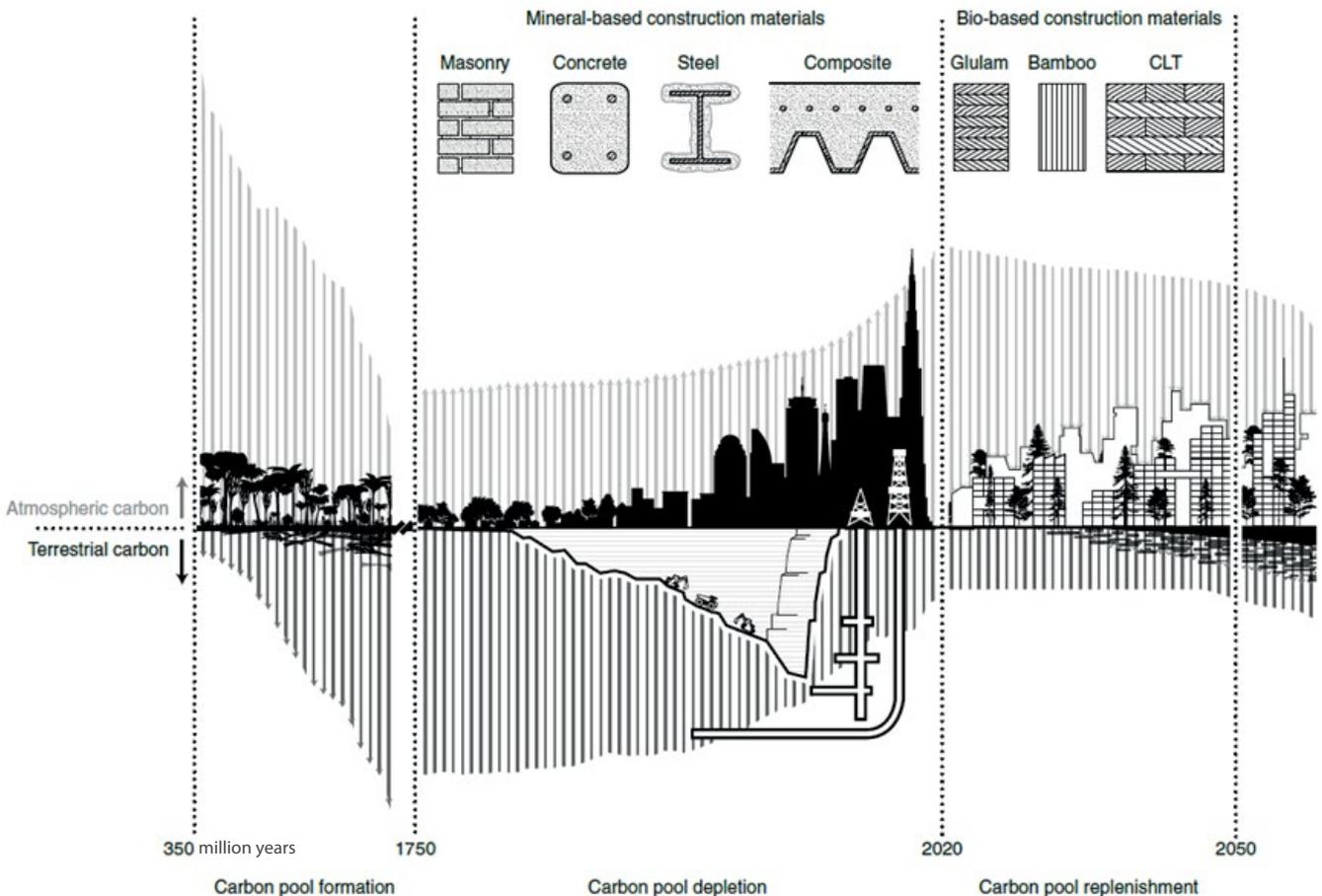
Urban building construction in the 21st century will predominantly happen in the global South. Africa will account for an extra 1.2 billion people by 2050. With millions of people in sub-Saharan Africa moving to cities, the region's 4.1% annual urban population growth rate is more than double the global rate.

Urban housing construction in Africa currently utilises high-carbon materials, usually cement and steel, whose production emits significant GHGs

— 0.93kg of CO<sub>2</sub> for every kg of cement produced.<sup>6</sup> With construction and building emissions estimated to grow with urbanisation, Africa can mitigate climate change and address its housing challenges using low-carbon solutions such as mass timber, also potentially supporting rural livelihoods.

Africa has a current deficit of 56 million housing units, 80% of them affordable housing for low-income people.<sup>7</sup> With thermal properties well suited to hotter climates, mass timber can unlock both energy savings and lower construction costs. With 25% faster construction times and being US\$14 cheaper per square foot than concrete and steel construction, mass timber provides an important opportunity for expanding Africa's housing stock.<sup>8</sup> It also tends to be modular in design, relatively easy to repair directly and more likely than cement and steel to provide high-quality living space for longer.<sup>9</sup> Being built of 'living' material, wooden buildings could also strengthen pro-nature attitudes in Africa and help conserve much of the world's remaining biodiversity.

**Figure 1. Construction processes responsible for formation, depletion and potential replenishment of land carbon pool and changes in atmospheric CO<sub>2</sub> concentrations over time (source: Churkina et al.)<sup>5</sup>**



Over millions of years terrestrial carbon (the land carbon pool) was formed and CO<sub>2</sub> atmospheric concentrations slowly declined.

Urban and industrial growth depleted the land carbon pool and increased atmospheric CO<sub>2</sub> concentrations. Buildings constructed from concrete and steel are intensive in energy consumption and GHG emissions.

Cities built from bio-based materials can be carbon sinks and help replenish terrestrial carbon storage and reduce atmospheric CO<sub>2</sub> levels.

Timber-based housing also presents an opportunity to tap into carbon market financing and to address affordability for low- and middle-income urban dwellers and related financing challenges. Carbon market financing can provide revenue streams to cover construction costs and cross-subsidise and increase housing affordability. For examples of planned CLT construction projects in Africa, see Box 1.

### Benefits for Africa

Mass timber and the wider forest economy have potential to create jobs and spur economic development in Africa. Forestry provided formal and informal employment for approximately 20 million people in Africa in 2014.<sup>10</sup> Timber production, including through new plantations, and wood processing for building materials to meet demand for housing could create an estimated 25 million jobs and contribute up to US\$83 billion towards Africa's bioeconomy by 2050.<sup>11</sup> An increase in plantations will absorb more carbon from the atmosphere and can create positive feedback loops, benefitting the climate, employment and the economy. Plantations must be developed on degraded or unforested land to protect biodiversity and forest-dependent people's livelihoods.

Africa's forest economy can also support ancillary sectors. Healthy forests encourage ecotourism. In addition, development actors in many African countries engage with local communities, including women and youth, seeking to include them in forest governance and to strengthen their tenure rights. Hence, local communities, women and youth should gain opportunities to benefit from economic growth and job creation.

Mass timber could enable parts of Africa to 'leapfrog' steel and concrete, creating a major

### Box 1. Examples of planned CLT construction in Africa

**Gabon Sovereign Wealth Tower.** The tower is envisioned at approximately 9,000 square metres of floor space over six or more floors and will be constructed in The Marina, a 13 hectare site at the tip of Gabon's capital, Libreville. This flagship project aims to house the country's sovereign wealth fund, the United Nations presence in Gabon, other offices, residential and retail units, and social and cultural infrastructure including public spaces.

**BuildX affordable homes, Kenya.** BuildX is a Kenyan design and construction company focusing on climate-smart building. BuildX's Circular Cooperative Affordable Housing Project aims to move urban residential construction away from high-carbon approaches. Impact investor Reall has invested in the project to pilot the construction of affordable timber-built houses with a financing plan involving tenant purchase arrangements for residents.

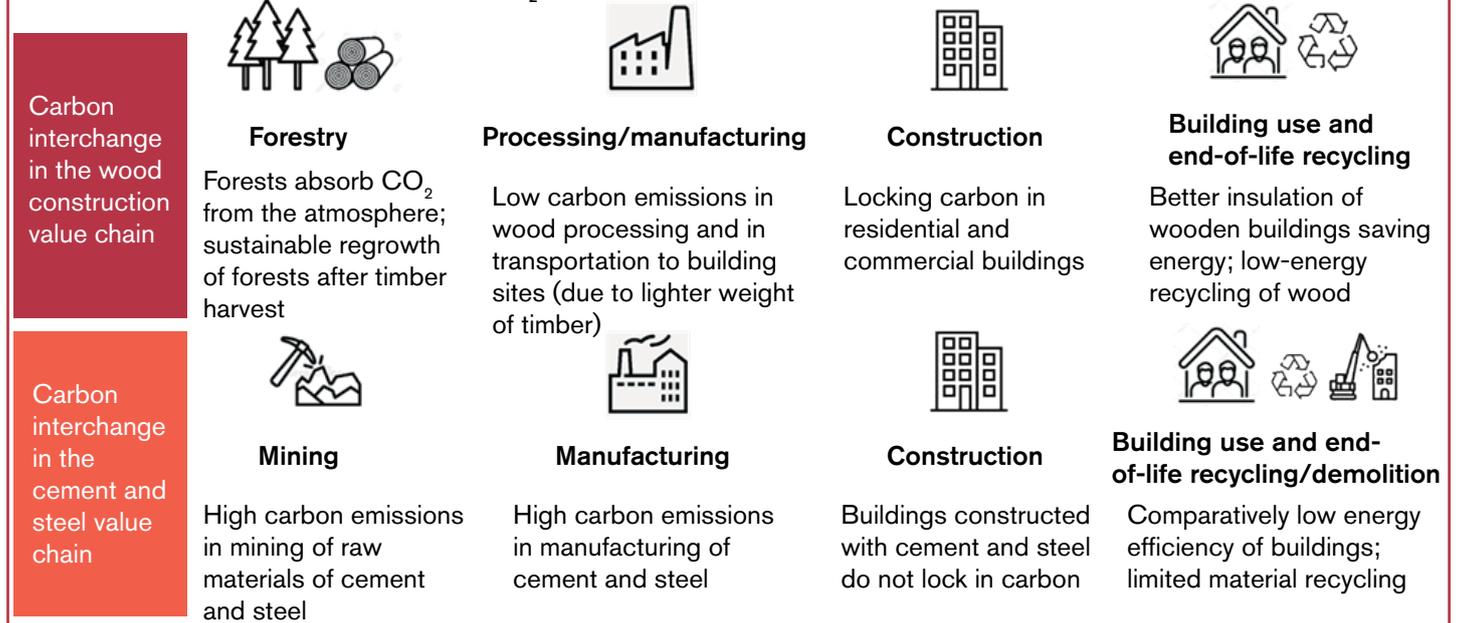
export industry. Worth approximately US\$1 billion in 2020, the global CLT market is expected to grow to approximately US\$2.3 billion by 2026.<sup>12</sup> With 26.3% of sub-Saharan Africa's land area forested, the region provides a vast potential source of mass timber construction materials. And, because sunnier and more humid climates enable faster tree growth,<sup>13,14</sup> sub-Saharan Africa can reasonably expect to enjoy a competitive advantage in composite timber production, although more research and development are required.

### Carbon sink potential

Mass timber in Africa has high carbon sink potential. To estimate its potential CO<sub>2</sub> reductions, we considered the whole value chain and compared it with the corresponding value chain for cement and steel (see Figure 2).

We used two scenarios, one assuming 50% of new urban buildings in Africa will be made of wood and the other assuming 90%. And we considered two sources of carbon reduction: carbon absorption by forests, which is later locked in

Figure 2. Land-based and atmospheric CO<sub>2</sub> interchange: wood compared with cement and steel construction



wooden construction and recycled at a building's end of life, while forests regrow and the cycle continues; and lower manufacturing emissions of timber compared with cement and steel. Additional areas where timber construction reduces carbon emissions include energy savings from lower heating and cooling requirements (wood is a more effective insulator) and the relative ease of low-energy wood recycling. Both factors are indicated in the figure's fourth column but were excluded from our calculations as being outside the construction steps of the value chain.

In our analysis, Africa can achieve total net emissions reductions of 5–10 GtCO<sub>2</sub>e by 2050 by substituting steel and concrete with mass timber in 50% of new urban buildings and 12–17 GtCO<sub>2</sub>e reductions by substituting 90% of new urban buildings.<sup>15</sup> Importantly, however, carbon abatement potential and the economics of timber construction must be considered in specific local contexts relating to proximity to raw materials, transportation infrastructure, manufacturing scale and urbanisation patterns.

## Recommendations

Governments and other development actors can support the use of mass timber in construction through the following policy interventions and a systems approach.

**Forestry.** Development actors should establish more inclusive small-scale certification models and provide rural communities with extension support, technical assistance and long-term security of tree tenure. Incentives for tree planting linked to GHG NDCs and to forestry programmes such as REDD+ can further help. To prevent land grabbing and other illegal and unfair practices, protection of rural communities is essential.

**Processing and manufacturing.** Development actors should scale up mass timber processing and manufacturing with low-cost financing and technical assistance to help processing plants' strategy, business plans and operations, such as through consistent supply of raw materials.

## Notes

<sup>1</sup> UN News (9 August 2021) IPCC report: 'Code red' for human driven global heating, warns UN chief. <https://news.un.org/en/story/2021/08/1097362> / <sup>2</sup> UN Environment Programme (2020) Emissions Gap Report 2020. / <sup>3</sup> UN Environment Programme (16 September 2021) COVID-19 caused only a temporary reduction in carbon emissions. [www.unep.org/news-and-stories/press-release/covid-19-caused-only-temporary-reduction-carbon-emissions-un-report](http://www.unep.org/news-and-stories/press-release/covid-19-caused-only-temporary-reduction-carbon-emissions-un-report) / <sup>4</sup> Global Alliance for Buildings and Construction, International Energy Agency and UN Environment Programme (2019) Global Status Report for Buildings and Construction: Towards a zero-emissions, efficient and resilient buildings and construction sector. / <sup>5</sup> Churkina, G, Organschi, A, Reyer, CPO, Ruff, A, Vinke, K, Liu, Z, Reck, BK, Graedel, TE and Schellnhuber, HJ (2020) Buildings as a global carbon sink. *Nature Sustainability* 3(4), 269–76. / <sup>6</sup> Ramsden, K (3 November 2020) Cement and Concrete: The Environmental Impact. Princeton Student Climate Initiative. <https://psci.princeton.edu/tips/2020/11/3/cement-and-concrete-the-environmental-impact> / <sup>7</sup> Makeka, M, Vussonji, D and Buberwa, E (25 September 2021) Could forests help solve Africa's housing challenges? <https://businessday.ng/bd-weekender/article/could-forests-help-solve-africas-housing-challenges/> / <sup>8</sup> Mallo, MFL and Espinoza, OA (2016) Cross-Laminated Timber vs. Concrete/steel: Cost comparison using a case study. In: *WCTE 2016 - World Conference on Timber Engineering*. Vienna University of Technology. / <sup>9</sup> American Institute of Architects (2020) Mass Timber in North America. [www.aiaosangeles.org/wp-content/uploads/2020/10/Mass-Timber-in-North-America.pdf](http://www.aiaosangeles.org/wp-content/uploads/2020/10/Mass-Timber-in-North-America.pdf) / <sup>10</sup> UN Food and Agriculture Organization (2014) State of the World's Forests 2014. / <sup>11</sup> UN Food and Agriculture Organization and UN Environment Programme (forthcoming) The State of the World's Forests 2022. / <sup>12</sup> IMARC Group (2021) Cross-Laminated Timber Market: Global Industry Trends, Share, Size, Growth, Opportunity and Forecast 2021–2026. / <sup>13</sup> Locosselli, GM, Brienien, RJW, de Souza Leite, M, Gloor, M, Krotenthaler, S, de Oliveira, AA, Barichivich, J, Anhof, D, Ceccantini, G, Schöngart, S and Buckeridge, M (2020) Global tree-ring analysis reveals rapid decrease in tropical tree longevity with temperature. *Proceedings of the National Academy of Sciences* 117(52), 33358–64. / <sup>14</sup> Henman, J (17 July 2019) Planting more trees can actually save the planet – so why aren't we doing it? <https://news.co.uk/opinion/comment/planting-more-tree-save-the-planet-climate-change-why-arent-we-doing-it-315293> / <sup>15</sup> Derived from note 5. Calculated at 30 sq m floor area per capita.

**Construction.** Governments should update legislation and building codes to support timber construction while ensuring quality and safety to increase market confidence and improve developer and end-user financing with bank lending and insurance company risk cover. Governments can make their intent more visible and encourage the private sector by using mass timber to construct public buildings (such as schools, hospitals and government offices).

### Building use and end-of-life recycling.

Governments and others' design guidelines should promote energy efficiency in timber buildings and post-use wood recovery (such as of beams and frames). Harmonised regulation of waste wood classification, sorting and cleaning techniques, and specifications for reuse, will assist recovery and recycling.

**Cross-cutting interventions.** More research is needed: to advance mass timber in ways consistent with international trade agreements, urban and regional planning, and workforce development; into policies promoting an inclusive, equitable, health-enhancing and environmentally sustainable bioeconomy; and to understand the climate change mitigation potential of different materials and local contexts, and to strengthen life cycle analyses and environmental product declarations.

Governments should provide tax incentives for value chain actors and, with others, address negative public perceptions of timber construction and educate people about the benefits, including with proof-of-concept demonstration sites. Trust-based multistakeholder coalitions can improve cohesion among diverse views and strong narratives on the mass timber value chain, benefits and risks can promote agreement.

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