

‘Timber Cities’ Might Help Decarbonize the World

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New research suggests that using wood for construction could avoid 100 gigatons of CO2 emissions through 2100, but building skylines of timber requires careful forest planning.

By [Bob Berwyn](#)

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Constructing new timber framed houses in Echuca, Australia. Credit: Ashley Cooper/Construction Photography/Avalon/Getty Images

Buildings constructed with more wood, and less cement and steel, would help decarbonize the construction and housing industries in line with global goals to cut greenhouse gas emissions 50 percent by 2030 and reach net zero emissions by 2050, new research shows.

The [paper](#), published Aug. 30 in Nature Communications, explains that building mid-rise wood dwellings to meet the demand from rapidly expanding urban populations could avoid about 100 gigatons of carbon dioxide emissions through 2100—about 10 percent of the reduction needed to cap global warming below 2 degrees Celsius.

“We do know we need to reach this net zero target as soon as possible,” said lead author [Abhijeet Mishra](#), with the [Potsdam Institute for Climate Impacts Research](#). “Reaching 1.5 degrees is getting quite dicey to achieve. An earlier paper from our colleagues really looked at how buildings can be a global carbon sink.” But that work did not answer the question of where the wood would come from. “The idea was to fill that gap,” he said.

The scale of wood construction envisioned would require about 555,000 square miles of additional tree plantations, an area slightly bigger than Alaska, on top of the 505,000 square miles of tree farms that exist globally today.

The study paints a broad-brush picture of where growing those trees might be feasible, factoring in projected patterns of forest growth and decline. The geographical distribution of urban population growth also matters, because using wood for building only reduces carbon emissions if it’s not transported too far.

In the meantime, planners and decision makers need to tackle the enormous challenge of rethinking the way people live, work and move about in cities, because mid-rise wood residential homes would alter population density patterns and transportation needs.

Any plans that include trees and wood as a way to reduce carbon emissions also requires being aware of how trees and forests are responding to the warming climate. Wildfires, insect outbreaks and drought make any new tree-planting schemes an uncertain bet, so some experts say a wider range of options for decarbonizing building and housing must be on the table, including building structures with smaller footprints, recycling waste and construction materials into new buildings and using other alternative low-carbon building materials.

New technologies could reduce the carbon emissions of the cement and steel used in construction in the years ahead, which would also change the equation, although there is no clear signal that’s already happening, or will happen very soon, Mishra said.

Effective regulations and careful planning for new tree plantations would be needed to limit impacts to biodiversity and food production. The transition to wood buildings can’t come at the expense of pristine forests or habitat conservation for biodiversity, said co-author [Alexander Popp](#), also a researcher at the Potsdam institute, who warned that establishing new timber plantations even on non-protected natural areas “could further increase a future loss of biodiversity.”

But other studies indicate that measures like transitioning to healthier diets with less meat consumption could help to free-up land for wood and food production while

conserving biodiversity, emphasizing that slowing climate change will require a web of complex and interrelated solutions, rather than a single silver bullet solution.

At the Global Carbon Scale

The Intergovernmental Panel on Climate Change's most recent [report](#) on climate adaptation and mitigation showed that buildings produce about 20 percent, or 12 gigatons, of global greenhouse gas emissions. About 18 percent of that total comes from the use of cement and steel, some of which could be avoided by using wood.

But any increased use of timber and other bio-based materials in buildings “brings not only benefits, but also risks,” the report found. “The increased use of timber can accelerate degradation through poor management and the pressure for deforestation, as already recorded in the Amazon and Siberia forests, and the competition for land and resources.”

“Promoting the use of more timber in buildings requires the parallel strengthening of legislation for sustainable forest management, forest certification instruments, and care for the people and social organizations that live in forests,” the report continued.

[Galina Churkina](#), an ecosystem researcher and carbon cycle expert at the [Technische Universität Berlin](#) and co-author of the new study, said current overall wood use-patterns help provide some context and nuance for the findings, and show how rethinking our current use patterns can bring some benefits.

About 67 percent of global annual raw wood production is either burned as fuel within a year or pulped for packaging and paper, resulting in short-term carbon dioxide emissions. Only about one third currently goes into long-term products, she said. “I think this is the bigger picture that one should see from the carbon perspective,” she said. “A lot of the carbon that is stored by trees is released right after they are cut.”

That adds to the dangerous concentration of heat-trapping greenhouse gas pollution, while using a higher portion of raw wood production to build long-lasting homes and buildings would keep the carbon locked up on a timescale that's meaningful for capping global warming, she said.

She also said most deforestation currently is not driven by timber for building, but by land clearance for agriculture, urban expansion and even mining, as shown by recent research that attributes 10 to 15 percent of the deforestation in Brazil to mining. Despite multiple pressures, there are options, including agroforestry, “where you can kind of combine food and timber production,” she said. “Especially in tropical countries, this is a good way to go, and I think many of these opportunities are not really utilized to the degree that they could be.”

Those options include the re-use of old wood, she added.

“What would be actually the best in the future is that this wood is reused, after the demolition, for instance, for new houses or restructuring houses,” she said. “Reuse of old timber, then, actually, it also lessens the pressure on forests and on production of new wood. If you can get it from somewhere else, you don’t need to cut the forest.”

Despite the growing evidence that building with wood benefits the climate, progress has been slow. Churkina thinks is due to an institutional tendency to stick with the status quo.

“I think there is no really strong incentive to do this,” she said. “One needs incentives at different levels, from investors, to developers, to the owners of the buildings.”

The profitability of the construction industry’s current business model gives it little reason to change.

“Why should they worry?” she asked. “There are a lot of companies that produce cement and build with cement with reinforced concrete and why should they change their businesses if they’re doing well?”

Part of the Climate Toolbox

[Michael Eliason](#), an expert on low carbon urban buildings and districts, said the new study gives a broader sense of the potential for carbon mitigation using mass timber on a big scale.

“It’s an issue that really hasn’t been explored to date, as most life cycle assessments look at the scale of a single building,” he said, adding that intelligent, cross-sectoral planning can help resolve the competing demands for land to sustain carbon-sequestering forests, food production and more wood for building.

“One of the ways to do this is to be incredibly resource-efficient when designing buildings,” he said. “Limiting sprawl can also play a significant role. The IPCC’s Working Group III report on mitigation highlighted that compact, walkable cities are some of the most effective means of mitigating carbon emissions. Mid-rise timber cities, such as those studied in this report, with resource efficient and sustainably sourced timber do exactly that.”

He said using other low carbon materials such as compressed earth bricks or insulating structural clay blocks, or bio-based materials like prefabricated exterior walls filled with straw or seaweed, can also reduce the demand for timber.

One of the big challenges is the lack of an organized approach to reducing carbon in building and housing, said [Monte Paulsen](#), a Vancouver-based building and climate expert with [RDH Building Science](#).

“The key is to clarify and agree on how to account for differing forestry practices when making embodied carbon calculations,” he said. “Unfortunately, many forestry companies are uninterested in this issue. And many embodied carbon modelers are pursuing simpler problems they feel they can solve.”

The huge wave of projected new construction is an important context, he added, with some reports showing it’s equal to building one New York City per month.

“That figure does not include all the buildings that now need to be rebuilt every year, after fires in Colorado, floods in Pakistan,” he said. “The ongoing climate destruction may force a return to simpler, cheaper, lesser buildings that can be built with local materials.

And regional nuances are important, considering the headline figures of the study. Using engineered wood products, sometimes called [mass timber](#), on a large scale probably won’t play a big role in Pakistan’s recovery, but new ways to use local wood components could help. But he said mass timber makes a lot of sense in places like Vancouver.

“Is mass timber appropriate for all of the needed construction? I doubt it,” he said. “Even in an ideal location like Vancouver, mass timber alone can cut embodied carbon by about 25 percent, when used for both structure and wall panels. And we estimate that an educated team could cut another 25 percent of embodied carbon through 99 other decisions: flooring, cladding, mechanical and other choices.”

And with innovations in the concrete sector, it’s possible that there will be lower-carbon material available in the future.

“All of this means that, today, one could achieve equal reduction to or greater than mass timber via other means,” he said. “And in a few years, one might be able to match mass timber with concrete. So, mass timber is an important tool, particularly in highly forested parts of the world, but it is not the only tool in our box.”