

Busting the carbon myths surrounding wood as a construction material

It has become received wisdom in green construction circles that wood is the most inherently sustainable building material.

Dirk-Jan Simons, PhD, partner at Netherlands-based consultancy LBP|Sight, says: “We've always looked towards bio-based materials and temporary carbon storage a bit romantically.

“Even within the Dutch government, it's an automatic assumption that because it is bio-based, it is always better than traditional (materials).”

Previous studies have indicated that constructing with wood would be better than traditional materials in terms of greenhouse gas emissions. Using wood instead of more carbon intensive materials, such as plastic-based products or traditionally produced concrete and steel, results in a net reduction of total carbon emissions, they show.

Replacing energy intensive products with bio-based ones is therefore a cure to the problems caused by climate change, according to life cycle assessment (LCA) guidance.

This matters because, as highlighted in a recent IPCC report, buildings have the potential to contribute more than 20% to the global effort to tackle damaging climate change. Greenhouse gas emissions associated with buildings amounted to 12 Gton CO₂eq in 2019, which was equivalent to 21% of the global total.

Trees in forests are natural carbon sinks. However they lose this property when they are cut down and used as building components, new research shows.

This study assesses the science base behind the principles of carbon storage in timber construction products and the impact of mass-supply of timber on the European forestry production chain.

It also assesses the way greenhouse gas emissions are accounted for in environmental impact assessment methodologies, specifically the LCA and the potential for mitigating climate change via temporary carbon storage.

The study, which is a collaboration between LBP|Sight and engineering consultancy Royal HaskoningDHV, says many hypotheses on the real impacts of greenhouse gas emissions for wood are ‘at least questionable if not wrong’.

Often the assumption is that the carbon balance can be restored by replacing a tree that has been cut down with a new one.

However, this restoration will be far from “immediate” as it will take decades for the new tree to grow, says the LBP study.

Replacing a new tree, depending on the species, can take up to a century. This means that compensating for the loss of carbon from the chopped down tree will take decades.

Restoring the original conditions carbon balance once trees have been cut down is not “immediate” but can take between 30 years and more than a century, says the study.

It is true that young seedlings and saplings grow faster than more mature trees, meaning more rapid uptake of carbon, but the contribution of the latter should not be discounted, it says.

“In terms of biomass, it's amazing how much larger older trees still accumulate each year,” says Simons, pointing to a study in ‘Nature’ magazine of 600,000 plus trees that showed continued growth in carbon uptake as trees grow older.

Not all biobased products can therefore be considered as carbon neutral in the short-term horizon, due to longer rotation periods or slow growing times. This is ‘especially’ the case for timber, says the LBP study.

By contrast, fast-growing biobased materials like straw, hemp, and bamboo, can remove carbon from the atmosphere more rapidly, especially when used to make products to wooden- or mineral-based construction products with a similar service life.

In addition, disturbing soil during the timber harvesting process releases further stocks of carbon into the atmosphere as will roots or any other material that have been left behind to rot.

“If the soil has been turned over, it takes a really long period of time to restore the soil carbon balance,” says Simons.

Whether wood products can be treated as carbon neutral must also take into account what happens to the timber after it has been harvested.

The transport and processing of the raw wood material causes carbon emissions, for example, as does burning and the degradation of products at the end of their life cycle.

If a timber construction product is to be counted as truly carbon neutral, the amount of carbon uptake must balance out the extra emissions during the production lifecycle, which will involve factoring in other emissions, such as from transporting the material.

While in the long term, substitution by wood of fossil fuel-based products can be beneficial, over the short term, increased wood use has negligible effects and can even result in increased net carbon emissions.

Temporarily storing carbon is effectively equivalent to delaying an emission by the number of years it is stored. The report acknowledges that any delay in re-emission is beneficial because it provides extra time to find or develop more effective solutions for mitigating climate change.

In order for harvested timber to deliver temporary carbon storage benefits, sustainable forestry and parallel active reforestation are ‘unequivocal prerequisites’, which is not a given at present, notes the study.

The science behind temporary carbon storage is both ‘unclear and disputed.’, says the LBP study, and therefore should not be used when setting regulations and standards.

Even the principle of ‘sustainably managed forests’ is ‘often misused’, says the study, which finds that ‘too often’ the label is applied without necessary controls being put in place.

The LBP study’s findings have been backed up by more recently published IPCC working group report on carbon mitigation strategies, which shows that decisions on whether to leave forests alone, re- or deforest can have “a much larger impact” than switching construction materials to timber.

Rather than increasing the harvesting of wood products, bodies like the IPCC and various NGOs have argued for the necessity of forest restoration and afforestation.

“They clearly underline the potential for existing forests, reforestation and better forest management to really outnumber the mitigation potential of increased biomass or biowaste material in housing or in construction,” says Simons.

Construction wood products should therefore not be treated as carbon neutral and ‘definitely’ not as carbon sinks, says the LBP research.

Unless countries can make clear where new forests must be planted, how they are managed and how much of the wood grown in them can be harvested, the contribution of forestry to the IPCC’s climate change mitigation scenarios of land-use change remains ‘ambiguous at best’, according to the LBP research.

The long-term mitigation benefits related to product substitution may have been overestimated by up to ‘100-fold’ in academic literature, it says.

Overall, according to the study, it remains ‘unclear’ whether the supply and demand of wood in European member states it examined are in balance and or sustainable.

This is due to the gaps in data and lack of information on how demand for wood in construction influences felling in forests.

Timber can play a role in construction if other materials are not easily available or lack a pathway towards decarbonisation, provided the harvested wood is sourced from a sustainably managed forest which may be “difficult to guarantee”, says Simons.

“If you want to go with biomaterials, go for the fast-growing ones,” he adds, highlighting bamboo and hemp as good examples of plants that can be grown rapidly and turned into materials, like constructive beams.

A potentially greater impact on decarbonisation, at least in the short term, can be achieved by making the production processes of other materials such as aluminium, steel and concrete, more efficient and sustainable, the study finds.

Therefore, instead of relying on wooden products to achieve carbon neutrality in the construction process, the research concludes that a better option for cutting emissions in the built environment is to decarbonise the manufacture of all construction materials throughout their entire life cycle.

Substituting wood for other construction materials isn't going to solve construction's emissions problem, the focus should be on decarbonizing other materials, says Simons.

Rather than focusing on tackling climate change by using bio-based products, policy should therefore seek to support innovation that decarbonises the whole construction sector by moving away from fossil fuels in the production of mineral products. This work should be done in tandem with developing the potential of forests as carbon sinks by letting trees grow, reducing harvesting and supporting afforestation, the study says.

Technological solutions are 'definitely available' for producers to decarbonise non-bio-based construction materials, Simons says: "We can no longer hide behind the technology."

Broader pressure to decarbonise means these producers don't have a choice anyway, meaning that the biggest hurdle is probably the "political courage" required to push them faster along this route.

And of the emissions from buildings highlighted earlier in the IPCC study, 81% stem from offsite generation of electricity and heat as well direct emissions produced onsite, the study points out.

"Even if we change all construction materials tomorrow for carbon neutral materials, we still haven't solved the major problem because the use phase of buildings also contributes a very large amount to carbon emissions. All those factors combined really indicate that we still, as a society, have a lot to do."

Written by David Blackman

About the construction products consortium

The consortium is a collaboration between European and global key players in the field of construction products: [Concrete Europe](#) (composed of the [Federation of the European Precast Concrete Industry](#) (BIBM), the [European Cement Association](#) (CEMBUREAU), the [European Federation of Concrete Admixtures Associations](#) (EFCA) and the [European Ready Mixed Concrete Organization](#) (ERMCO)), the [European Ceramic Industry Association](#) (Cerame-Unie), the [European Autoclaved Aerated Concrete Association](#) (EAACA), the [European Calcium Silicate Unit Producers Association](#) (ECSPA), the [European Mortar Industry Organisation](#) (EMO), and the [Global Cement and Concrete Association](#) (GCCA).

