TALKING TIMBER

CIRCULAR ECONOMY OF TIMBER BUILDINGS

***Dr Andrew Shea** and **Dr Eleni Toumpanaki** discuss the cradle-to-cradle and multi-disciplinary approach for affordable timber housing in the UK*

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Climate change is the principal challenge of our time and is inexorably linked to material resource use. In Europe, the building sector is the largest user of energy (at 40%). Globally, buildings and their construction contribute 39% of the world's carbon footprint, 11% of which consists of those emissions associated with construction and production of building materials. Additionally, the building and construction sector in Europe consumes around 10 million tonnes of plastics each year, making it the second largest application for plastics after packaging.

A GW4 interdisciplinary research community has recently been established between the Universities of Bristol, Bath, Exeter and Cardiff to investigate the full potential of British-grown timber in the design of affordable and low-energy housing, exploring current and future trends in a 'systems-thinking' approach and bringing together significant expertise in strategic areas such as forestry, architecture, timber engineering, building physics, and the circular economy.

Circular construction aims to reduce waste generation and to re-use or recycle materials upon completion of first use, resulting in the circulation of materials in multiple re-use loops. This contrasts with the linear economy 'take-make-waste' model which ultimately generates waste products requiring disposal and generating demand for new materials. The design of circular buildings presents a great opportunity for the use of bio-based materials that are uniquely suitable for circular construction—they are renewable when sustainably and responsibly managed, often fast-growing and, if not recycled in the same or different form, are usually bio-degradable, resulting in minimal hazardous waste. The UK has limited wood resources and is the world's second largest importer of timber – a circular economy approach to manage the finite local wood resources is critical.

The use of timber in construction offers potential benefits in biogenic carbon storage which when combined with a renewable supply chain present an opportunity for the construction sector to meet its net zero carbon targets alongside meeting the increased need for sustainable housing.

Manufacturing and transportation account for the majority of the embodied carbon and energy associated with timber use. Therefore, it is necessary to optimise the use of timber and focus on local resources and market opportunities and improve timber expertise and manufacturing methods. Trees sequester biogenic carbon during growth, and this is stored in timber products until end-of-life (around 1.6kg CO_2e/kg of timber). The longer those products are in-use, the greater the size of the carbon sink this creates, and the greater the potential for circularity and re-use.

Any increased demand for timber must be well managed within current UK forestry stock and afforestation strategies, with due consideration of climate-related forestry risks (eg, droughts, fires, pests and diseases). Additionally, a transition to increased use of locally-grown timber and related bio-based materials for use in construction will impact UK greenhouse gas removal afforestation strategies, biodiversity and land management scenarios (eg, displaced CO_2 emissions from reductions in agricultural land). In turn, this transition will have socio-economic impacts, climate-related design implications (eg, risk of summertime overheating in buildings) – these consequential impacts and design considerations warrant investigation in order to increase certainty that an expansion of timber-based construction is truly sustainable. Accordingly, the objectives of our GW4 research community are to investigate:

- The full potential of British-grown timber in the design of affordable and low-energy housing.
- The thermophysical properties of timber buildings to explore the potential for environmental control.
- Barriers and future possibilities for high-grade engineered wood products in the UK.
- Afforestation strategies, considering climate change effects, and better management of current forestry for commercial timber.
- End-of-life scenarios and ways to increase durability performance to increase opportunities for circular solutions.

Our first two GW4 research community workshops on the Circular Economy of Timber Buildings ran in July and October 2022. A summary of discussions from the first can be found here at https://tinyurl.com/mw5wuxe6. Visit our project website https://cetimber.blogs.bristol.ac.uk/ to meet the team and for updates on our work including our design competition. ■