RP2007

REPLACEMENT SCENARIOS FOR CONSTRUCTION MATERIALS BASED ON ECONOMY-WIDE HYBRID LCA

Research Question

What is the potential reduction in future GHG emissions by replacing the use of reinforced concrete with Engineered Wood Products (EWPs) in a building design?

Figure 1: Cross Laminated Timber Building

Source: klhusa.com

Methodology

Scenario analysis derived from input-output (IO) based hybrid life-cycle assessment (LCA) was conducted to evaluate the carbon footprint (CF) of timber building stocks compared to more common building materials such as concrete. Two types of ten-story buildings, those predominantly made of either reinforced concrete or cross laminated timber (CLT) as the main structural material, were applied in this case study for the residential and non-residential sectors. The inputs of construction materials to the building sectors were changed by gradually replacing concrete and steel with timber over time at the rate of 2.4% per year until the material is 100% replaced in 2050.

Results

The CFs of four different scenarios for the residential and non-residential building sectors are presented in Figure 1 and 2, excluding and including sequestration respectively.

The best-case emissions scenario would require all new building stock (both residential and non-residential) to be constructed from a timber structural design (timber scenario), whilst the worst-case emissions scenario is represented by the one in which new building stock is constructed from conventional reinforced concrete design (BAU scenario).

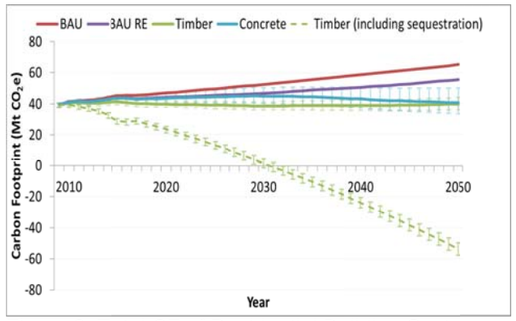

Figure 2: Total CF of Residential Building Sector.

If 100% of new residential building structures were to be constructed from EWPs instead of 100% reinforced concrete, a saving of 26 Mt CO_2e can be achieved by 2050. This saving is even greater when sequestration is considered, with a potential to reduce emissions by 119 Mt CO_2e.

Similarly, if 100% of new non-residential building structures were to be constructed from EWPs instead of 100% reinforced concrete, a saving of 13 Mt CO_2e can be achieved by 2050 and when sequestration is considered, a higher emission saving of 28 Mt CO_2e can be achieved .

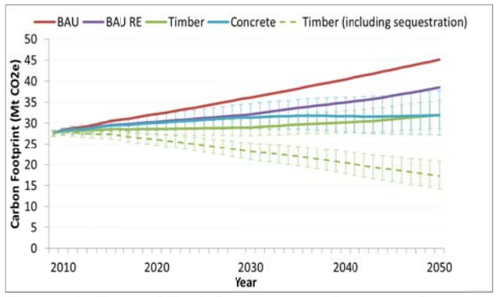

Figure 3: Total CF of Commercial Building Sector.

The total Australian CF of all the scenarios as compared to the BAU scenario showed significant reductions, with the timber and geopolymer concrete scenario achieving 26% (213 Mt CO_2e) reduction, followed closely by the BAU-RE scenario with 23% (187 Mt CO_2e) reduction by 2050 (Figure 4).

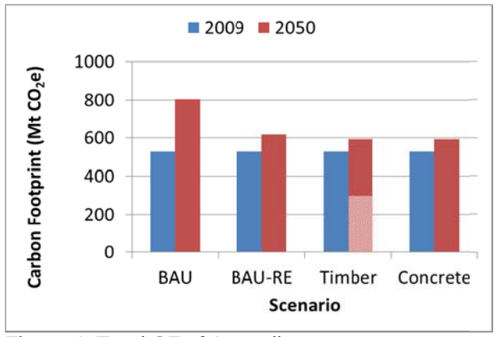

Figure 4: Total CF of Australia.

Conclusions

This study shows that the building sector continues play a crucial role in carbon emissions through embodied emissions. Hence, it proposes that the use of timber as a low embodied energy construction material should be recommended in the construction of buildings, at least with respect to lowering GHG emissions.

Anticipated impacts

The recent amendments to the National Construction Code (NCC) and the Building Code of Australia (BCA) have allowed for the construction of residential and non-residential buildings of up to 8 stories, and this is a step forward for Australia in the utilization of timber in new building stocks.

The use of timber in building design is key for the construction industry to achieve emission reduction targets

This change in policy is anticipated to create greater opportunity and incentive for a more extensive use of timber in the development of Australia's city and urban landscapes.

Further information

Teh, S. H., Wiedmann, T., Schinabeck, J. and Moore, S. (2016) Replacement Scenarios for Construction Materials based on Economy-Wide Hybrid LCA

http://lowcarbonlivingcrc.com.au/

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