Confederation of Finnish Construction Industries

Climate impact of wood construction considering the carbon balance of the forest

Starting points for the research field (1/2)

- **The bioeconomy based on the use of forests and wood has in many ways been consider as a climate-positive industry and its growth has been seen as an effective means of mitigating climate change.** The forest acts as a carbon sink as it grows, and wood products manufactured after harvesting can replace other materials with higher carbon emissions. Sustainable forestry is crucial to the maintenance of the carbon sink.
- **Recent studies on construction have also seen the use of wood as climate positive and have also made policy recommendations based on it.** For example, Amiri et al. 2020 studied the carbon stocks of wood materials contained in residential buildings and made an estimate of the increase in the carbon stocks of buildings in Europe in 2020-2040 with various sections of wood construction. According to the results, the amount of carbon stored in buildings each year could be between 1 and 55 Mt CO2 and account for between 1% and 47% of the emissions from the cement industry in Europe.

Starting points for the research field (2/2)

- Forest science studies on the effects of wood use and interviews with forest and climate scientists raised **concerns about the impact of growing wood use and harvesting on forest carbon sinks and storages, and the net climate impact of wood use**.
- The negative climate impact of harvesting is due to the fact that **forest harvesting immediately loses the carbon sink of growing trees and contributes to the development of carbon storages in the soil**. In a slowly growing boreal forest, it takes at least decades to repay the negative change in carbon stock and carbon sink (the "carbon debt“) from the harvesting of raw materials for wood products. It is not self-evident that it will even occur.
- **The climate benefits of using wood depend heavily on the time considered**. According to the researchers, it can be said that, on average, every million cubic metres of wood taken from each forest will reduce 1.5 million tonnes of CO2 sink in the short term.

Comments raised in interviews (1/2)

- The experts interviewed for the study partly disagreed on the impact of wood use and wood construction on the climate in the short term. However, the interviewees agreed that long-lasting wood products and wood construction are the best way for the climate to use wood and their share should be increased.
- Wood construction can generate long-term carbon storages that delay emissions and give more time for action against climate change. However, the challenge with wood construction is that about half of the log wood used by the sawmill industry also ends up in short-lived use.
- According to some interviewees, wood construction and its addition will speed up, facilitate and improve Finland's carbon neutrality target. **However, even if Finland were to achieve the most ambitious targets for wood construction, this would mean an increase in the use of sawn timber of only 0.7 million cubic metres, which is a very small part of Finland's total harvesting. Thus it would not have any significant positive impact for the climate.**

Comments raised in interviews (2/2)

Accounting issues

- The life cycle assessment of wood products and wood construction is guided by European EN standards.
- In the standards, phase A1 of the life cycle assessment describes the procurement of materials. At this stage, however, the impact of harvesting on the carbon cycle of the forest is not taken into account in the case of wood products. By standards, timber is carbon neutral if it comes from sustainably managed forests. Neutrality is based on the assumption of regional balance, according to which there is for a harvested forest area (and its reduced carbon storages and sinks) another forest are, with corresponding increases in sinks and storages, i.e. the system is regionally balanced.
- **In the literature on life cycle assessment, criticisms have been voiced, among other things, against lack of so-called baseline used for comparisons or ignoring the tempor dimension of emissions. In addition, there is also a great deal of uncertainty about the assumption of regional balance in forests.**

Views on key sticking points (1/4)

Is wood from sustainably managed forest a carbon-neutral raw material for construction?

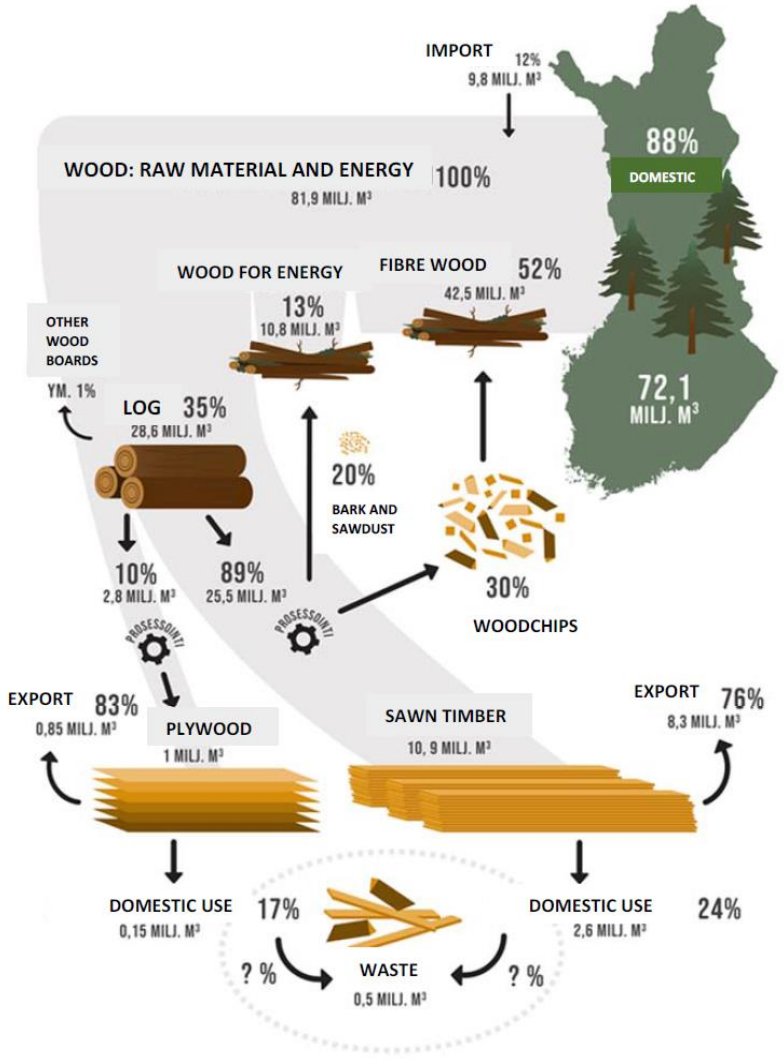
- When it is ensured that the area of forest land does not decrease and that the forest grows back after harvesting, the amount of carbon transferred from the forest with harvesting returns to the forest back by carbon sequestration. This takes place over a time period that depends on the growth rate of the forest. Compared to the millions of years of fossil carbon cycle, carbon sequestration occurs in the blink of an eye, typically in less than 100 years (although this also under debate).The task of sustainable forestry is to ensure that the conditions for growth are maintained.
- **With shorter review times than the regeneration cycle – which are currently being examined in the context of the most burning issues of climate change – harvesting generates carbon debt i.e. reduces the forest's carbon storage**. The essential question in this case is the net emission impact of wood use, i.e. whether carbon is stored in wood for long enough or whether wood use replaces something that reduces emissions more than carbon debt in the forest.

Views on key sticking points (2/4)

Will carbon storage of wooden structures achieve climate benefits?

- The greatest climate benefits from wood use are achieved with wood-based long-lasting products.
- The production of wood products alone will not solve the issue of carbon storage, but the product must also be used long-lastingly. Some of the timber is used on construction sites during construction, for example, in scaffolding and as form timber and plywood, which means that wood products end up in very short-term use.
- Temporary carbon storages and carbon dioxide release later are estimated to be useful in mitigating climate change. The postponement of emissions as such is considered useful because it is estimated that, over time, emission-free technologies will evolve, and emission pressures will decrease.
- According to the researchers interviewed, when assessing the amount of carbon bound to wood products, i.e. the carbon storage of wood products, the impact on the carbon sink and storage of forest and forest land should also be considered, and the net and total impact of carbon storage should also be considered.

Raw material flows in the forest industry



- The data in the picture have been collected from National Resources Institute Finland's (LUKE) statistics and Forest Industry's estimates. The amount of wood waste as an expert assessment from reports of Gaia Consulting et.al.
- In Finland, roughly 35% of raw wood ends up in the wood products industry, from which long-term products can be manufactured with a carbon storage that will remain for decades, at best for more than 100 years.
- More than half of the raw wood is used in the manufacture of short-lived products, in which carbon is released quickly, usually in 1-5 years.
- Only about one-fifth of the Finnish forest industry's production of long-lived products remains in Finland. The amount of wood waste created is approximately 250,000 tons, even 400,000 tons

Views on key sticking points (3/4)

Will the carbon storage remain in the forest?

- Sometimes the reason for the manufacture and use of wood products is that in forests carbon storage is at risk of being released quickly and unexpectedly, for example as a result of forest damage or fires. This may be justified in countries where the extent and frequency of various forest damages are high. In Finland, the prevalence and extent of natural disturbances, such as forest fires, insect or storm damage, are relatively small compared to, for example, North America.
- **Finland's forests can therefore act as relatively sustainable carbon storages**, but it should be noted that the effects of climate change may increase the risk of forest damage in the future.
- Another argument relating to the permanence of carbon storages is that if a person did not exploit wood and it was left in the forest, it would, however, release bound carbon into the atmosphere when it dies and rottens. This is true, but it is often forgotten that dead wood, which naturally decomposes in the forest, constitutes relatively long-term carbon reserves.

Views on key sticking points (4/4)

What does the emissions calculation of the land use sector have to do with this?

- In Finland, the impact of wood use and harvesting on forest carbon sinks and storages is calculated at national level as part of the land use sector (LULUCF). Regulation (EU) 2018/841 on the land use sector defines the calculation rules for how sinks and emissions from land use, land use change and forest management will be taken into account in the EU's climate targets for the period 2021-2030. Often, the argument for ignoring the biogenic carbon cycle of wood products is that emissions have already been taken into account in the national calculation of the land use sector.
- **Such a calculation at national level is not relevant for the calculation of the carbon footprint and handprint at product level**. The reasoning for the product level calculation cannot be used as an argument that emissions have already been calculated at national level, as the levels of calculation are different.
- The standards for carbon footprint calculation and life cycle assessment also take into account biogenic emissions and land use change emissions, although these are also calculated in the land use sector.

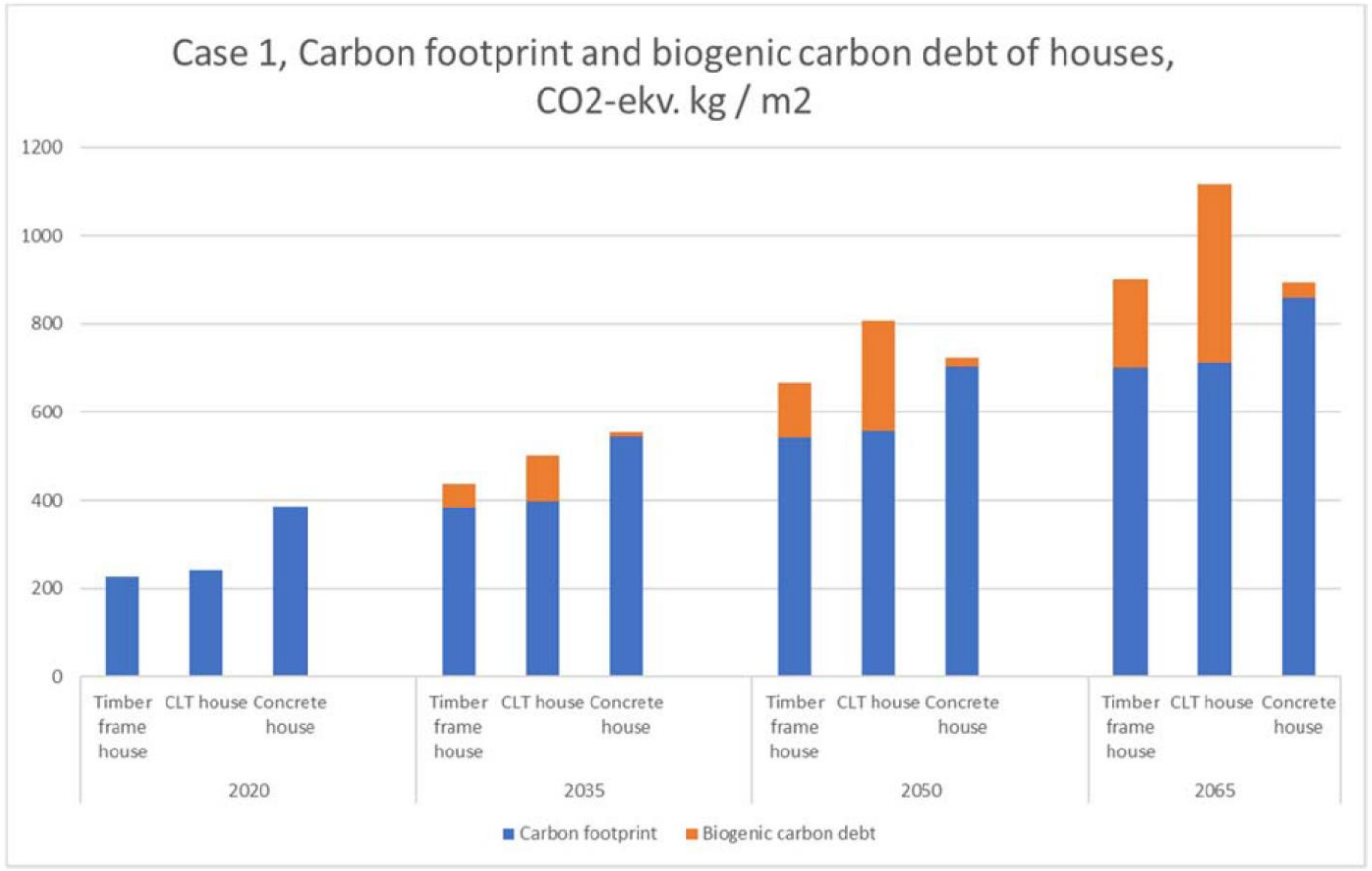
Case studies (1/2)

- **The aim of case studies 1 and 2** was to calculate an estimate of how the carbon footprint of wooden apartment buildings would change if the calculation takes into account the biogenic carbon impact of wood production, i.e. carbon debt. The biogenic carbon effect here refers to the effects of logging on forest carbon stocks and sinks, which are typically excluded from life cycle estimates. In the following, this effect is called **biogenic carbon debt.**
- The starting point for the calculation was a case study prepared by Viljakainen and Lahtela in 2019 on the calculation of the carbon footprint of different types of buildings. The study examined the usability of the Ministry of the Environment's carbon footprint calculation tool and how material and frame choices affect the carbon footprint of construction.
- **A typical five-storey apartment house with either concrete , traditional timber or cross laminated timber (CLT) as main building material, or hybrid structures was used for comparisons. The floor area of the building was 1994 m2.**

Case studies (2/2)

- In order to assess the biogenic carbon footprint of buildings, a calculation scenario based on normal forest was formed.
- Initially, the forest area needed to produce the amount of wood used for the concrete, frame, wooden (timber) frame and CLT frame apartment buildings was estimated. The area required depends on the production time; this was chosen to be the same as the service life of the buildings, i.e. 75 years in this case.
- Two different versions of the calculation were made. In case 1, the wood needed for the building is produced in an average heath spruce forest in northern Finland, and in case 2 in northern Finland.
- The forest patterns of the normal forest were formed on the basis of the MOTTI programme simulating the growth of production/commercial forests. The pattern data was exported to the Monsu programme, which calculates the forest's carbon balances. Monsu simulated the development of normal forests without harvesting and calculated the carbon balance of trees and soils cumulatively for 2020, 2035, 2050 and 2065.

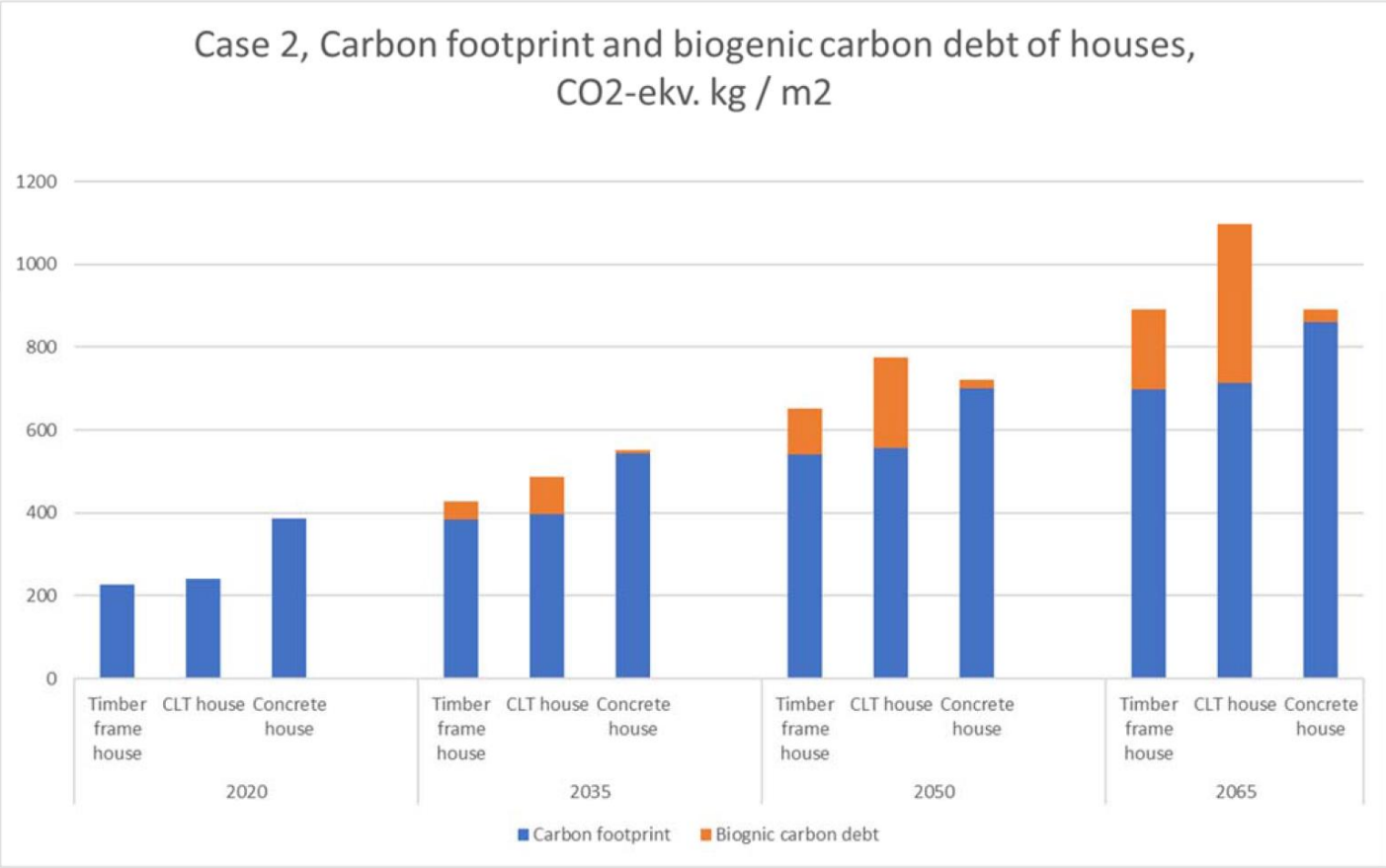
Results of case study 1



Carbon footprint of houses (blue bar) and biogenic carbon debt (orange beam) when the wood is produced of a spruce tree in southern Finland. Source of carbon footprint: Viljakainen & Lahtela 2019.1

- The amount of biogenic carbon debt is directly affected by the amount of wood used in houses. Compared to a traditional timber frame house, about twice as much wood goes into a CLT house. In a concrete house only less than one fifth of the amount of wood in traditional timber frame house is use.
- **Adding biogenic carbon debt to the carbon footprint will change the position of different apartment buildings in the comparison**. Although the emissions from the concrete house during the construction phase are higher than those of houses with more wooden structures, in the longer term the carbon footprint of the CLT house becomes the biggest.

Results of case study 2



Carbon footprint of houses (blue bar) and biogenic carbon debt (orange beam) when the wood is produced of a spruce tree in northern Finland. Source of carbon footprint: Viljakainen & Lahtela 2019.

- The results are very similar for Case 2. A small difference in the size of biogenic carbon debt is due to the fact that forest growth in northern Finland is slower and the share of log in the wood obtained is lower.
- The results of the calculation show that the share of biogenic carbon debt is a significant increase in the carbon footprint of wooden buildings, and that taking into account the carbon balance of forests in the life cycle assessment of wood products and wood construction, as set out here, changes the affordability of wood use from a climate perspective.
- On the other hand, it should be noted that the results are greatly influenced by the assumptions made, for example, about the time of wood production, the selected comparison scenario and the allocation of the forest's carbon balance to a single building.

Conclusions from case studies 1 and 2

- In these case studies, from the forest's carbon balance only the share of long-term products from the log wood produced was calculated to the share of one wooden building. This is based on the basic principle of life cycle assessment, in which emissions are allocated according to the share of each production sector and raw material user. However, it could also be justified to include the entire log wood with side streams in the share of wood construction, which would increase the biogenic carbon footprint accordingly.
- **This scenario looked at the development of the carbon balance and carbon footprint over the next 45 years. If the review were to continue further to the end of the life cycle of buildings, the differences between buildings would probably increase further with the increase in the biogenic carbon footprint.**
- The benchmark scenario chosen for the calculation, the exclusion of harvesting, is consciously the one that is usually not even thought of when considering possible alternatives to the use of production/commercial forests. This is understandable when the review is carried out only in the light of the current laws governing forestry. However, if an objective climate impact assessment is to be carried out, this option must be taken into account. In the future, the price of carbon will rise, and if it is possible to obtain compensation for the accumulation of carbon storages in the forest, postponing harvesting is a real option for the forest owner.
- Other relevant comparison options could also include different options for the use of wood, such as using wood used for construction as fibre or energy wood.