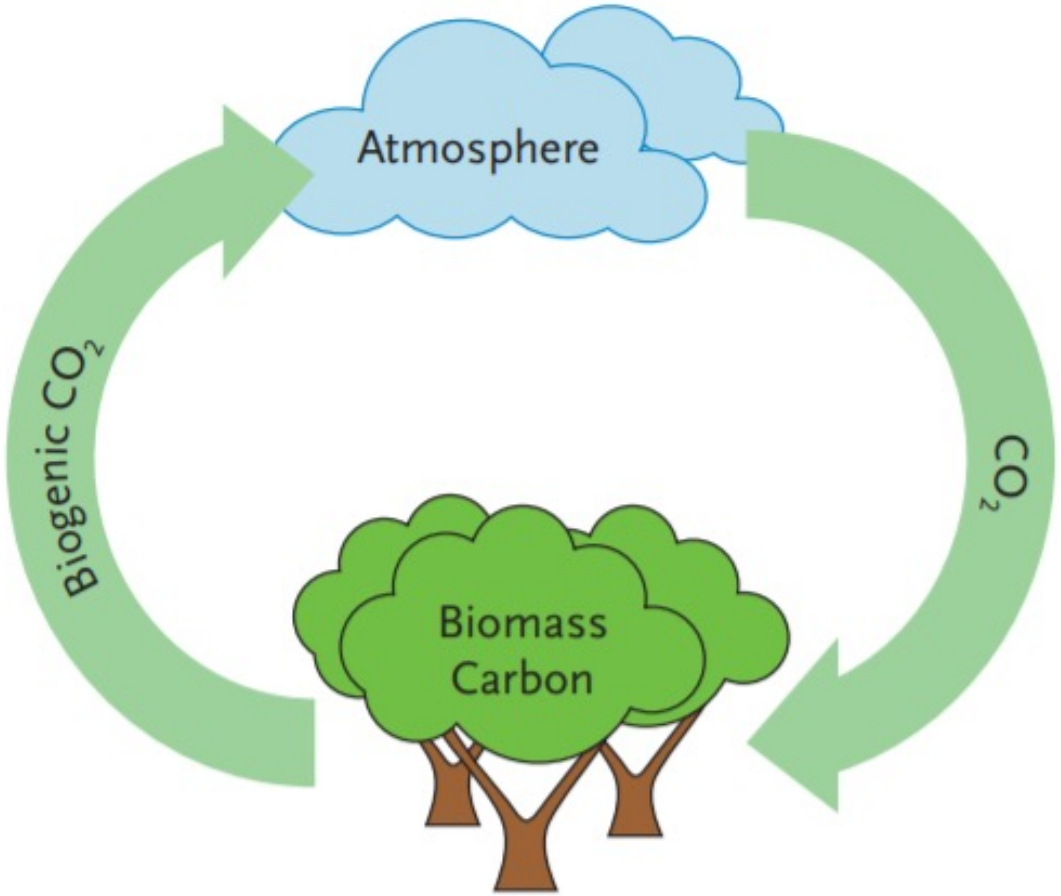
CLIMATE CHANGE MITIGATION POTENTIAL OF WOOD CONSTRUCTION: THE BIG PICTURE

Drivers for Wood Construction, Joensuu, 15.5.2023

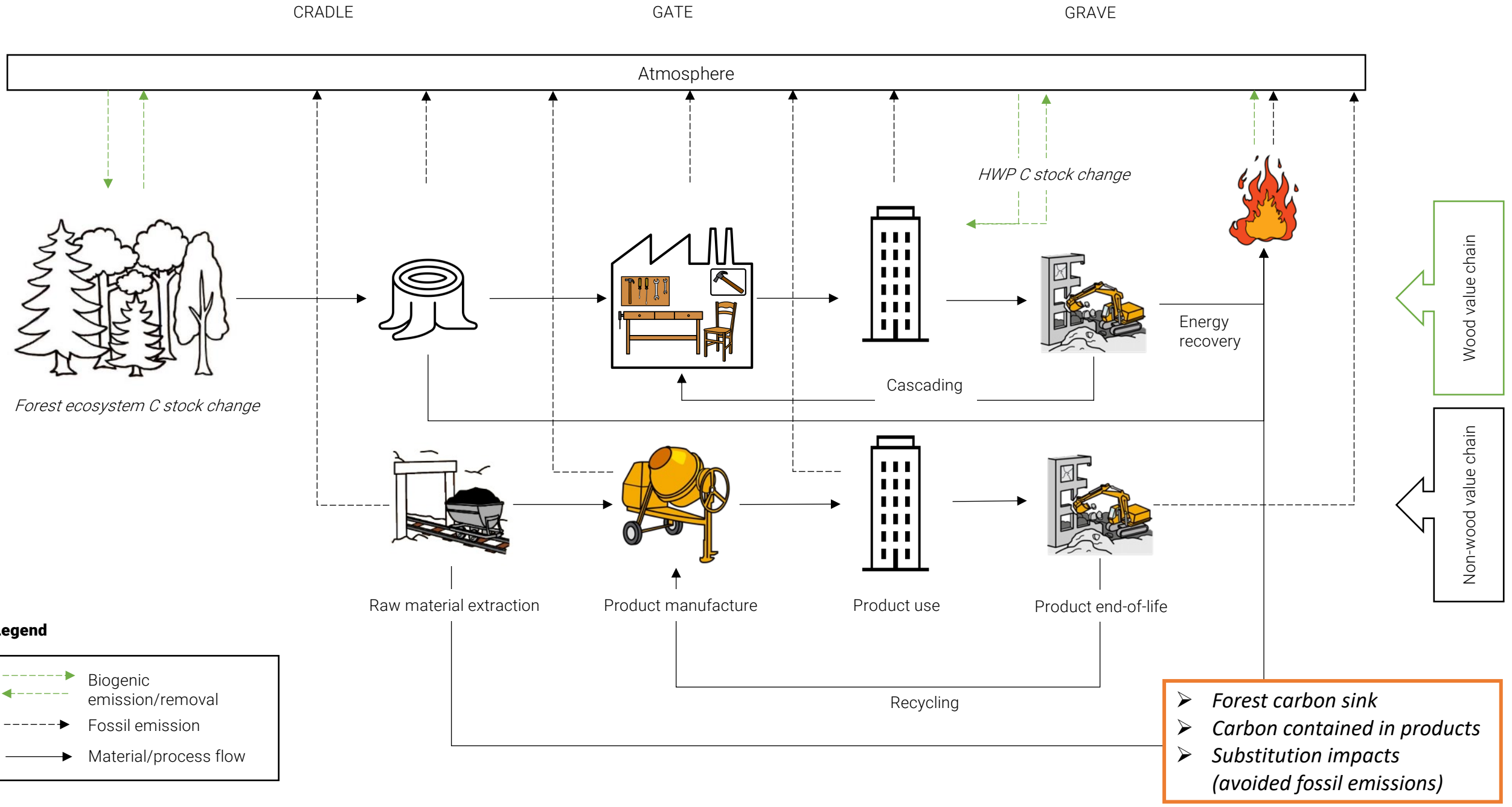
Elias Hurmekoski, University of Helsinki

Climate benefits of wood construction

- Renewability ➔ reduces dependence on fossil resources
- One of the best wood uses:
  - Longevity (carbon storage)
  - Fossil GHG emissions of wood-framed multi-storey buildings 30–50 % lower compared to an equivalent concrete-framed building [1]
- However: Biogenic carbon cycle is more nuanced



1 Duan, Z., Huang, Q., Zhang, Q., 2022. Life cycle assessment of mass timber construction: A review. Building and Environment 221, 109320.


CRADLE
GATE
GRAVE
Atmosphere
HWP C stock change
Forest ecosystem C stock change
Energy recovery
Cascading
Wood value chain
Non-wood value chain
Raw material extraction
Product manufacture
Product use
Product end-of-life
Recycling
Legend
Biogenic emission/removal
Fossil emission
Material/process flow
Forest carbon sink
Carbon contained in products
Substitution impacts (avoided fossil emissions)

Biogenic carbon

Compared to baseline, 1 m^3 <u>additional</u> harvest leads to:

- **0.4** $tCO_2eq./yr$ permanent substitution impact [1]
- **1.2** $tCO_2eq./yr$ reduction in forest carbon sink for 100 years [2]

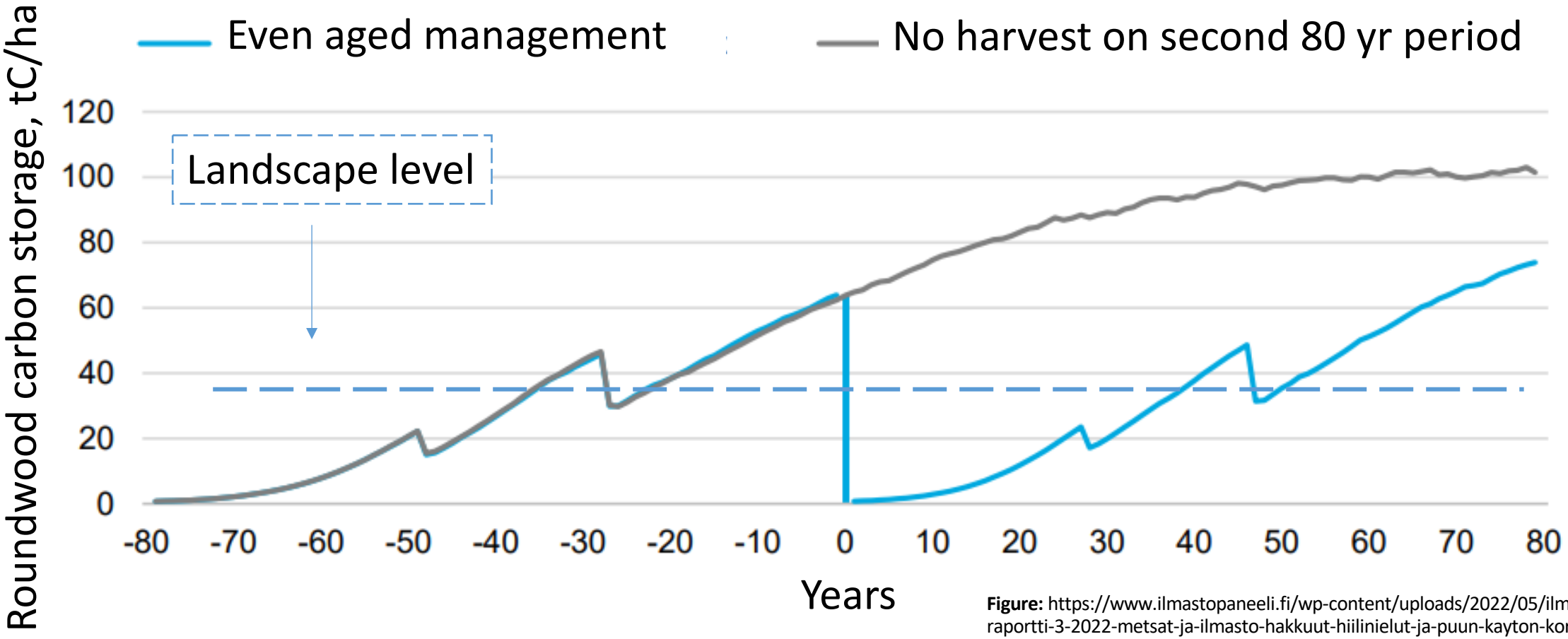


Figure: https://www.ilmastopaneeli.fi/wp-content/uploads/2022/05/ilmastopaneelin-raportti-3-2022-metsat-ja-ilmasto-hakkuut-hiilinielut-ja-puun-kayton-korvaushyodyt.pdf

1 Hurmekoski, E., et al. 2021. Substitution impacts of wood use at the market level: a systematic review. Environmental Research Letters 16, 123004.
2 Soimakallio, S., et al. 2022. Closing an open balance: the impact of increased tree harvest on forest carbon. GCB Bioenergy 14, 989-1000.

How to maximise the climate benefit of wood construction?

- Rather than additional harvest, changes in product portfolios
  - E.g., Increasing the share of log from total harvest by lengthened rotation periods, continuous cover forestry, or fertilization, when feasible
- Scale: 100% market share of Finnish residential multi-storey market would require additional harvest of <5 Mm^3

Image: Sami Tuoriniemi / University of Helsinki

See also: https://www.helsinki.fi/en/researchgroups/forest-bioeconomy-business-and-sustainability/news/blog-five-fundamentals-on-the-climate-impacts-of-wood-construction

Complexities at systemic level

- Decarbonization and rate of substitution
- Increased forest disturbances ➔ may threaten forest carbon stocks, but possibly limited impact on (additional) mitigation potential
- Carbon leakage ➔ Real phenomenon, but neglects the Paris Agreement
- Incentives ➔ e.g., globally, increased wood demand could help fund afforestation [1]
- Price mediated rebound and multiplier effects
- Recycling / cascade uses
- BECCS/BECCU ➔ Can increase removals on system level (no influence on subst impacts)
- Other societal demands such as employment (fair transition)

1 Mishra, A., Humpenöder, F., Churkina, G., Reyer, C.P.O., Beier, F., Bodirsky, B.L., Schellnhuber, H.J., Lotze-Campen, H., Popp, A., 2022. Land use change and carbon emissions of a transformation to timber cities. Nat Commun 13, 153. https://doi.org/10.1038/s41467-022-32244-w.

Take home points

- One of the most attractive wood uses
- Major increase in market share feasible with existing forest resources, due to relatively small amount of wood required
- Measures unrelated to harvest level should be preferred to pursue both short-run and long-run benefits

Further reading:

Available at: ScienceDirect

Renewable and Sustainable Energy Reviews 174 (2023) 113152

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

Does expanding wood use in construction and textile markets contribute to climate change mitigation?

Elias Hurmekoski [a,*], Janni Kunttu [b], Tero Heinonen [c], Timo Pukkala [c], Heli Peltola [c]

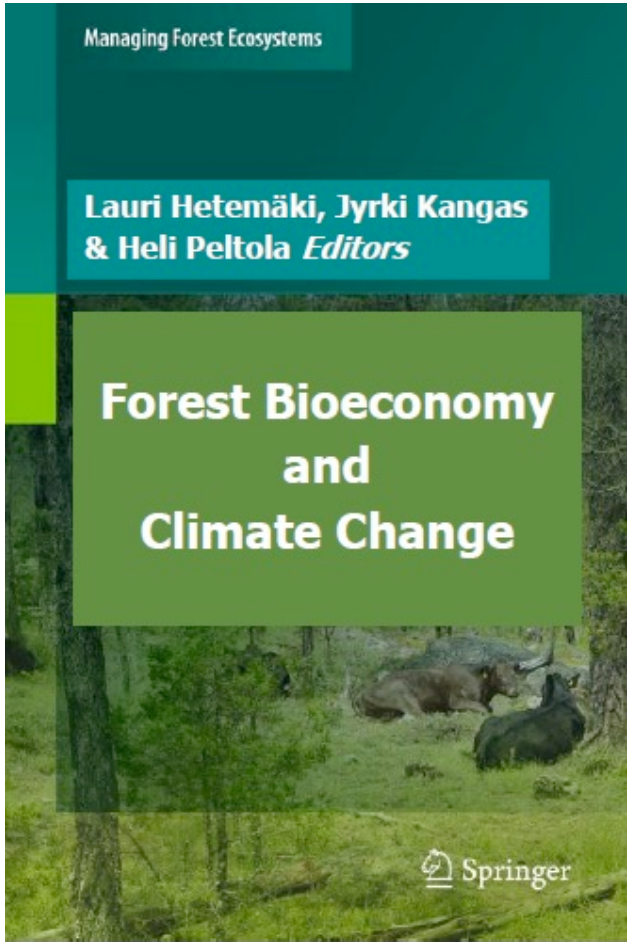
[a] University of Helsinki, Department of Forest Sciences, FI-00790, Helsinki, Finland
[b] European Forest Institute, FI-80101, Joensuu, Finland
[c] University of Eastern Finland, School of Forest Sciences, FI-80101, Joensuu, Finland

ARTICLE INFO

Keywords:
Substitution
Climate change mitigation
Textile markets
Construction markets
Avoided fossil emissions
Wood products
Life cycle assessment

ABSTRACT

Wood use is expanding to new markets, driven by the need to substitute fossil-intensive products and energy. Wood products can contribute to climate change mitigation, if they have a lower fossil footprint than alternative products serving the same function. However, the climate change mitigation potential is contingent on the net fossil and biogenic emissions over time, as well as the realism of the counterfactual scenario and market assumptions. This study aims to improve the consistency of assessing the avoided fossil emissions attributed to changes in wood use, and to estimate the additional mitigation potential of increased wood use in construction and textile markets based on wood harvested in Finland. The results show that, compared to baseline, an increase in the market share of wood leads to an increase in atmospheric CO_2 concentration by 2050. Thus, the substitution impacts of wood use are not large enough to compensate for the reduction in forest carbon sinks in the short and medium term. This outcome is further aggravated, considering the decarbonization of the energy sector driven by the Paris Agreement, which lowers the fossil emissions of competing sectors more than those of the forest sector. The expected decarbonization is a highly desirable trend, but it will further lengthen the carbon parity period associated with an increase in wood harvest. This creates a strong motive to pursue shifts in wood uses instead of merely expanding all wood uses.



Available at: Springer

Available at: efi.int

Thank you!

elias.hurmekoski@helsinki.fi

Fig: Lakea Oy