The climate change mitigation potential of forest biomass production and its utilization in Finland

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The aim of this work was to calculate net climate impacts (in terms of radiative forcing) of forest-based materials and energy in Finnish boreal forests when substituting fossil-based materials and energy (**Figure 1**).

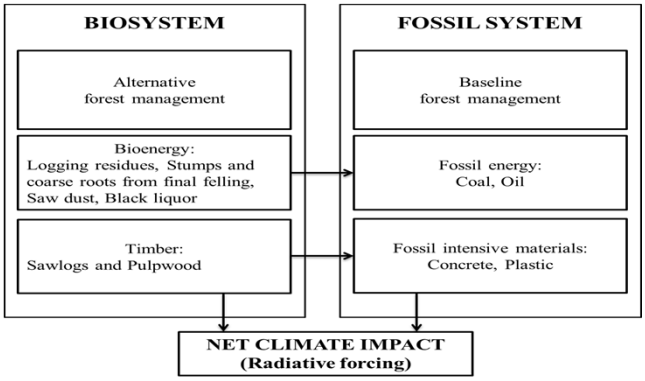

Figure 1. Calculation of net climate impacts between the forest-based biosystem and fossil system.

Forest ecosystem model (SIMA) (e.g. Kellomäki et al. 2008) simulations were employed for assessing carbon sequestration and biomass production of forests, and a life cycle assessment (LCA) tool (Kilpeläinen et al. 2011) for assessing net climate impacts of biomass utilization. The effects of alternative forest management scenarios on net climate impacts were calculated by integrating the carbon sink/source dynamics in both biosystem and technosystem (**Figure 1**).

The results showed that the use of forest-based materials and energy (logging residues and stumps/roots) in substituting fossil-based materials and energy would provide an effective option for mitigating climate change in Finland. Maintaining 20% higher stocking in thinning could improve the net climate impact of biomass compared to the current forest management (baseline), opposite to maintaining 20% lower stocking (**Figure 2**).

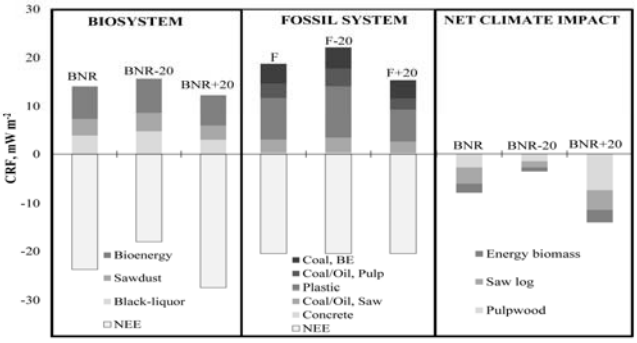

Figure 2. Cumulative radiative forcing, CRF (mW m^{-2}) of different components of the biosystem and the fossil system at the end of the 90-year period in Finland. NEE: net ecosystem CO_2 exchange, BNR: baseline management with energy wood thinning and harvesting of branches, needles (70%), tops of stems, and stumps and roots from final felling, BNR±20: 20% higher or lower stocking in thinning with harvesting of energy biomass, and F±20: corresponding fossil system (Kilpeläinen et al. 2015).

The net climate impacts for energy biomass utilization varied substantially over time, depending on forest management scenario and initial forest structure **(Figure 3)**.

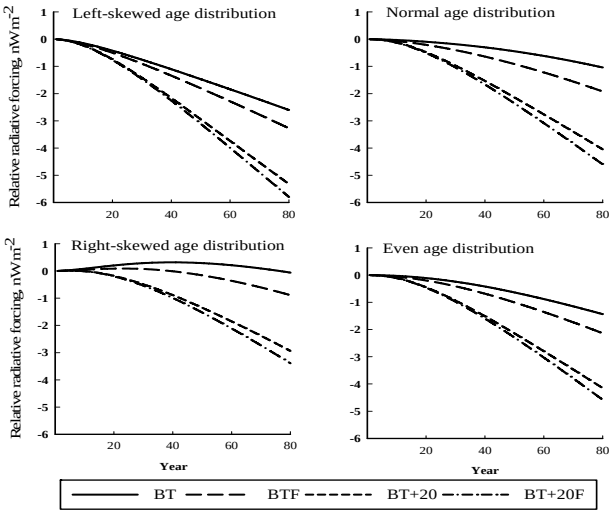

Figure 3. Impact of forest management and initial stand age structure on net climate impact of energy biomass from final felling of Norway spruce (incl. logging residues and stumps/roots). BT: baseline forest management, BTF: fertilisation, BT20: maintaining 20% higher stocking in thinning and BT+20F: maintaining 20% higher stocking in thinning and fertilisation (Kilpeläinen et al. 2015, unpublished)

References:

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