Wood construction and climate change mitigation

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Economics of Climate Change Mitigation Options in the Forest Sector
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How can the forest sector contribute to mitigating climate change?

A holistic understanding is required

Goal: Minimise net GHG emissions to the atmosphere

- Non-forest Land Use
- Forest Ecosystems
- Wood Products
- Biofuels
- Other Products
- Fossil Fuels

Land-use Sector  Forest Sector  Services used by Society
Wood construction and climate change mitigation

• Consider all significant net greenhouse gases in a life-cycle perspective of wood construction and non-wood alternatives

• Important parts:
  – Forest management
  – Building materials and construction
  – End-of-life implications

• Forward looking analysis— not historical average values
How can the forest sector contribute to mitigating climate change?

- Maintain (increase) carbon density of forests
- Maintain (increase) forest area
Standing stemwood volume on Swedish productive forest land and scenarios for 2010 - 2110

Source: Skogsstyrelsen, Skogliga konsekvensanalyser och virkesbalanser 2008
How can the forest sector contribute to mitigating climate change?

- Use wood construction instead of non-wood construction
- Use woody biofuels instead of fossil fuels
A modern wood-frame building

- 8-storey wood-frame building
- Built in Växjö Sweden in 2009
- 33 apartments
- 3374 m² heated floor area
- Total four buildings

Winner of 2010 Swedish large prize for Society Constructions (*Samhällsbyggarpriset*)
Climate advantages of wood construction

1. Less fossil energy used to manufacture wood products compared with alternative materials
2. Avoided industrial process carbon emissions such as in cement manufacturing
3. Use of wood processing and construction residues as bioenergy to replace fossil fuels
4. Temporary storage of carbon in wood materials
5. At end-of-life, wood is a carbon-neutral energy resource
Case study: Välludden building

4 stories, 16 apartments, 1190 usable m²

Case-study building: Wood frame

Built in Växjö, Sweden

Reference building: Reinforced-concrete frame

Hypothetical building with identical size and function
Primary energy use for the production of buildings

![Primary energy use chart]

- **Wood frame building**
  - Biofuels: 200 GJ
  - Fossil fuels: 1000 GJ
  - Electricity: 800 GJ

- **Concrete frame building**
  - Biofuels: 200 GJ
  - Fossil fuels: 2000 GJ
  - Electricity: 1000 GJ

Primary energy use (GJ) vs. building type.
Sources of biomass residues from building life-cycle

- Forest residues
- Wood processing residues
- Construction residues
- Demolition residues
More biomass residues from production and end-of-life of construction

- Production energy use
- Biofuel availability

Wood frame building

- Demolition residues (90%)
- Construction residues (100%)
- Processing residues (100%)
- Forest harvest residues (70%)
- Building production energy use

Concrete frame building
Swedish use of biofuels, waste and peat, 1983-2012

Policy instruments important:
- Energy tax
- Carbon tax
- Renewable electricity certificates
Carbon balance of the buildings over a 100-year lifecycle

![Chart showing carbon emissions for different building materials and lifecycle stages.](chart_url)
Conclusions

• Climate implications of construction should be considered in a life-cycle system perspective

• Important parts to consider are forest management, building production, and end-of-life management

• Biomass residues are an important energy resource
Conclusions

• Wood building materials gives high economic added value and high climate change mitigation per hectare of forest land

• Swedish energy and carbon taxes increase competitiveness of wood buildings but only by about 1% of the construction cost

• Multi-storey wood buildings are a new innovation that needs policy support
References


