The Interaction of Economics and Technical Solutions in Substitution Management

Wood instead of nonwood materials in building construction

- Technical issues related to substitution
  e.g. can wooden constructions provide the same function as concrete or steel constructions?

- Issues related to environmental benefits
  e.g. greenhouse gas balances for different constructions in a life-cycle perspective

- Issues related to economic competitiveness
  e.g. life-cycle cost of different constructions, policy instruments

- Issues related to the wishes of consumers (society), building standards, local building traditions, etc.

- Other issues
  e.g. different resistance to fire, earthquakes, hurricanes, insects, etc.

Building standards, building traditions and financial systems

- May vary greatly between different countries
- Building traditions may also vary greatly between different parts of a country
- But they may change over time
- The heat consumption in buildings varies with the standard used (Swedish figures, kWh/m^2 per yr):

1960 ˜	≈ 200
2000 ˜	≈ 100
2010	≈ 50

- Traditions may be more difficult and take longer to change than standards and financial systems
- Existing capital-intensive infrastructure and corporate culture may also represent obstacles to change (e.g. existing investments in the cement industry)
- Environmental and sustainability issues may be important driving forces for change

(Consumer) Preferences

- Society, e.g. fire regulations
- Building consultants (architects, construction engineers)
- Building contractors
- Consumers

How can we increase the use of wooden buildings?
– Some aspects of a complex issue

- Demonstrate the environmental benefits of different construction alternatives

- Demonstrate the cost competitiveness of different construction alternatives and identify when the use of wood is economically feasible

- Explain the consequences of possible changes in policies, e.g. changes in environmental taxes, building standards & financing systems

- Consider other significant aspects of different construction alternatives, e.g. risks associated with earthquakes, fire, hurricanes & insects

- Inform and convince decision makers

Greenhouse gas balance of a building construction versus running

- Varies with climate conditions
- Primary energy use in running a well-insulated Swedish building might be 90-95 percent of the life-cycle primary energy use
- How can we argue for wood constructions from an environmental point of view if a building is not energy efficient?
- Low-energy buildings – greenhouse gases from construction will be more important (an optimum exists between reduced energy use in running and increased use of energy for construction)
- Could we use standardised information to inform the market? (e.g. primary energy use and greenhouse gas balance per square meter of living area, in constructing and running buildings in different climate types)

Greenhouse gas balances in building construction
– A complex issue with considerable uncertainties

- Few estimations based on a very limited number of buildings
- The reference could be difficult to choose and define
- Primary energy use for the production of different building materials varies in different studies (e.g. for wood, steel, concrete and aluminium products)
- Energy supply systems vary in different studies (e.g. marginal and average electricity production; a trend towards integrated energy markets in electricity, natural gas, & biofuels)
- Final and primary energy use are sometimes compared in the same study
- How should we regard wood waste?
- How should we regard demolition wood?

Large uncertainties.
Figure 3a. Variability in cumulative energy demand for wood-based products
From Klaus Richter

How can we use wood waste and wood materials at the end of their life?

- To replace fossil fuels?
- What type of fossil fuel systems can be replaced?
  (Type of technology and fuel?)
- What type of bioenergy systems can be used?
  (Type of technology?)

Amount of carbon fixed in different wood products in a timber-framed building (tonnes C)

• Wood materials used in the final building:	44
• Waste products e.g. bark, sawdust, and wood cut-offs:	44
• Logging residues (from final felling):	22

From: Wälludden - a new multi-storey building

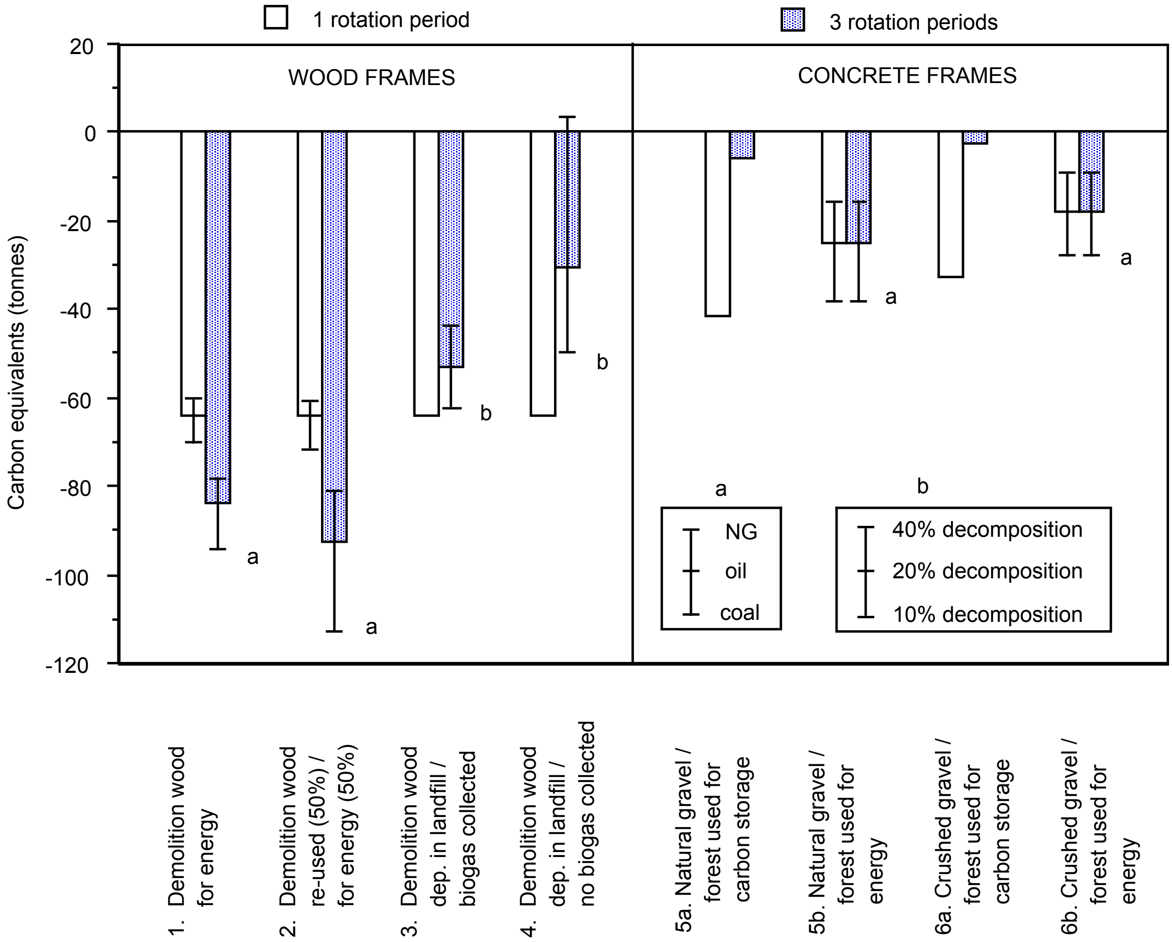
Flow of CO_2 and CH_4 to the atmosphere over different periods (tonne C-equivalents)

Wood for structural and non-structural purposes is included but wood waste and logging residues are not.

	Period of Time (years)			
	- 100 to 0	0	100	100 to 200
Photosynthesis	- 44			
Concrete frames				
Fresh timber & demolition wood replacing				
Natural Gas		18	2	
Oil		13	1	
Coal		1.8	0.2	
Concrete frames				
Forest for carbon storage				
Demolition wood replacing				
Natural Gas			2	
Oil			1	
Coal			0.2	
Wood frames				
Demolition wood replacing				
Natural Gas			20	
Oil			14	
Coal			2	
Wood frames				
Demolition wood deposited in landfills				
10% decomposition				25
20% decomposition				50
40% decomposition				100

Average net GHG balances for one and three forest rotation periods (100 and 300 years), when 2.0 hectares of forest are used for different purposes, in the production of building materials (Wälludden)

The energy required to produce the building materials is supplied by the forest. The excess biomass (forest) is used to replace fossil fuels or for carbon storage. The collected biogas is used to replace oil.



Some points to be discussed

- Do we need to improve our knowledge about greenhouse gas balances of different building constructions, e.g. to convince decision makers to choose timber-framed buildings?

- Do we need a standard methodology for such types of evaluations?

- Which economic policy measures would be most efficient?

- Would a general tax on carbon dioxide emission from fossil fuels improve the competitiveness of wood constructions?

- Would a general credit for carbon storage *not* improve the competitiveness of wood constructions (better to use the forest for carbon storage)?

- Should an increase in the use of wood in construction be understood in a local perspective, considering local building traditions and consumers' preferences, apart from the national building standards?

- How do we reuse/plan for the reuse of wood materials?

- How do we use wood waste and demolition wood at the end of its lifetime?

What could be included in a paper?

Should we focus on the substitution aspects and, in particular, on the competitiveness of wooden materials and wood fuel for substitution (supply and demand, cost and benefits) to achieve a better understanding of supply and demand for wooden materials and wood energy in the reduction of greenhouse gas emissions.

Should the supply, demand, and competitiveness aspects be considered from a system point of view, i.e. how different parts of the system are linked and influenced, including specific technical solutions, potential for greenhouse gas emission reduction, and cultural and social aspects.

(Important to identify gaps in knowledge and to suggest suitable areas of research.)

Some issues to be discussed

- Local building traditions
- Preferences in the market & consumer preference
- Greenhouse gas balances in wood-based systems in relation to other systems (e.g. different construction systems)
- A standard methodology for greenhouse gas balances for wood products in relation to other products
- Regulations
- Market barriers
- Policy instruments (taxes, tax reduction, sustainable forest management, etc.)
- Supply and demand aspects for substitution, including connections between them