Incorporating Life Cycle Assessment (LCA) of wood materials in green building design

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Presentation

- Established knowledge on wood products
- Remaining LCA gaps
- Developments in methodology

*Combination of LCA and other knowledge*
Key aspects of LCA – ISO 14040

- Based on a functional unit, scientific and engineering data are used extensively
- Define system boundary - determines which processes are included in the analysis
- Comparable between systems - same functional unit, equivalent system boundary and methodology considerations

Transparency and Completeness
Current knowledge

Wood supply can be sustainable

From IEA Task 38: ‘Answers to ten frequently asked questions about bioenergy, carbon sinks and their role in global climate change’
Current knowledge

The carbon content of timber-based products comes from fixed atmospheric CO$_2$ via photosynthesis

- **Wood (oven dry) is 50% carbon by mass**
- **Molecular weight of CO$_2$ is 44; C is 12**

So:

1000 kg of oven dry wood = 500 kg C
500 kg C x 44/12 = 1833 kg in CO$_2$ ‘equivalents’
Wood processing and additives to make ‘functional’ products. In many of the cases we have examined, wood retains a beneficial environmental profile compared with alternatives.

Current knowledge

Example for illustration: ModCell™ ‘BaleHaus’ at Bath University 2009, MSc thesis by Amelie Seguret, Imperial College London
Wood fuels, processing residues and end-of-life ‘products’ (EfW) provide excellent low-carbon energy sources

Current knowledge

- SRC chips
  - saving 80 Kg CO2 eq./MWh
  - saving 160 Kg CO2 eq./MWh

From Carly Whittaker
Current knowledge

Positive social, economic, and land-use values are attainable from forestry and wood processing activities

‘Bench Press’ in American tulipwood
- unique design
- species use range extended
- recycled material
- public interest/use
Negative aspects of the forest and wood products sectors exist. They are well recognised, well characterised and well publicised. Several measures and initiatives are in place to eliminate them (e.g. Certification systems, the work of CIFOR, ITTO etc).

They must be understood and accommodated in all responsible uses of wood and claims for wood ‘benefits’
We often undertake LCAs (and carbon footprinting etc) with imperfect knowledge.

To an extent this is inevitable – but we need to continually improve.

There are some knowledge gaps.
Desirable knowledge

Carbon storage ‘values’ in managed forests

- LCA and carbon accounting require us to include the operations of forest management, harvesting, transport etc in the inventory data
- But forest carbon dynamics are complex –
  - Forests accrue carbon in biomass and soils
  - Carbon may be lost from forests by disturbance and decomposition, disease, fire etc
Desirable knowledge

Question – can and should we account for the wider forest ‘processes’ that relate to the provision of wood raw material?"
Desirable knowledge

2 distinct cases: 1) Forest ‘conversion’ and 2) Sustainable forest management

• for 1) There are significant losses of soil carbon when land is converted from forest cover to other land cover

• PAS 2050, RFA etc include default data for such losses

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<th>Country</th>
<th>Current land use</th>
<th>Previous land use</th>
<th>GHG emissions (t CO₂e / ha/yr)</th>
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Desirable knowledge

2 distinct cases:  
1) Forest ‘conversion’ and  
2) Sustainable forest management

- for 2) There is significant uncertainty over the net ‘balance’ of the competing effects on carbon emissions and carbon capture in forests over the long term
- Wood harvested from forests clearly removes carbon from the system - this is replaced by re-growth under sustainable management
- But over successive rotations is there a net accumulation of carbon in the forest soils? .....and, if so, should this be ‘allocated’ as a ‘credit’ to the wood removed?
Desirable knowledge

‘Accumulated’ benefit from managing for production of wood products, includes credit for the emissions reduction from avoided fossil resource consumption

After Nabuurs (1996)
See Forestry Commission Information Note: Forests, Carbon and Climate Change
There is also **uncertainty** on climate change effects on the net ‘sink or source ‘value’ for forests.


“**limited field data (for tropical forests) have produced conflicting views of the net impacts of these changes so far (rising atmospheric CO$_2$, increased temperature and drought)”**

“**recent studies combining biometric and eddy covariance approaches now point to the (tropical) forests being net CO$_2$ source or, at most, a quite small sink”**
Desirable knowledge

Some guidance….. coming from carbon footprinting methodology (proscriptive)

- PAS 2050 provides a clear requirement in Section 5.4.1 Note 3

“Note 3: While forest management activities may result in additional carbon storage in managed forests through the retention of forest biomass, this potential source of storage is not included in the scope of this PAS.”
on balance then...at least for a PAS 2050 assessment

- Account for CO$_2$ incorporated in the wood raw material that forms part of the product under examination – *this will have a ‘negative’ GWP effect*

- *In sustainable forest management systems* - exclude other aspects of carbon dynamics in the forest system

- *Harmful land use change* aspects must be included in PAS 2050 calculations and is likely to have multiple undesirable consequences on other, non-GHG impact categories in LCA
Desirable knowledge

There is relatively poor data availability on some processing stages for wood products (e.g. some additives, diverse sawmilling processes and recoveries, composite manufacture etc)

Service life determination is complex – considerable variation occurs between ‘technical’ and ‘actual’ service lives achieved (in both directions !)

Disposal options are usually ‘modelled’ rather than traced – issues of timescale and changing waste management sector These are important - it’s the ‘fate’ of the sequestered carbon
Landfilling of wood has much uncertainty – is it a GHG sink or a GHG source? Highly sensitive to assumed degradation rate.
Methodology developments

- LCA well established under ISO 14040 series
- International Reference Life Cycle Data System (ILCD) Handbook etc
- Carbon footprinting – e.g. WBCSD, PAS 2050, ISO
Conclusions

• There is a clear case for wood as a positive material in green building and to help mitigate climate change

• Removal of, or clarification of the effects of, some remaining uncertainties in LCA of wood products will be valuable

• Partnership between the forest/forest products sectors and other agencies to develop LCI datasets will greatly support the place of wood in green building and design
Acknowledgements

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