Wood, buildings and the circular economy

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• Globally, more than 30% of materials are used in building construction

• Over one third of primary energy is used in buildings

• Huge impact!

• Huge potential to have an impact!!
Why wood in construction?

1. The substitution of energy-intensive materials

2. The carbon storage effect of wood products

3. The energy-efficiency benefits from the material
Great potential to improve the sustainability of the built environment by increasing the total amount of wood used in construction!

• Various mechanisms and incentives required to increase the proportion of wood used in construction

But in the longer term, might we face supply shortages if we wish to maintain and develop the role that forests play in climate change mitigation and the provision of other ecosystem services?
How much scope is there to increase wood use?

How do we maximize the substitution and carbon storage benefits of wood products in construction, without compromising the sequestration and sink potential of forests as well as other eco-system services?
Systems thinking approach

In 1999–2005, Europe's 1.5 million square kilometres of forests absorbed about 100 teragrams of carbon more each year than they released, or 10% of the region’s fossil-fuel emissions. Carbon is absorbed by growing trees and is released during decomposition and burning. Wood products act as a temporary carbon sink, and can substitute for fossil fuels.
Materials efficiency

Efficient utilisation of raw material (‘biorefinery’)  
Efficiency in use (extend time in use)  
Efficiency after use (cascade use)
How much wood do we currently use?

Global production of sawnwood and wood-based panels was 884 million cubic metres in 2016\(^1\)

Roughly equivalent to 750 million tonnes of CO\(_2\)

\(^1\)FAOSTAT-Forestry database
The “urban forest”: a source of future materials?
How much wood is available from buildings?

For example, a recent study\textsuperscript{1} showed that there is a stock of approximately 32 M m\textsuperscript{3} wood in residential buildings in Austria, increasing to over 50 M m\textsuperscript{3} by 2100.

\textsuperscript{1}Kalcher et al (2017): Resources, Conservation and Recycling 123 143–152
Resource cascading

\[ Q = \text{resource-quality} \]
\[ T = \text{utilization time} \]
\[ \Delta T = \text{life time per application} \]
\[ \Sigma \Delta T = \text{overall life time} \]
\[ \Delta Q = \text{quality loss per application} \]
Wood cascades

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Barriers to solid wood cascading

- Cost, quality and other technical considerations
- Use as an energy source – competing priorities
- Currently no business models
Design for Disassembly

• Current demolition practices not compatible with material recovery for cascading

• Buildings to be designed with disassembly and recovery of elements and materials in mind

• How to implement?
Wood and circular economy projects

Current:
• **REWoo**d: Design for disassembly in wood (Climate-KIC)
• **SMARTA wood**: Sustainability impact assessment of wood in construction (Climate-KIC)

Forthcoming:
• **CircWood**: Modelling the sustainability impact of implementing cascading (YM)
• **InFutureWood**: Design for deconstruction and cascading (Forest Value ERA.net)
Final thoughts

**Systems** thinking required – avoid zero sum games

Regard buildings as *temporal* stores of materials

**Build** to last 250 years

**Design** to recover > 95% of materials for reuse