



InnoRenew CoE

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Critical Appraisal of Building Materials

A Critical Appraisal of Wood as a Building Material

Reconstructing the Future for People and Planet

Pontifical Academy of Sciences (PAS), Vatican, June 9-10, 2022

Prof. Andreja Kutnar, PhD,
Director, InnoRenew CoE, Slovenia





Where would you rather be?



Most people spend 80-90 % of their time indoors, separated from nature. **Where would you rather be?**



Photo: Kambič

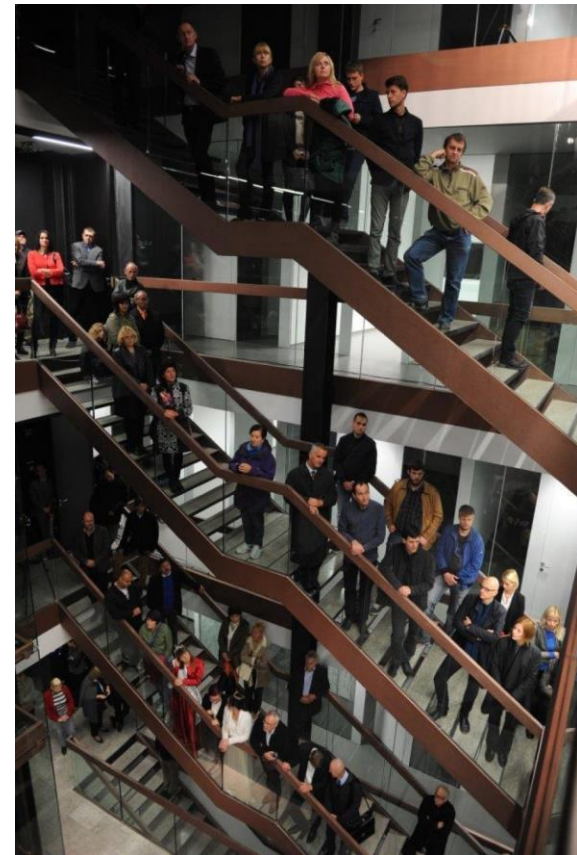


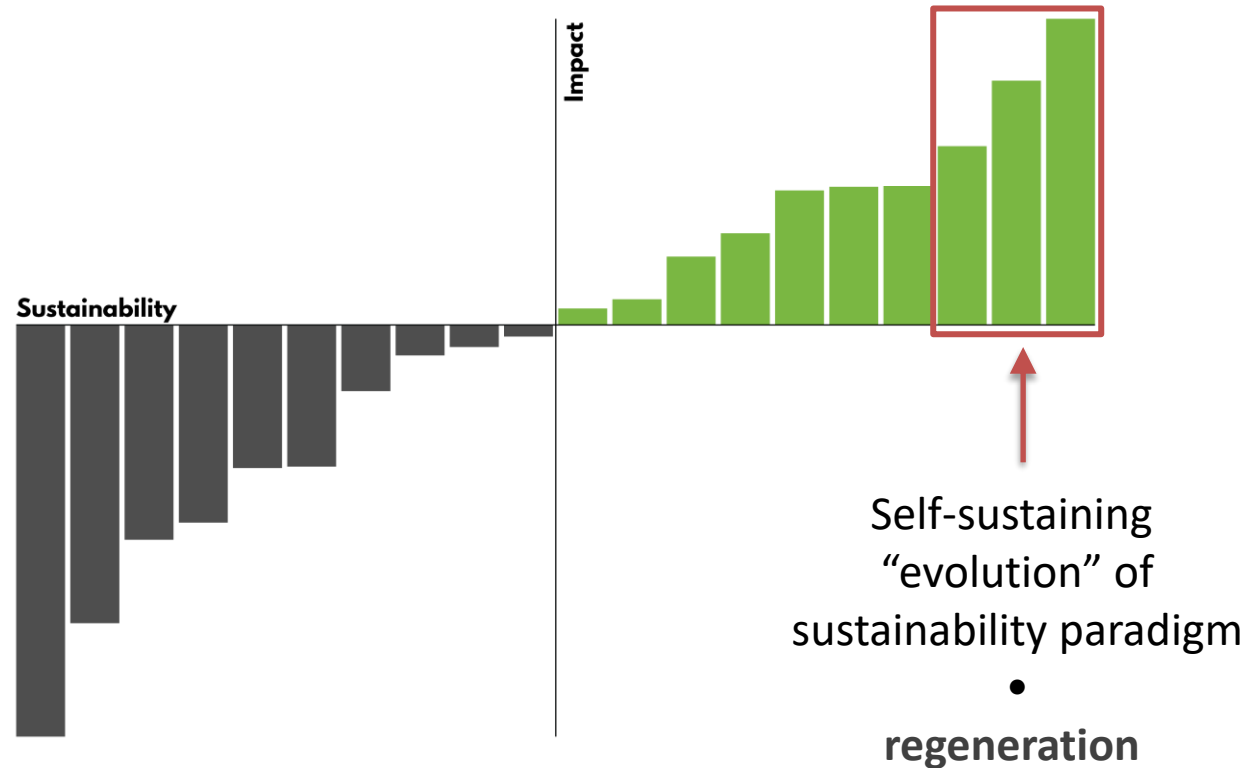
Photo: University of Primorska



Regenerative Sustainability

Multiple sustainability targets:

- Environmental
- Human
- Social
- Economic





Transforming the built environment into a carbon sink

Wood and other nature-based materials sequester and store carbon in multiple products, which can be reused, remanufactured and recycled over centuries.



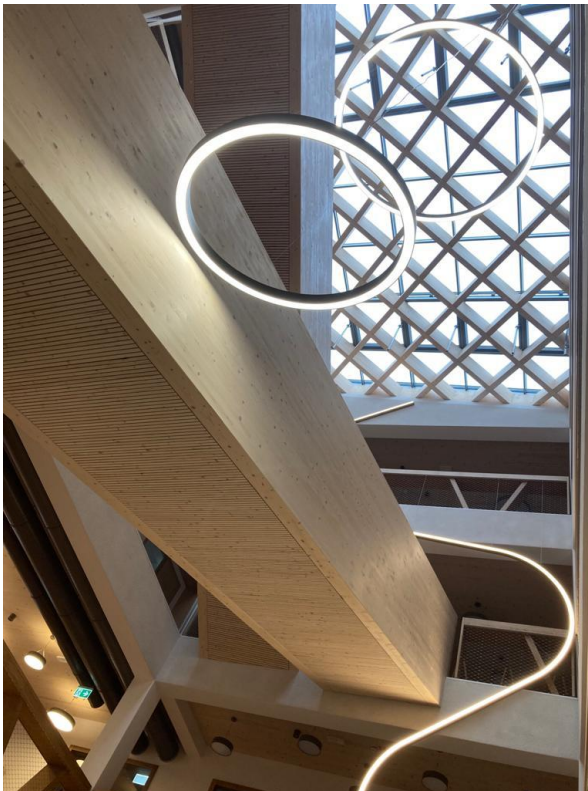


Wood is an ideal material for **Restorative Environmental and Ergonomic Design (REED)** that satisfies both general tenets of the design paradigm - **sustainability and a connection to nature.**

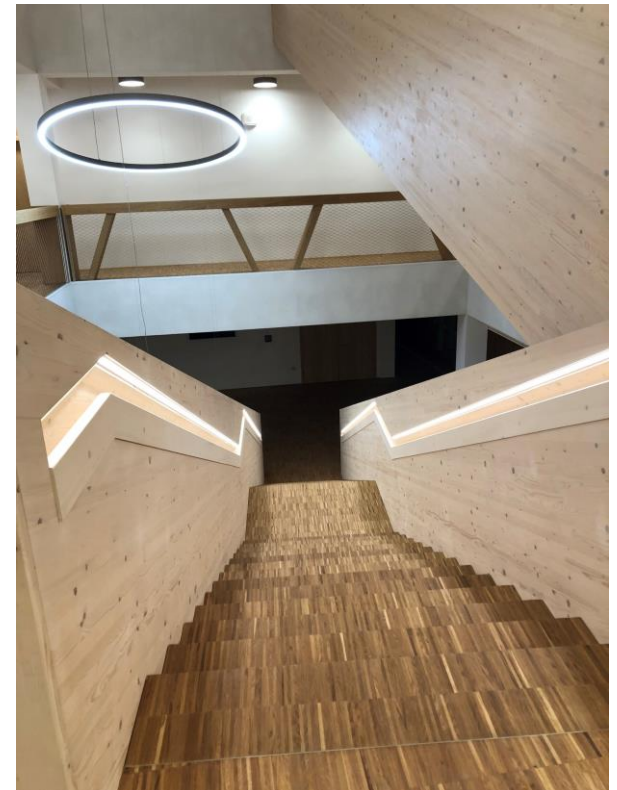




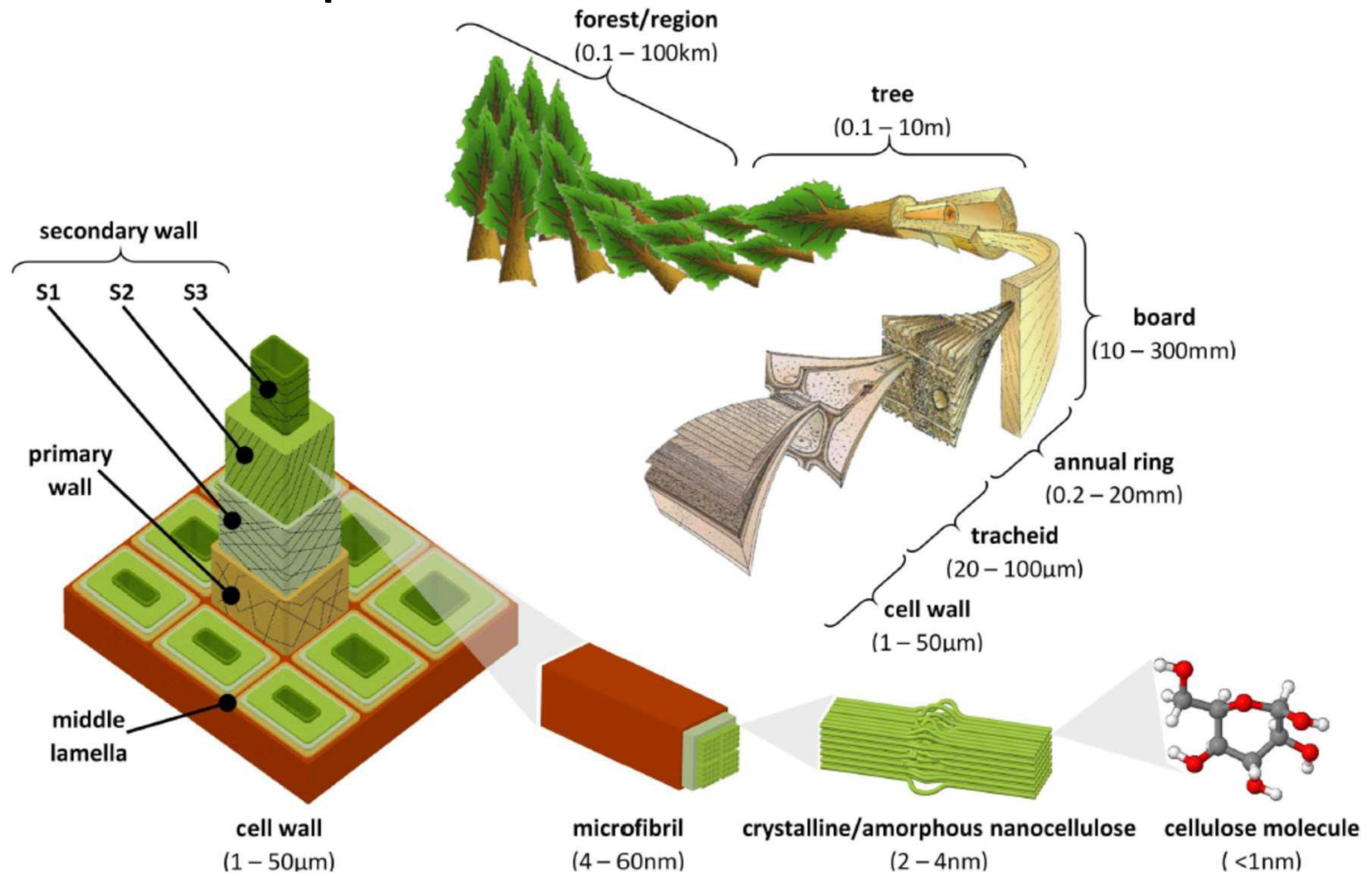
Bringing nature indoor connects people to life and life-like processes (biophilia), has direct health benefits, & inspires building users to care for their environment.



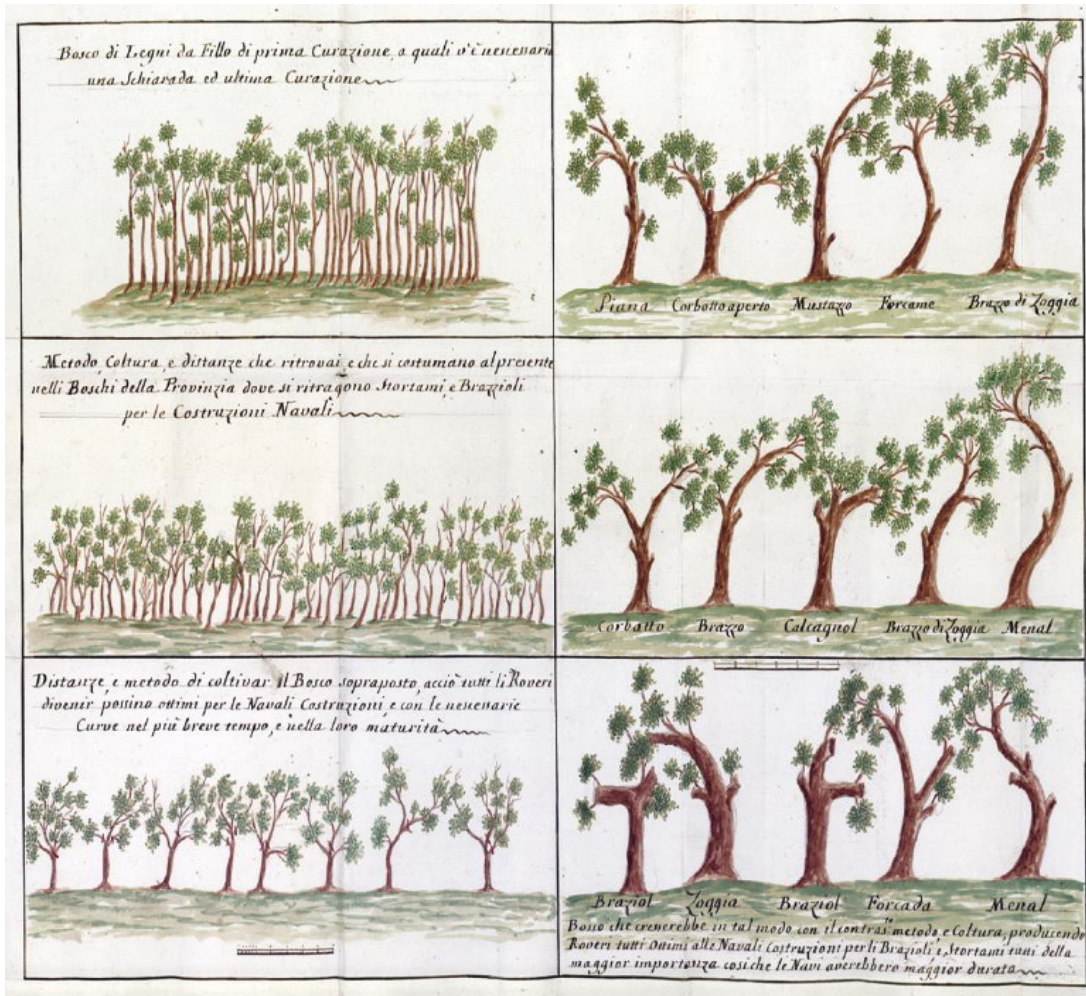
Natural materials, like wood, are one way to connect people to nature indoors.



Wood – complex material of nature



Inspired by artwork of Mark Harrington (1996 PhD Thesis, University of Canterbury), adopted by Jakub Sandak.



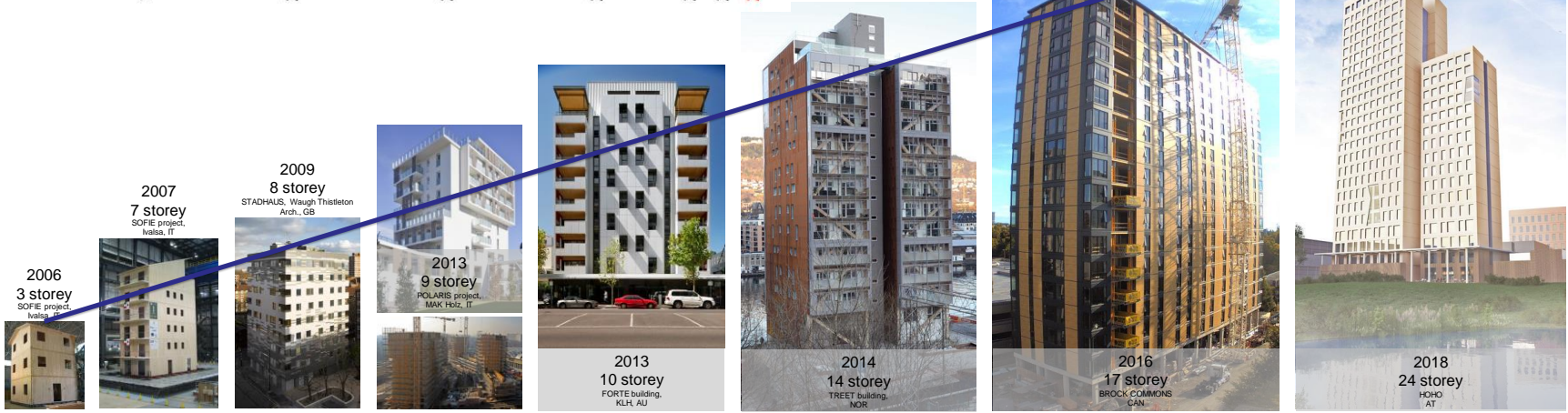
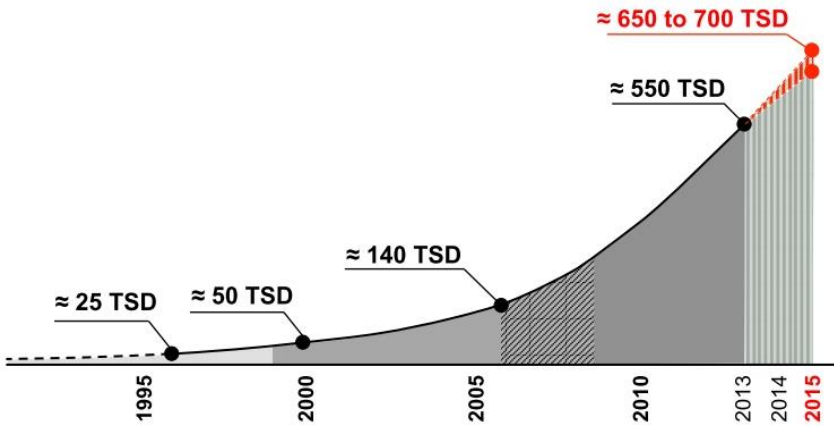
Wood products in the past

Illustration of the method of cultivation of oak forest and various forms of pruning of trees for the needs of the Venetian Navy – example from Istria

(G. C. Vittori, 1777, ASV, Senato, Arsenal, 133, 2). From Panjek (2015)

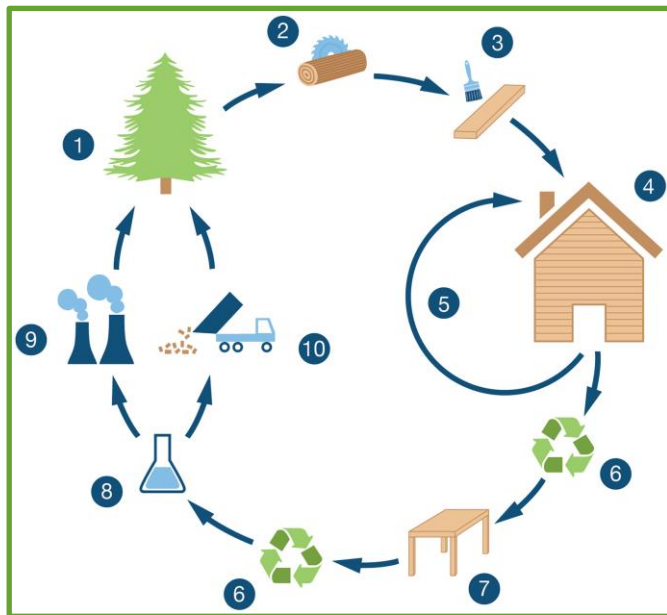
<http://www.hippocampus.si/ISBN/978-961-6963-35-0.pdf>

Wood today – Multi-story timber

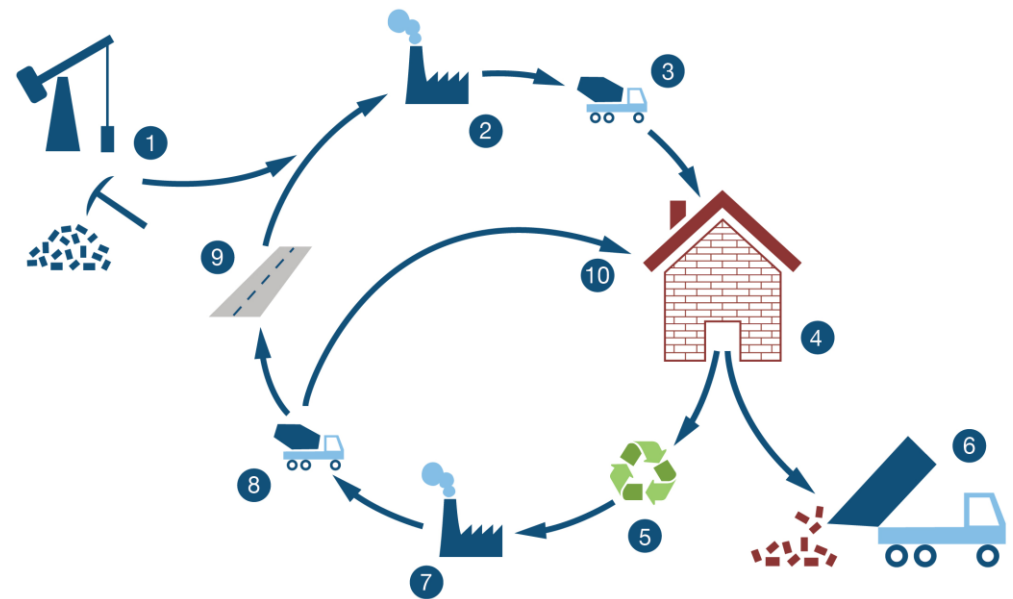


(Iztok Šušteršič)

Why wood?



Renewable

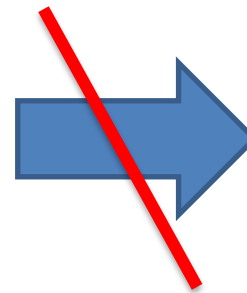
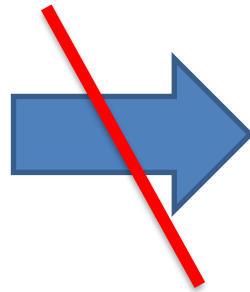


Non-Renewable

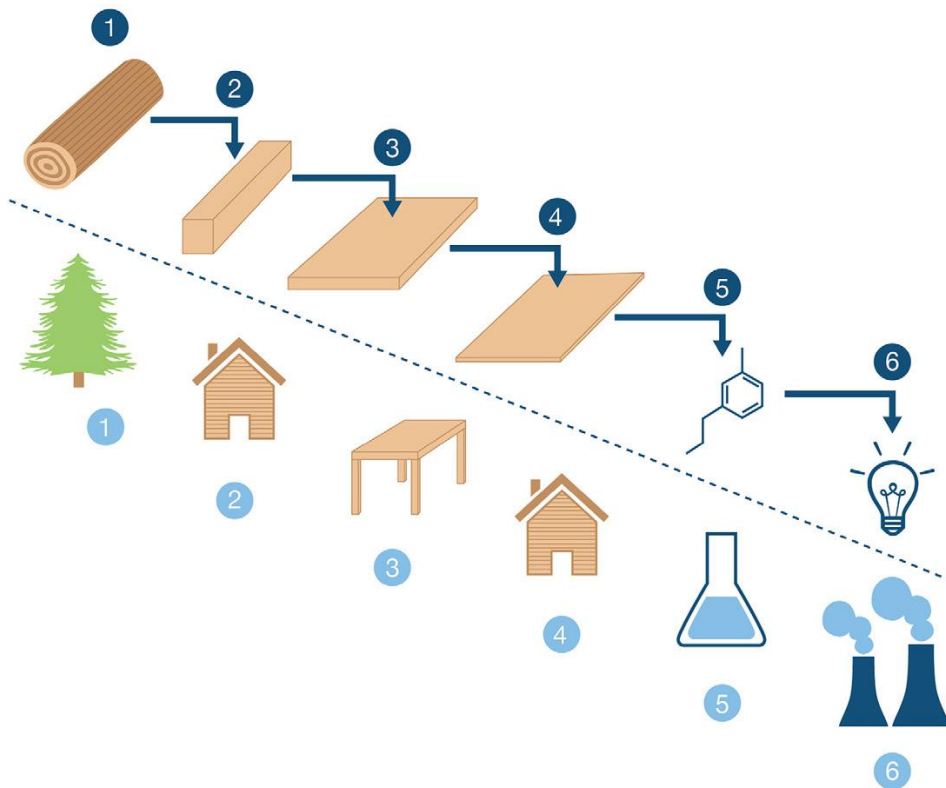
(Sandak et al., 2019)



Reclaimed timber – raw material for new products



Cascade utilisation of wood



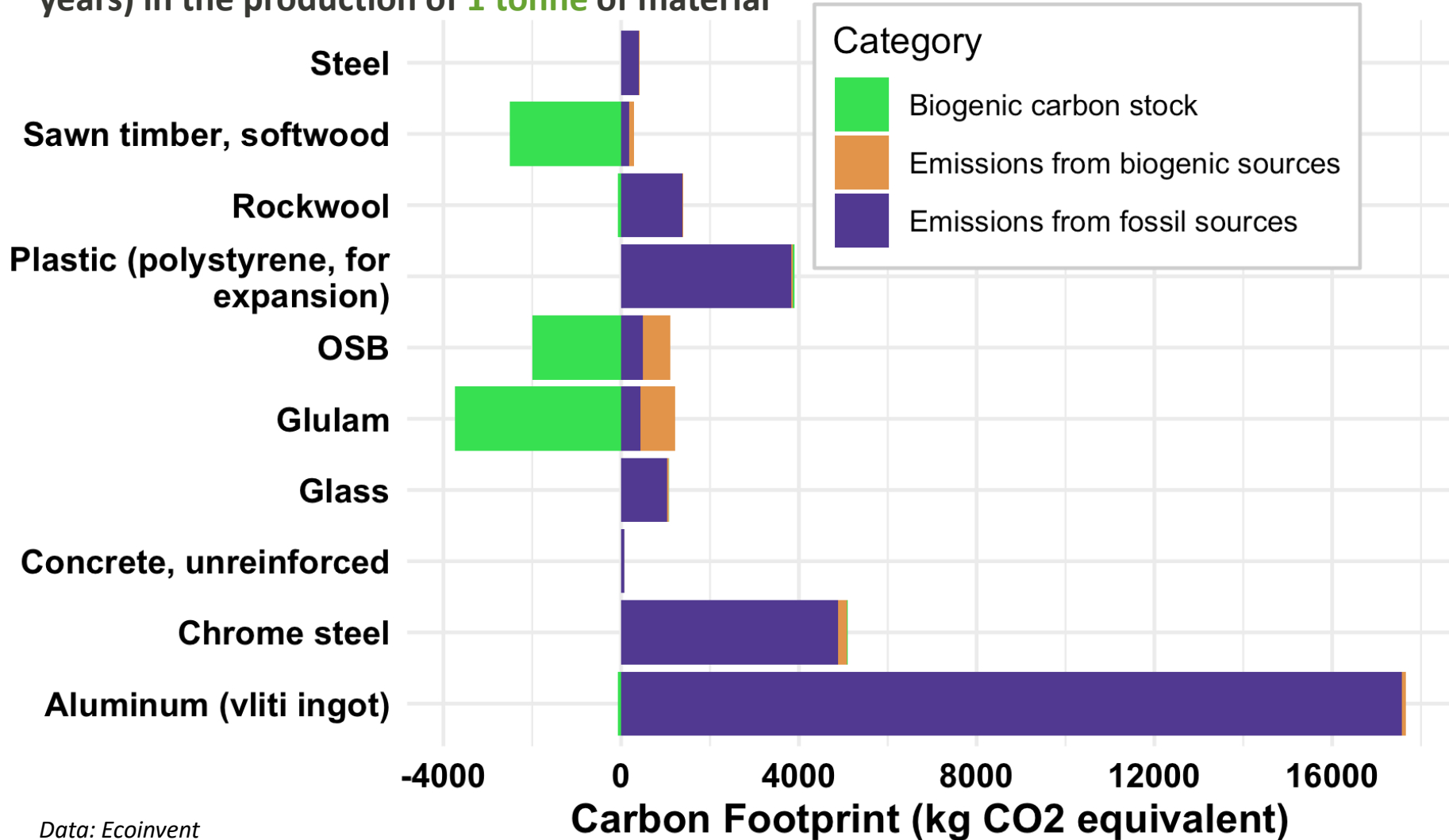
- (1) roundwood,
- (2) large-dimension sawn or engineered timber assortments,
- (3) strand- or particle-based composites,
- (4) fibre-based composites,
- (5) chemicals, and
- (6) energy

Material cycles: (1) resource extraction, (2) 1st life cycle, (3–4) 2nd life cycle, (5) chemicals processing, (6) energy generation

(adapted from Sandak et al., 2019)



Carbon footprint [kg CO₂e] and biogenic carbon stock (sequestration for at least 100 years) in the production of 1 tonne of material



Data: Ecoinvent

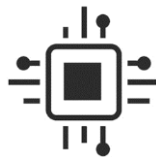
**We need to
use more
timber.**

But, how?



Interdisciplinary problem solving

Combine modern research fields with concepts of sustainability and sensible use of natural resources. In this case, *wood*.





VR walk through a building during the design phase

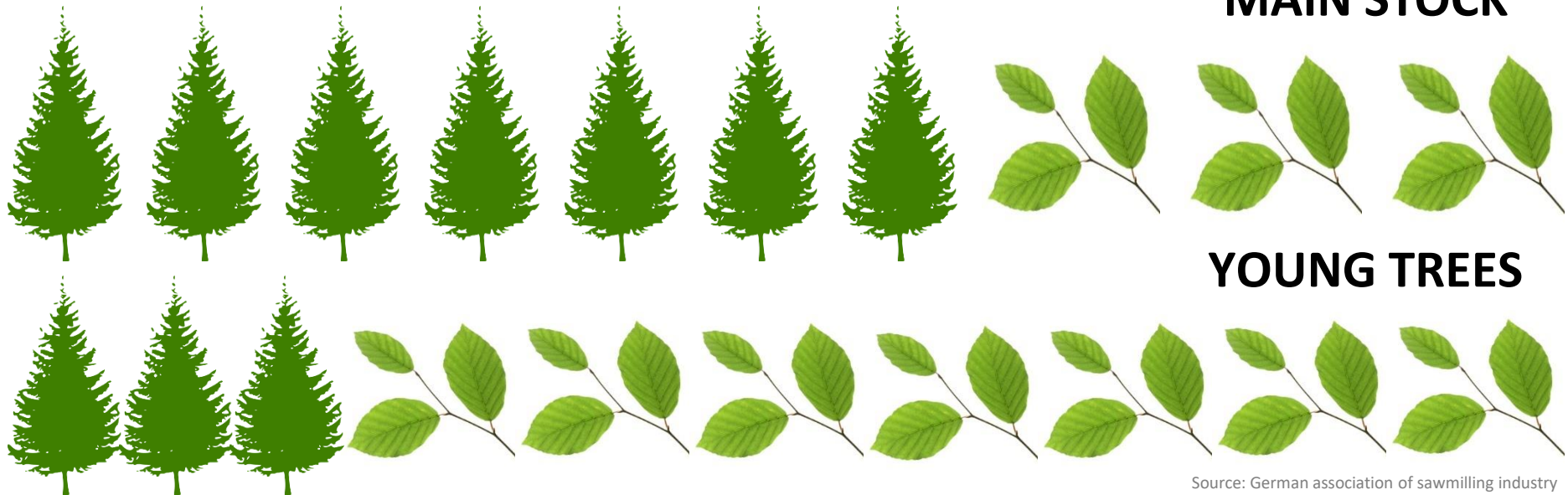
Photo: Anna Sandak



New timber species

MAIN STOCK

YOUNG TREES



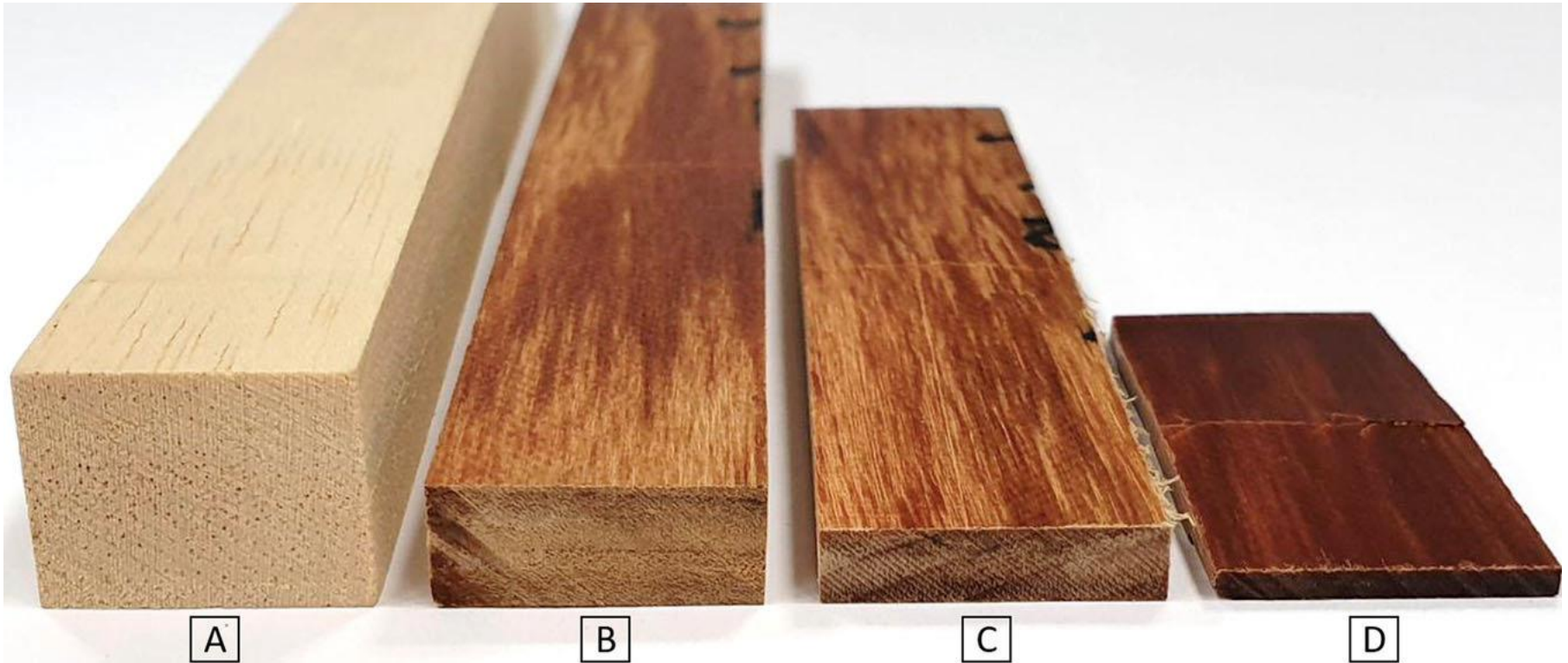
Source: German association of sawmilling industry



Wood modification

MetaDense (European Patent EP19204677.9.)

Densified wood impregnated with phenol resin for reduced set-recovery



Poplar specimens: (A) un-densified 15 mm thickness, (B) densified to 7 mm, (C) densified to 5 mm, and (D) densified to 2 mm.

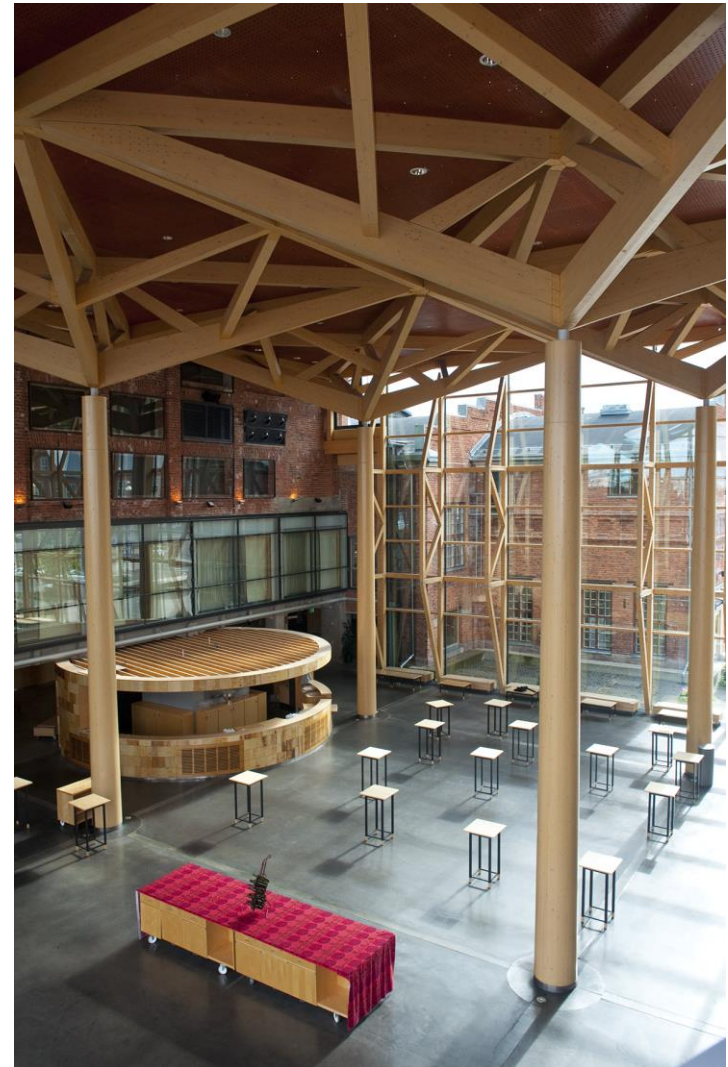


REED & Regeneration

Limit waste through **design for disassembly**

Limit environmental impact by using **renewable materials, recovered materials**

Support the local economy by using **local materials and processing** (also limits transportation impact)



(Photo: Michael Burnard)



REED & Regeneration



(Photo: Rene Gomolj)

Engage all building users with their environment (built and natural).

Natural sounds, views of nature, and other links to nature are all considered beneficial for building.

Health monitoring of timber buildings



Renovation of old building stock

Servite monastery (1492) – Cultural monument of national importance



**Monastery,
hospital,
maternity
hospital and
methadone clinic**

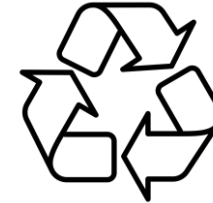
Timber & the 9R Principle



Refuse



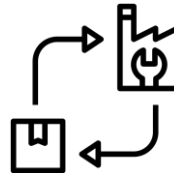
Repair



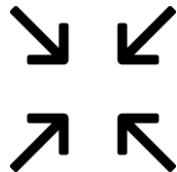
Recycle



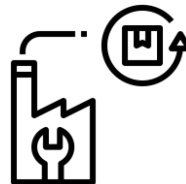
Rethink



Refurbish



Reduce



Remanufacture



Re-use

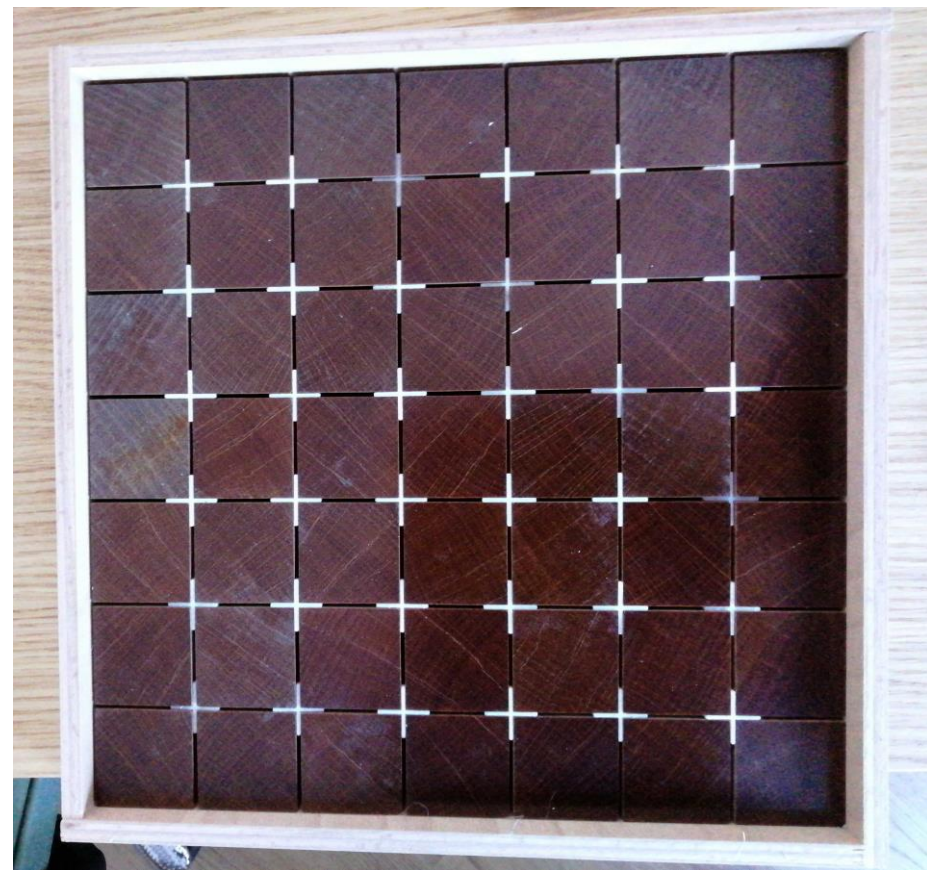


Repurpose

European Commission, Directorate-General for Research and Innovation, Schempp, C., Hirsch, P., Categorisation system for the circular economy : a sector-agnostic categorisation system for activities substantially contributing to the circular economy, Publications Office, 2020, <https://data.europa.eu/doi/10.2777/172128>



Timber & the 9R Principle: R1 - Refuse



Timber & the 9R Principle: R2 - Rethink



Timber & the 9R Principle: R3 - Reduce



Timber & the 9R Principle: R4 – Re-use



Timber & the 9R Principle: R5 - Repair



Timber & the 9R Principle: R6 - Refurbish



Timber & the 9R Principle: R7 – Remanufacture



Photo: EPF

Timber & the 9R Principle: R8 - Repurpose



Photo: EPF

Timber & the **9R** Principle: R9 - Recycle



Wood is good – but so are other renewables.

reed fibers



cotton wool



duck feathers



linen wool



wood fibers



cellulose



wool



coconut fibers



straw



hemp



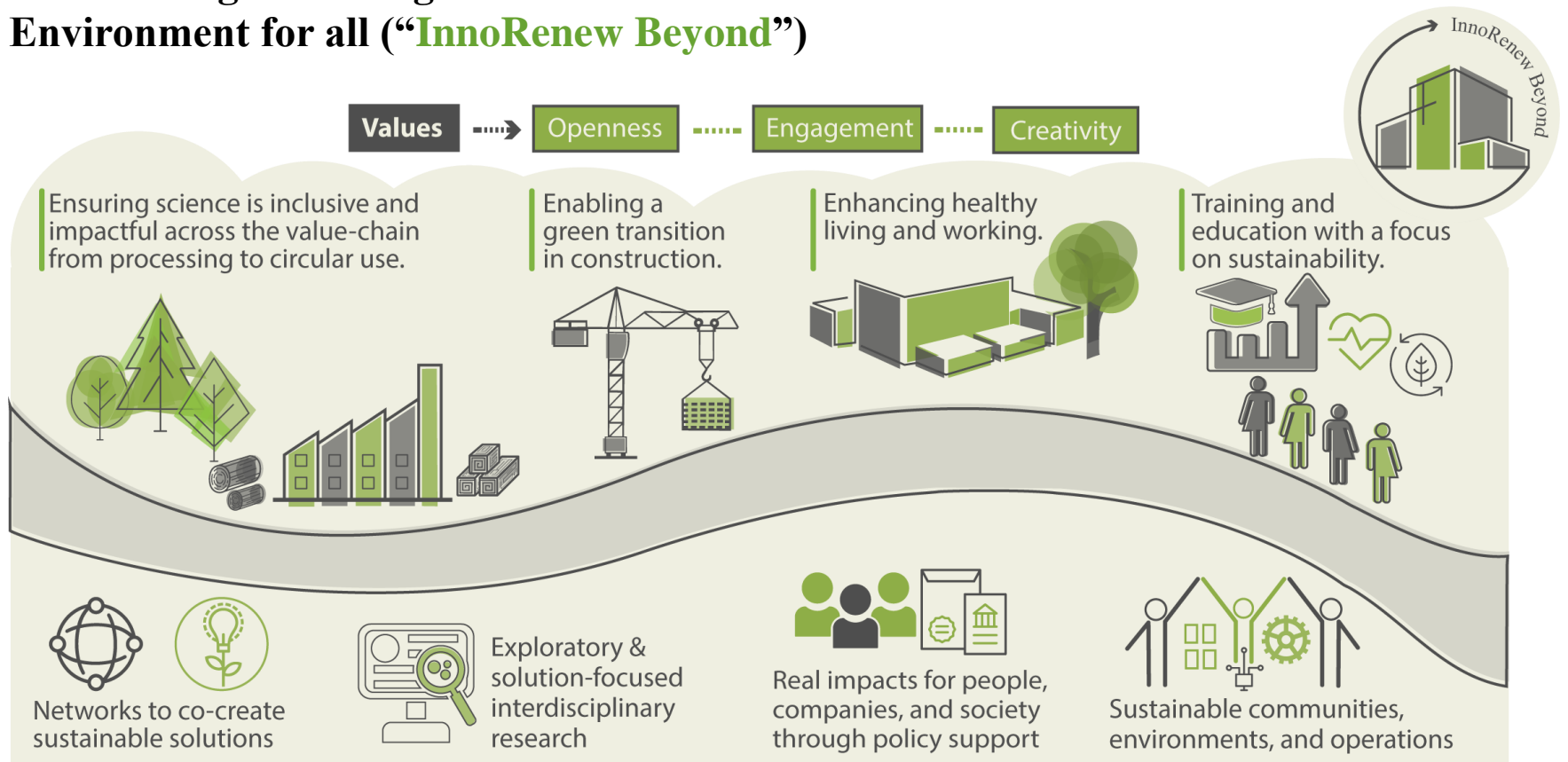
cork



(Anna Sandak)

How to make more of wood?

Accelerating Knowledge Transfer to Co-Create a Beautiful and Sustainable Built Environment for all (“InnoRenew Beyond”)





InnoRenew CoE is hosting Woodrise 2022

WOODRISE 2022 TECHNICAL CONFERENCES AND TOURS



6-7
September 2022

Congress Center
Bernardin Portorož,
Slovenia

<https://woodrise2022.eu/>





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Thank you!



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SCIENCE AND SPORT

