
# Innovative Design For the Future – Use and Reuse of Wood Building Components

Madrid 29 September 2022

Project name/website: https://www.infuturewood.info/
Project acronym: **InFutUReWood**

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 773324

# Project partners

22 partners (1 RI, 7 U, 14I)
7 countries Finland, Germany, Great Britain, Ireland, Slovenia, Spain and Sweden.

Total project budget
2 364 492 EUR

Project time
1/3 2019 - 28/2 2022

ForestValue

# Introduction

**How should we build today to be able to circulate timber tomorrow?**

Design out waste from timber structures, WP2

Inventory, deconstruction and quality of recovered wood, WP4

Product design using recovered timber, WP3

Focusing on design, reuse and quality

Properties and grading of recovered, WP5

Environmental and economic assessment of design for reuse, WP6

InFutURe Wood

# Results

## Inventory, deconstruction and quality of recovered wood

**Quality** of reclaimed timber matters

Inventory


Set of criteria

| | |
|---|---|
| **Contamination** | • Chemical contamination (e.g. surface treatment)<br>• Mechanical contamination (e.g. fasteners, holes, notches)<br>• Other contamination (e.g. insulation material) |
| **Deviation from standardized length** | • Changes in length |
| **Biological defects** | • Fungal<br>• mould<br>• Insects |
| **Deviation from flatness** | • Wane<br>• Cupping<br>• Bowing<br>• Spring<br>• Twisting |
| **Cracks** | • Internal/External/Through<br>• Radial/ Tangential/Longitudinal |



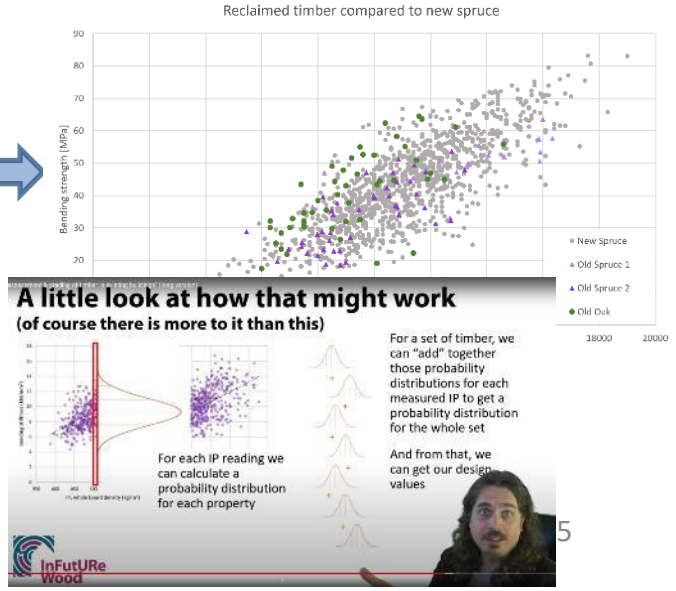
What kind of reclaimed wood that is currently available in buildings

# Results

## Testing and grading of recovered wood

**Specification** of properties of recovered spruce and oak



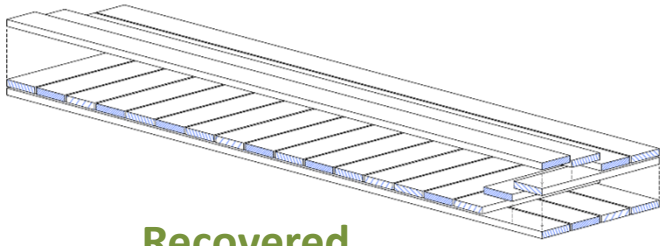




A potential alternative grading framework

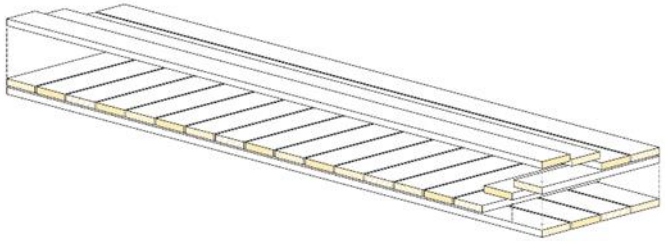
# Results

## Mass timber products from recovered timber

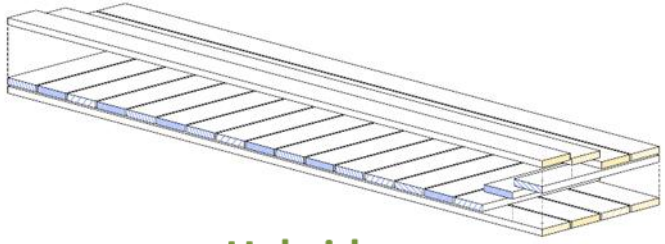
**Utilize** material from existing buildings in new wood products.



Recovered



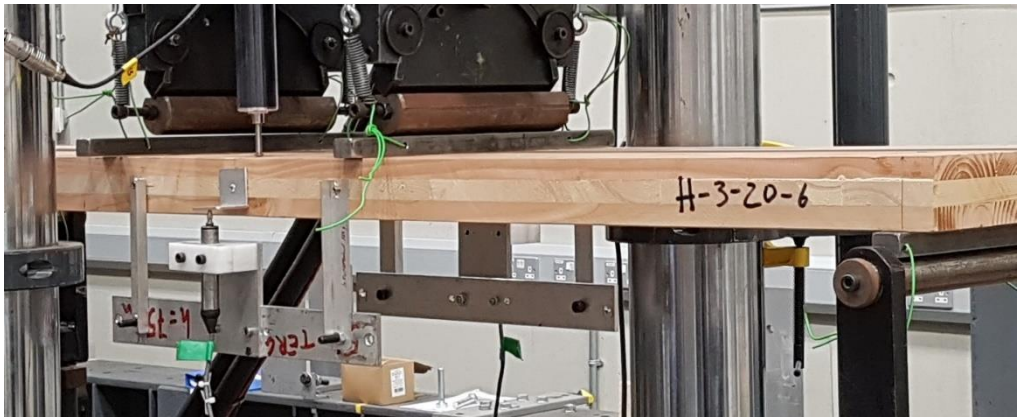
New



Hybrid

CLT panels, GLT

| Panel type | | $E_{m,a}$ (N/mm²) | $f_m$ (N/mm²) |
|---|---|---|---|
| Recovered | Mean | 10340 | 49.4 |
| | COV | 5.9% | 7.5% |
| New | Mean | 10870 | 49.7 |
| | COV | 6.1% | 8.7% |
| Hybrid | Mean | 10780 | 41.7 |
| | COV | 2.8% | 8.2% |
| Hybrid - 2 | Mean | 8870 | 36.2 |
| | COV | 2.8% | 14.8% |




Potential use of timber recovered from demolition in the manufacture of mass timber construction products

# Results Designing out waste

**Design** buildings specifically to facilitate disassembly rather than demolition.
Increase the **efficiency** of material use by optimizing the primary design.

Method to adapt an existing design
*-researcher*

Indicator system →
*ReBuilding Index*
*-industry*

A design decision matrix
*-architects*

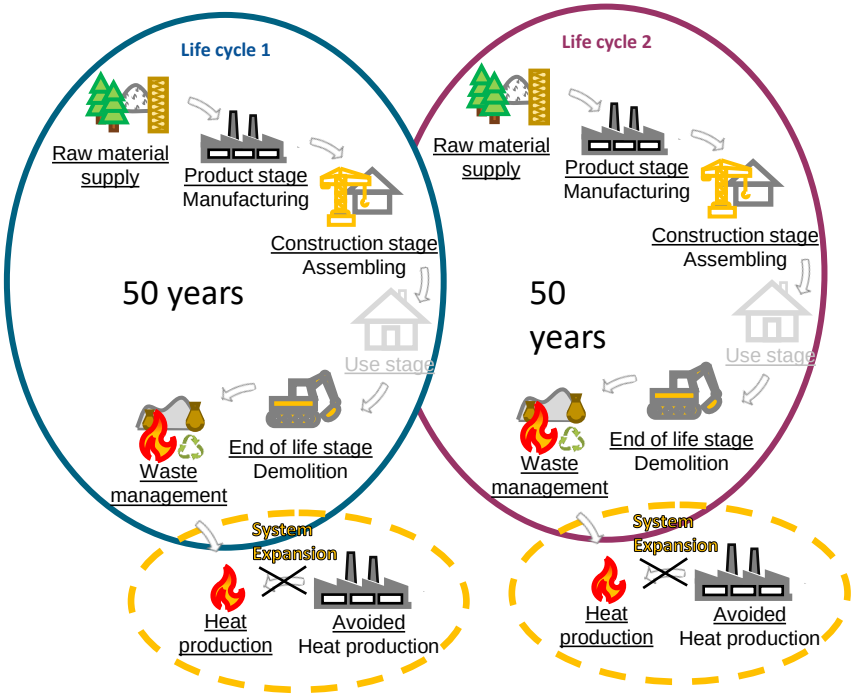
New design solutions
Guidelines for deconstruction and reuse

# Results

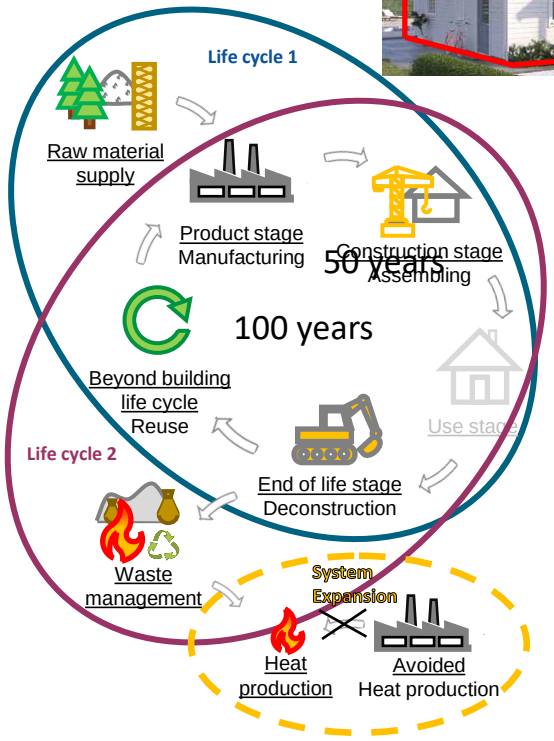
## Environmental and economic assessment

System boundary and whole life cycle scenarios


**Reference system (RS)**




**DfDR system**

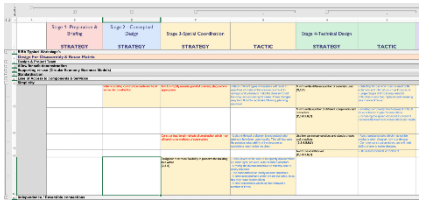


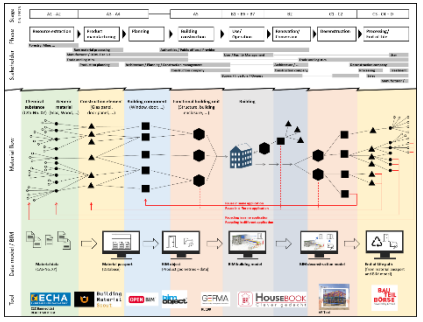

Special focus on the demolition phase

# Results summary

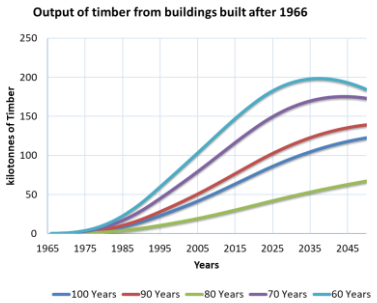
Buildings constructed to date are most often demolished at end-of-life and go to incineration. But there are promising results

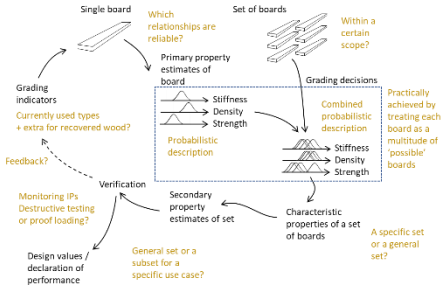
- Design for deconstruction and reuse (DfDR) can be implemented with small changes and existing technologies.
- DfDR can contribute to reduce the environmental impacts of timber frame constructions for residential buildings.
- Products from recovered timber tested structurally show similar properties to equivalent new products.
- Environmental benefits can be achieved from the use of recovered solid timber in high-quality CLT panels.
- Recovered spruce and oak shows promising results of stiffness and density compared to new timber. A new framework for strength grading was developed.
- There is a huge amount of wood in existing buildings with potential for reuse.





| DfD/A Category | DfD/A Principle | Principle Score | Principle mean value score | Total Score | Weight Factor |
|---|---|---|---|---|---|
| 1.0 Adaptability | 1.1 Versatility (ISO20887 - Sec. 5.2.2) | 1.0 | 0.5 | 54 | 0.2 |
| | 1.2 Convertibility (ISO20887 - Sec. 5.2.3) | 2.0 | 0.7 | | |
| | 1.3 Expandability (ISO20887 - Sec. 5.2.4) | 1.0 | 0.4 | | |
| 2.0 Construction Design | 2.1 Simplicity (ISO20887 - Sec. 5.3.6) | 1.0 | 0.5 | 62 | 0.2 |
| | 2.2 Standardization (ISO20887 - Sec. 5.3.7) | 2.5 | 0.7 | | |
| | 2.3 Accessibility (ISO20887 - Sec. 5.3.2) | 2.5 | 0.9 | | |
| | 2.4 Independence (ISO20887 - Sec. 5.3.3) | 1.0 | 0.5 | | |
| | 2.5 Durability (ISO20887 - Sec. 4.3.2) | 0.5 | 0.5 | | |
| 3.0 Disassembly Design | 3.1 Safety (ISO20887 - Sec. 5.3.7) | 1.5 | 0.8 | 73 | 0.2 |
| | 3.2 Deconstruction process (Sec. 5.3.7) | 1.5 | 0.5 | | |
| | 3.3 Finishes (ISO20887 - Sec. 5.3.4) | 1.0 | 1.0 | | |
| | 3.4 Connections (ISO20887 - Sec. 5.3.2/5.3.3) | 4.0 | 0.6 | | |
| 4.0 Circularity | 4.1 Reusability (ISO20887 - Sec. 5.3.5) | 0.5 | 0.5 | 42 | 0.2 |
| | 4.2 Refurbishability (ISO20887 - Sec. 5.3.5) | 0.5 | 0.5 | | |
| | 4.3 Remanufacturability (ISO20887 - Sec. 5.3.5) | 0.5 | 0.5 | | |
| | 4.4 Recyclability (ISO20887 - Sec. 5.3.5) | 1.0 | 1.0 | | |
| | 4.5 Reclaimed material (ISO20887 - Sec. 5.3.5) | 0.0 | 0.0 | | |
| | 4.6 CE Market (ISO20887 - Sec. 5.3.5) | 0.0 | 0.0 | | |
| 5.0 Documentation | 5.1 General design documentation (ISO20887 - Sec. 6.1) | 4.0 | 1.0 | 58 | 0.2 |
| | 5.2 Construction documentation (ISO20887 - Sec. 6.1) | 2.0 | 1.0 | | |
| | 5.3 Disassembly documentation (ISO20887 - Sec. 6.2) | 0.0 | 0.0 | | |
| | 5.4 Material and manufacturers information (ISO20887 - Sec. 6.3) | 1.0 | 0.4 | | |
| | 5.5 Documentation handling and transference (ISO20887 - Sec. 6.5 & 6.6) | 1.0 | 0.5 | | |



# Impacts

New design solutions (3 methods) and the practicing of ISO 20887
- industry, researchers, architects, standardizations

First version of deconstruction plans
- industry, policy makers

Logic for measuring (grading) quality of reused timber
- standardization, researchers

Stock and flow model predict the volumes and mass of timber in built environment
- policy makers, researchers

Reused timber can be used in engineered wood products and recovered rates
- industry, researchers

Anneberg Villa, AHus, © Derome

Anders Carlsson, R&D Manager, Derome, Sweden

Everett Grand Villa
©Robertson Timber Engineering

Nicola Jackson – Technical Manager at Robertson Timber Engineering and Chair of Offsite Solutions Scotland

Case study object: Villa Forshälla Sund. © Erik Persson

Janina Östling, sustainability manager, Isotimber

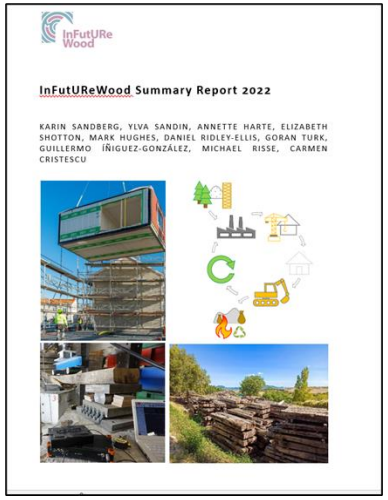
Co-operation between partners from industry and academy was achieved through a series of case studies

# The value of scientific cooperation

**Learning** from the differences in construction methods, supply chains, building regulations, standards and culture between the countries.
**Sharing**: knowledge, glossary of terms, education material, study visits, national projects, research reports and articles, conferences and seminaries, held a international webinar, workshops with stakeholders: municipalities, architects, wood component suppliers, timber house manufacturer, demolition companies …


Several videos at https://www.youtube.com/channel/UCdpJNt6h3eBD6NFmZQXuErw

Seminar WP2 leader Ylva Sandin interview industry partners Anders Carlsson and Janina Östling.




Summary report of the project is published at DiVa portal www.diva-portal.org and website https://www.infuturewood.info/

# Unexpected peculiarities / barriers

Moving away from the current state has many challenges and obstacles that can be barrier for implementation.

The methods developed still need to be improved.

Gathering the required data for wood characterisation, product certification, development of indicator system, design matrix etc are **very large tasks**!

Solution - cooperate to share data so that a sufficient shared body of knowledge can be accumulated over time.

Sara culture house and The Wood Hotel, Skellefteå built in CLT and glulam, 80 meter, 20 stories

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# Thank you!


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# ForestValue

Website: https://forestvalue.org/
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# InFutUReWood

## **In**novative Design For the **Fut**ure - **U**se and **Re**use of **Wood**

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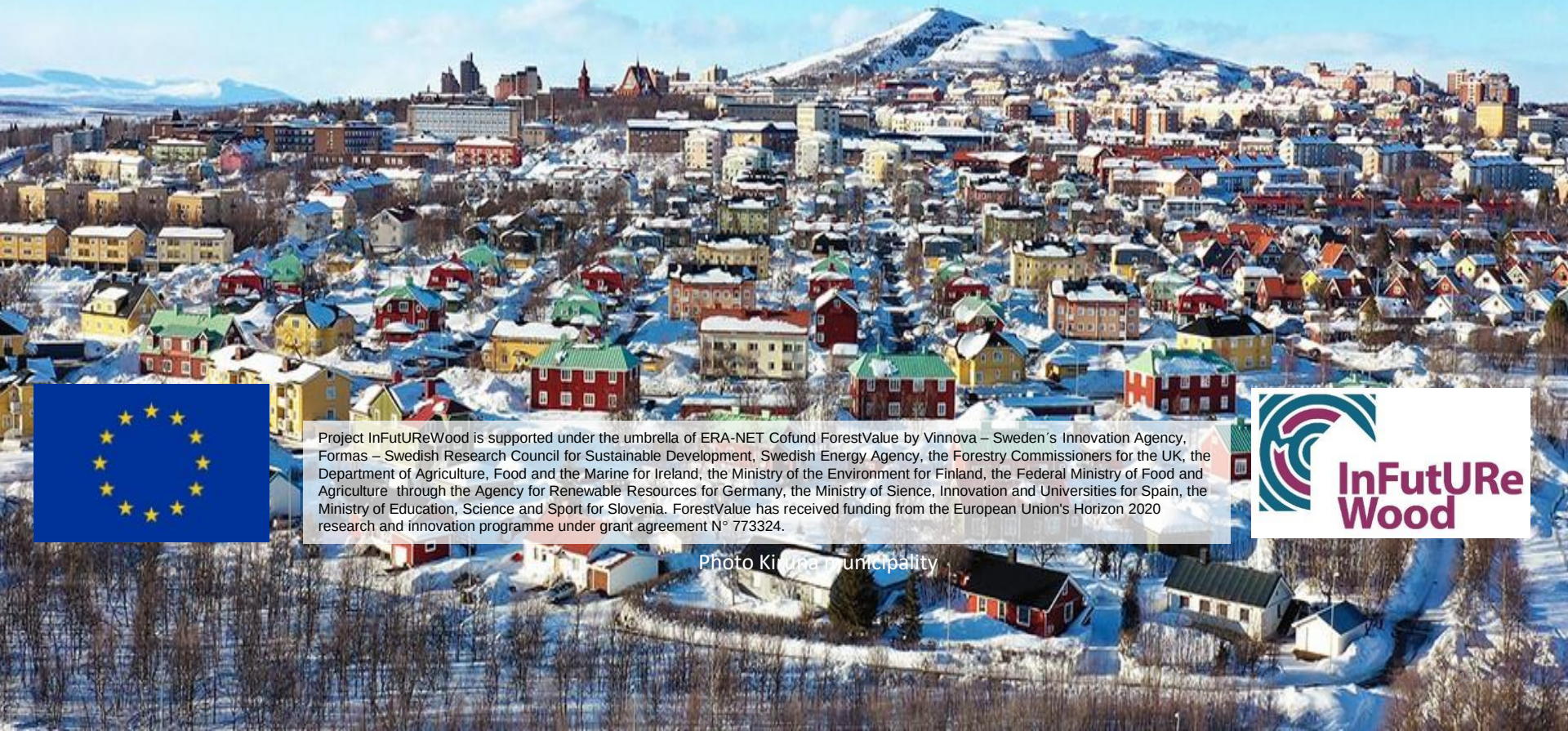

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Photo Kiruna municipality