Wood pre-treatments: a short review

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Objectives

- Understanding the building/designer point of view in LCA analysis and in design
- Overview on different treatments and their consequences on LCA of buildings
- Overview on treatments and their consequences on the assemblies and design possibilities
- Design improvements to increase the possibility of components reuse after the end-service life of buildings

Thermal pre-treatments

Thermal pretreatment either in ''wet'' or ''dry'' environments is used to modify the composition and the structure of wood.
Although a **reduction** of **mechanical** properties of thermally modified wood has been observed, thermal treatment of wood is the most commercially developed strategy to modify wood characteristics.

DRY

WET

HWE

	Dimension stability	Water absorption	MOE	MOR
OSB	↑	=	↓	↓
MDF	↑	=	↓	↓
WPC	↑	↓	↑	↑

Pelaez-Samaniego, & al.(2013). A review of wood thermal pretreatments to improve w ood composite properties.

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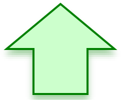
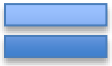
Chemical pre-treatments

Chemical pre-treatments can be applied on the **external** layer of the material, or by means of long lasting impregnation of the components.
They are usually administered on wood to prevent **performance reduction**, improve **water resistance**, reduce the effects of ultraviolet **radiation**, or decrease **flammability**.
Treated wood must be non-toxic and recyclable at the end of its service-life.

IMPREGNATION

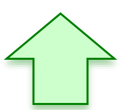
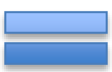
CHEMICAL BOND

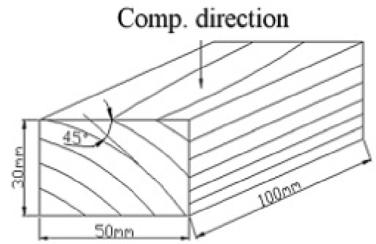
Dimension stability	Water absorption	MOE	MOR
		?	?

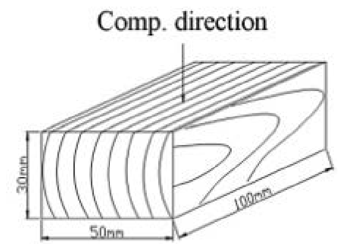
Hill, C. A. S. (2006). Wood Modification: Chemical, Thermal and Other Processes
Davies, I. (2015). Development of performance-based standards for external timber cladding

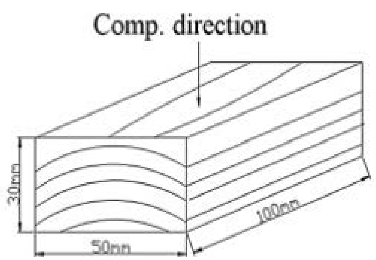
Mechanical pre-treatments

Mechanical pretratments reduce the moisture content (MC) by compression in a short time. This procedure was systematically studied in terms of effects of compression ratio, compression direction and compression speed on the reduction of MC.

Dimension stability	Water absorption	MOE	MOR
		?	?







Zhao, Y.et al. (2015). Studies on pre-treatment by compression for w ood drying I: effects of compression ratio, compression direction and compression speed on the reduction of moisture content in w ood.

HOW CAN THIS BE USEFUL FOR DESIGNER/ARCHITECT?

LCA

- End of life scenario

End of life scenario

- Landfill
  - Landfill for later recovery
  - Landfill
- Disassembly
  - Recycling
  - Reuse
- Energy recovery
  - Pyrolysis
  - Incineration
  - Chemical extraction
  - Gasification

End of life scenario

Landfill

PROs	CONs
• Does not require ground space for storage	• Chemicals can be spread into the ground
• Treated timber can be extracted in the future for better use	• Requires large areas
• It's cost effective and quick	• Waste burying sites must be recorded

End of life scenario

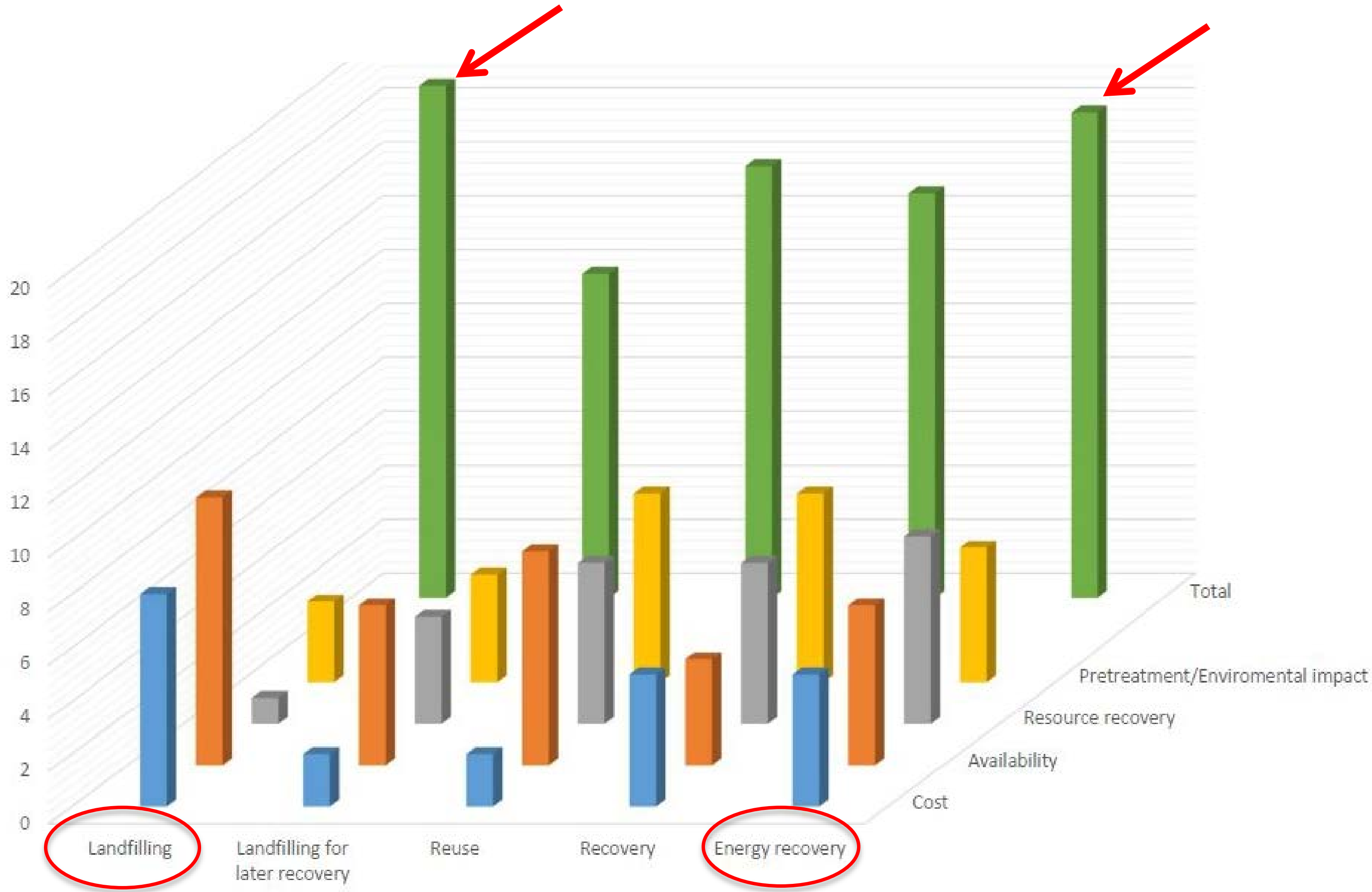
Disassembly

PROs	CONs
• New products from waste • Low energy input for reuse • No chemicals released in the environment	• High costs • Need manual disassembly (slow demolition procedure) • Reuse depends on original treatment

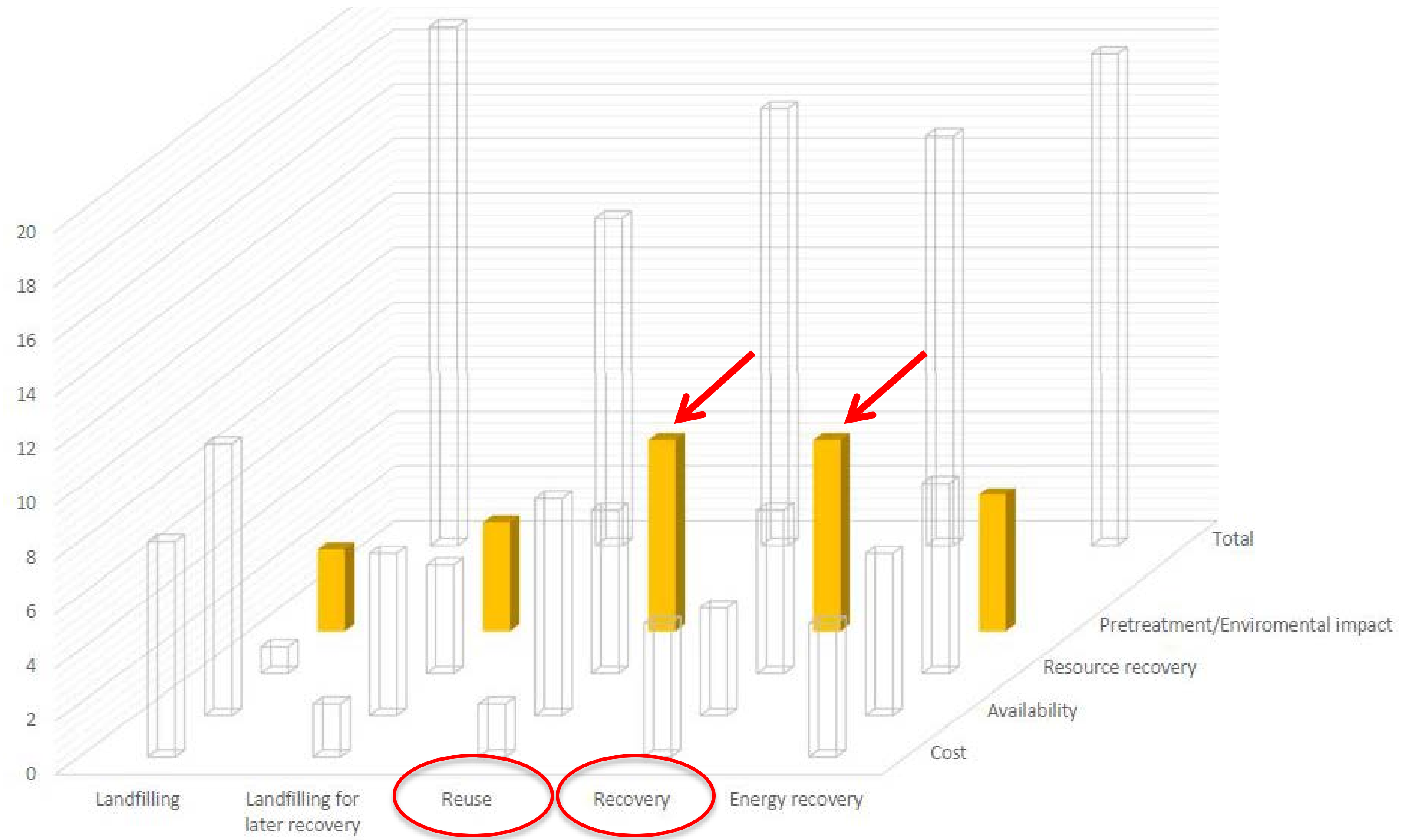
End of life scenario

Energy recovery

PROs	CONs
• Energy recovered	• High costs
• No emissions (for gasification an pyrolysis)	• Chemicals can be released in the atmosphere
• No release of fossil carbon in the atmosphere	• Leachate from landfill sites



John, S., Buchanan, A. H., Keeling, C., & Love, S. (2013). Review of end-of-life options for structural timber buildings in New Zealand and Australiam http://hdl.handle.net/10092/10296
P.F.H. Harmsen et al. (2015) Literature Review of Physical and Chemical Pretreatment Processes for Lignocellulosic Biomass, https://www.ecn.nl/docs/library/report/2010/e10013.pdf



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Ongoing and future research:

- Do architects and engineers know how their project will be disassembled? And when?
- Strategies for disassembly related to the durability of treatments of each single component
- A comparative study on costs, treatments and design of elements

Thank you for your attention

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