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LCA supporting the design of circular biobased wall panels

LCM 2021

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Outline of the presentation

- Context
- Goal and scope of the LCA
- Results and discussion
- Conclusions

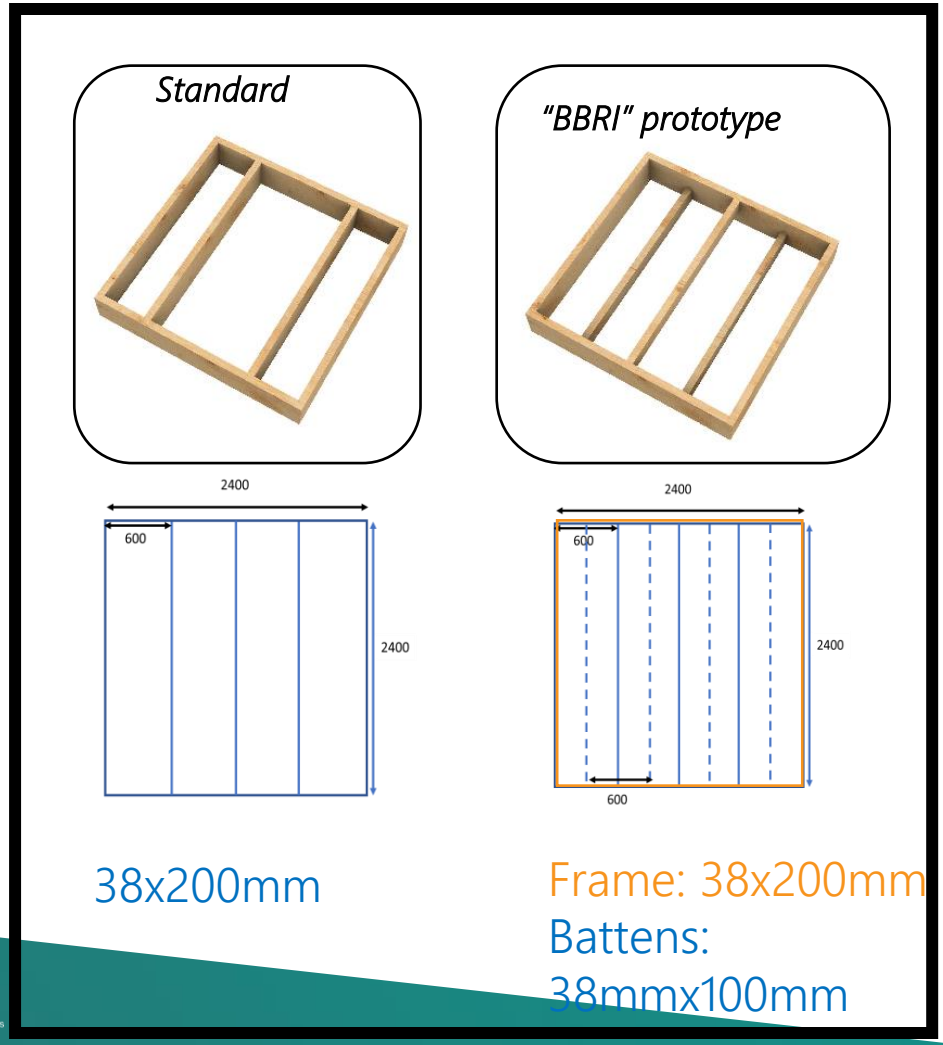
Context

- Circular Biobased Construction Industry
- Set up the bases for the circular bio-based construction to become an integral part of the construction market
- **Integral approach**
  - Business models
  - Framework and regulation
  - Technical aspects: develop and test protypes

This project has received funding from the European Union's Interreg 2 Seas 2014-2020 Programme under grant number 2S05-036 CBCI.
https://www.interreg2seas.eu/en/CBCI

Context

- Different prototypes (1st iteration)



38x200mm

Frame: 38x200mm
Battens:
38mmx100mm

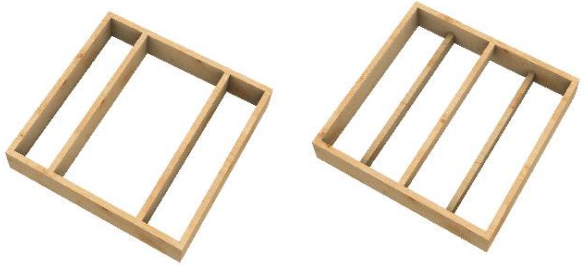
38x200mm

38mmx100mm

Goal and scope

Object of assessment

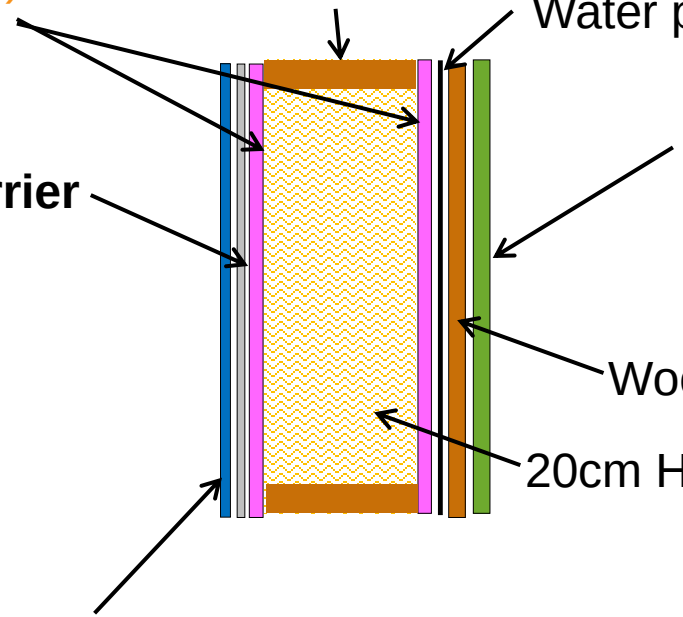
2,4m x2,4m modules (Standard/BBRI)



Wooden structural frame (standard/BBRI)

Panel (OSB/bonded straw panel)

Water proof membrane (HDPE)



Vapour barrier

Cladding (Impregnated larch (SL=20yr)/circular biobased composite (SL=40 yr) (waste reed, bio-polyester resin, CaCO3)

Wooden sub-structure (European Spruce/Siberian Larch)

20cm Hemp-cellulose **insulation**

Interior finishing panel (13 mm gypsumboard/ 22mm claypanel)

Goal and scope

Goal

1. How does the new (BBRI) module compare to the standard one?
2. Impact/added value of using specific Aluminium connectors (instead of screws to enable easy dismantling and reuse of the structure)
3. Hotspot analysis to identify further optimisation strategies

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Goal and scope

Methodology, data and assumptions

- SimaPro
- According to EN 15804+A2 methodology (allocation, LCIA,…)
- Normalisation and weighting: EF 3.0 (november 2019)

Product stage			Construction installation stage		Use stage							End of life stage					Beyond the system boundaries
Raw materials	Transport	Manufacturing	Transport	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Demolition	Transport	Waste processing	Disposal		Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4		D

Goal and scope

- Ecoinvent 3.7 (cut-off by classification) + product data provided by Ubath
- Reference study period: 60 years
- Transport and end-of-life scenarios representative of current Belgian situation

NBN/DTD B 08-001: 2017 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products - National supplement to NBN EN 15804+A1:2014

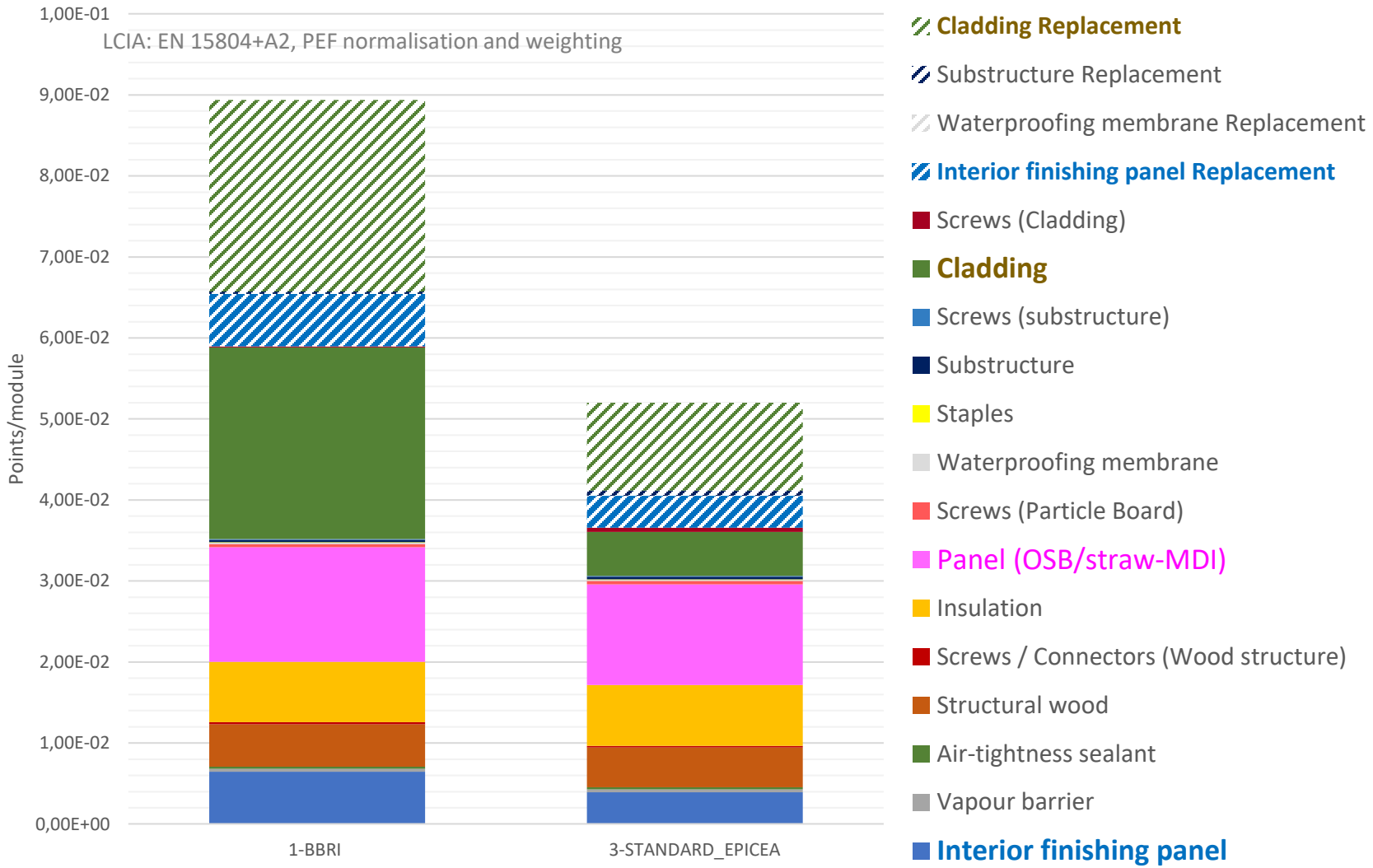
Goal and scope

	End-of-Life scenario				Service life
Components	recycling	reuse	landfill	incineration	years
wood untreated (structure)	75			25	
wood untreated fixed **with connectors**		100			
Clay panel	100				30
Gypsum board	20		80		30
hemp-cellulose insulation	5			95	
OSB/straw-MDI	5			95	
Biobased composite cladding	5			95	40
Impregnated softwood (cladding)				100	20
Metals	95		5		
Membranes (PE/PP)	5		10	85	

Note: Water membrane and wooden substructure for the cladding are replaced with the cladding

Results and discussion

Comparison with the standard panel



Total BBRI ≅1,6 standard

Claypanel=1,6 gypsum board

- More mass (2x density, 22mm vs 13mm)
- 3% (wt) of jute ≅ 50% impact

Straw-MDI=1,1 OSB

- Transport (by boat) from China=40% of c2g impact

Biobased composite cladding ≅ 3 spruce cladding (incl. replacements)

- High impact of (bio) polyester resin (30% by weight, 60% of c2g impact)

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Results

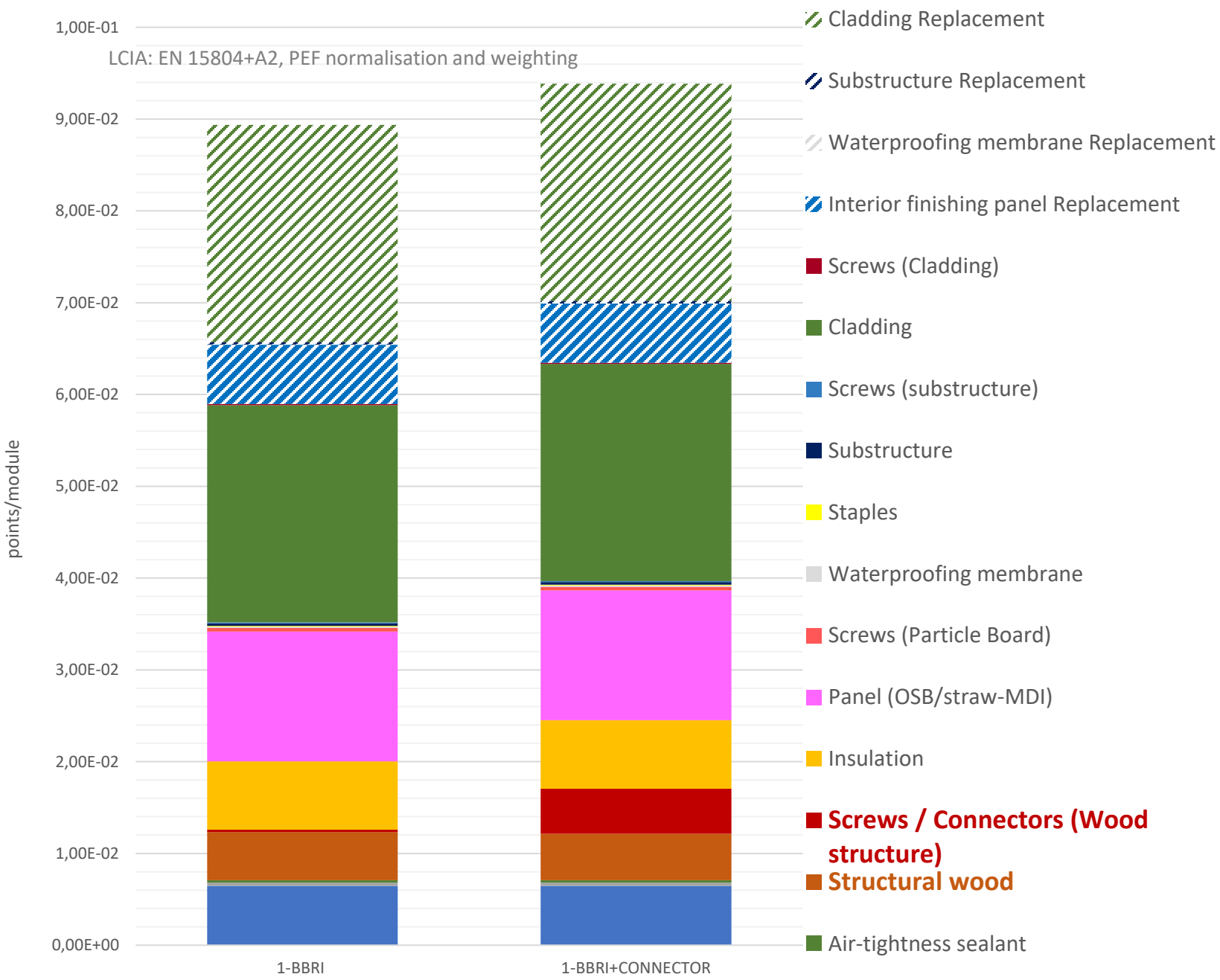
Connectors

Impact connectors

>> screws

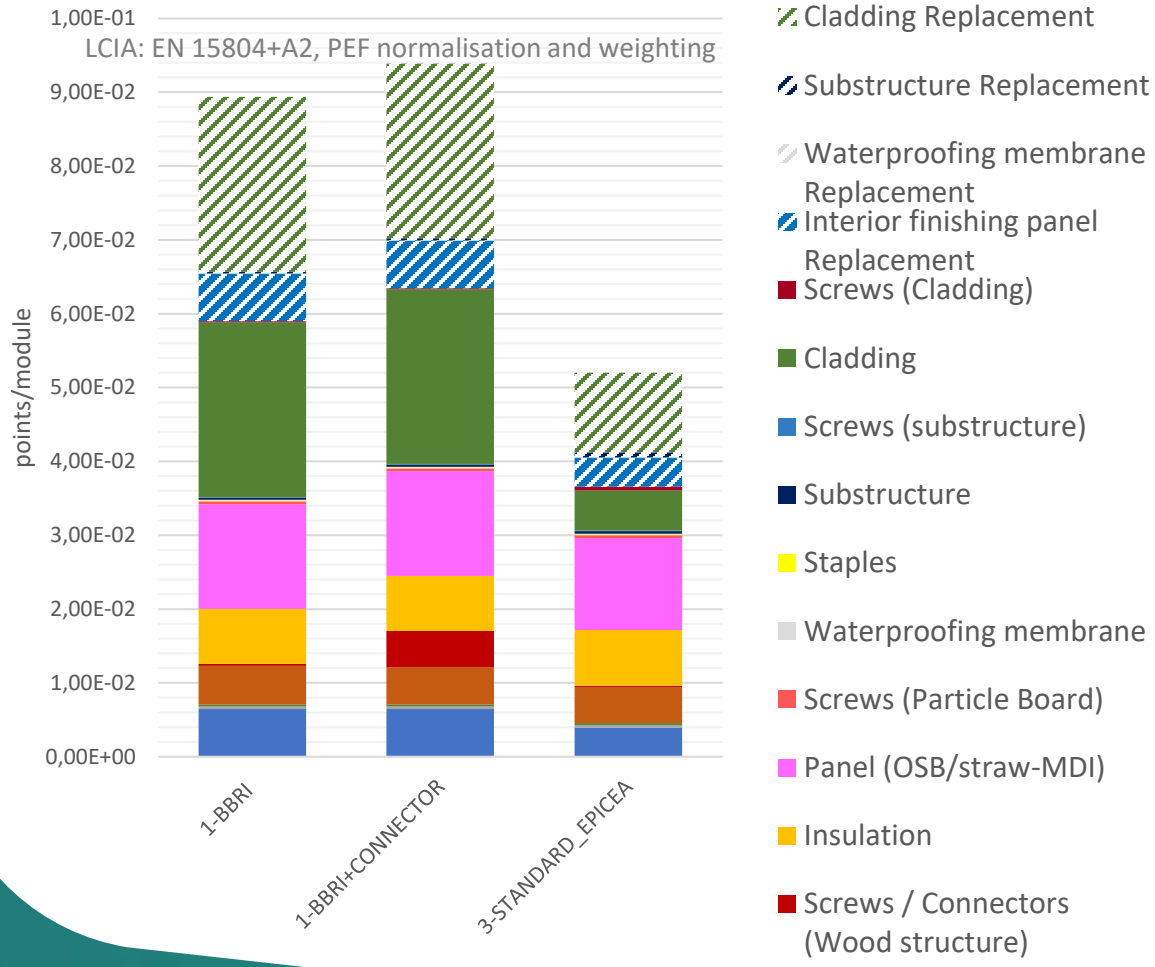
≅impact wooden structure

Structure needs to be reused at least once



Results and discussion

Hotspot – optimisation strategy



- Screws, stapels, sealant, membranes: insignificant impact
- Contribution of the structure is small compared to other materials (interior finishing, panels, cladding)
- Need to clearly define the **intended application** of the panel
  a) 60 years in place
  b) Temporary application (e.g. panel is moved every 5 years)

→Composite biobased cladding + connectors are interesting in temporary applications

→b) should focus on dissasembly of the entire module

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Conclusions

- Circular - biobased solutions do not systematically lead to a lower environmental impact

⇒Important to include LCA in the design/optimisation process

- Clearly define the intended use of the circular design

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