Life Cycle in Timber Facade Systems – Robust Design Patterns

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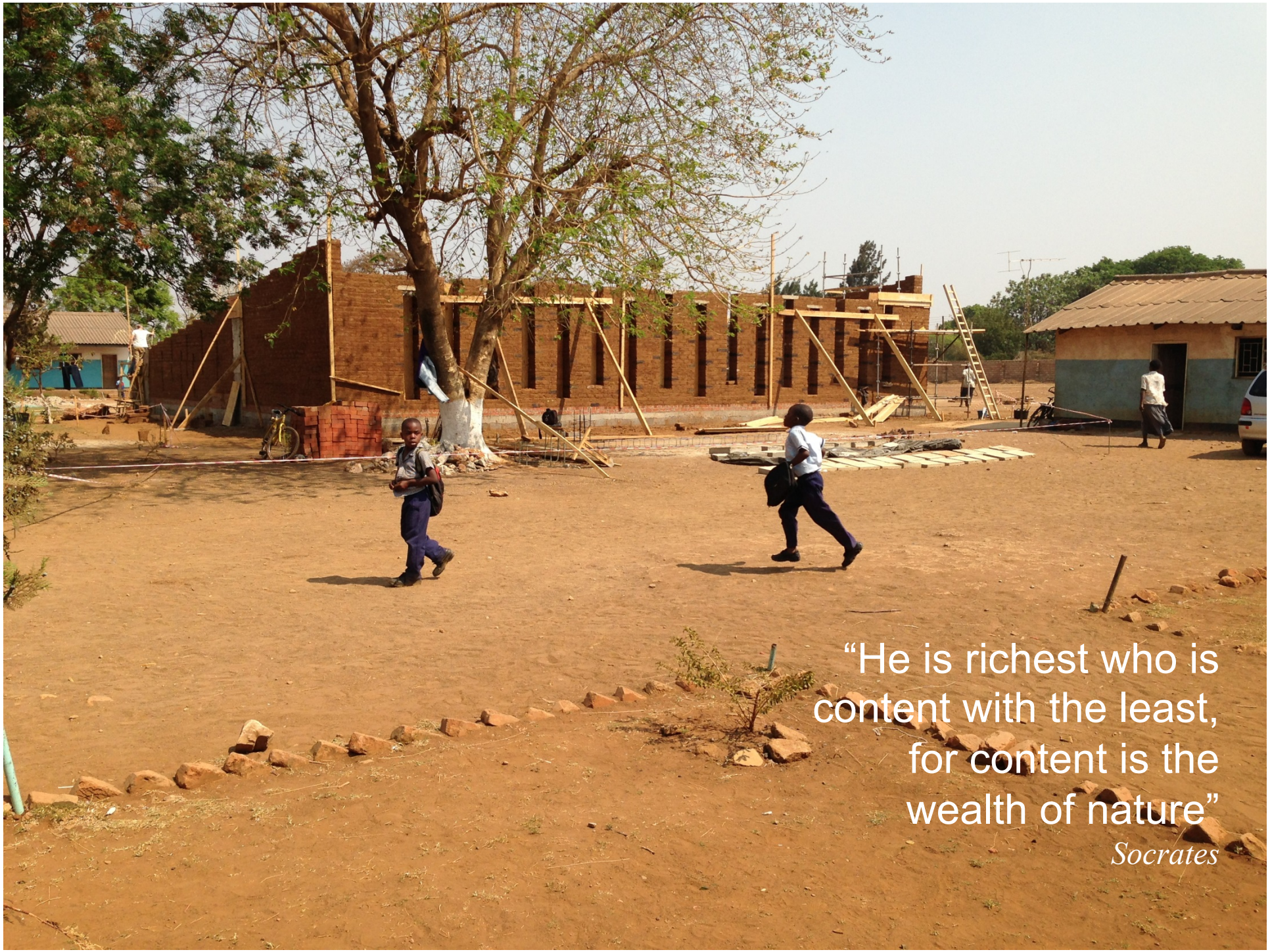
“He is richest who is
content with the least,
for content is the
wealth of nature”
Socrates

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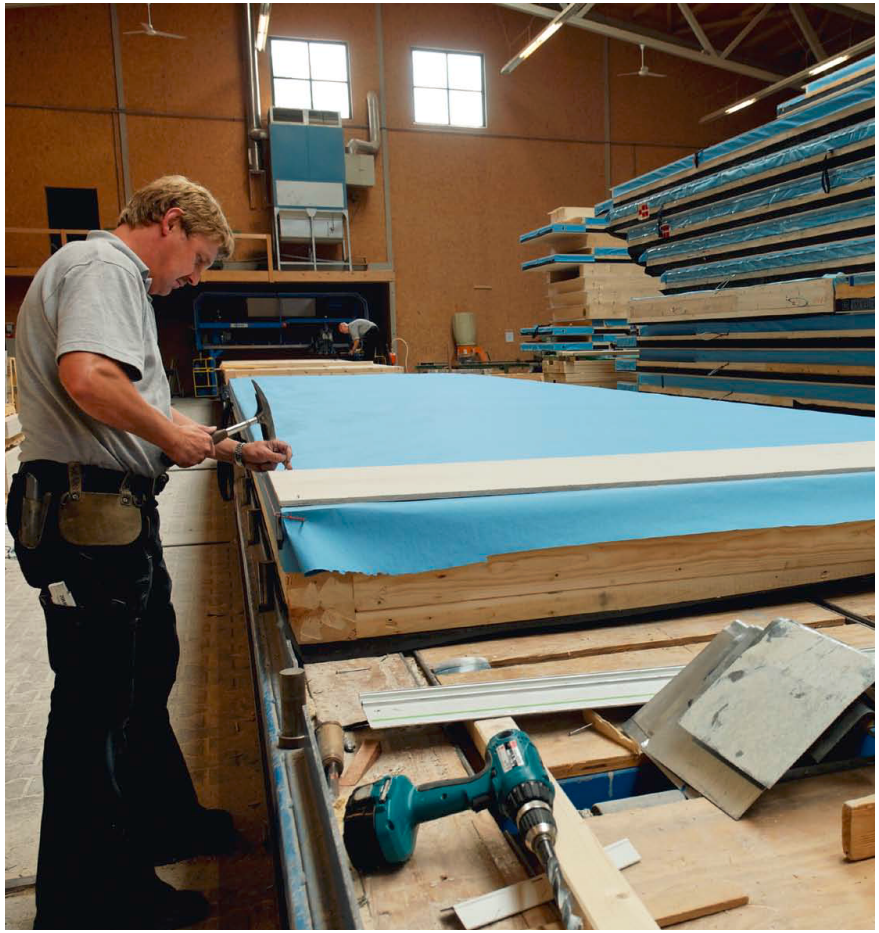
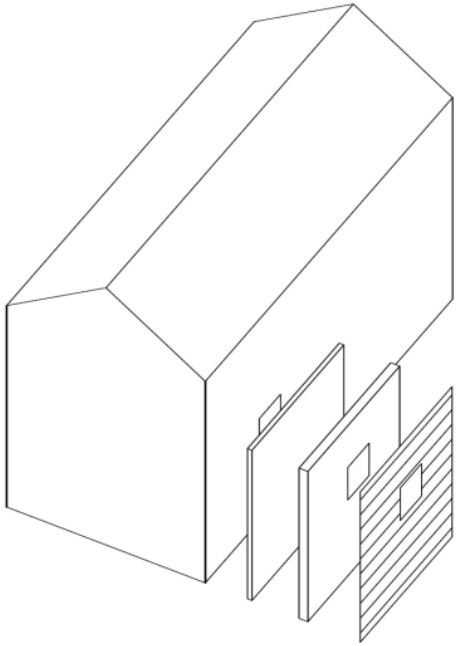
1. Prefabricated Timberbased Element System

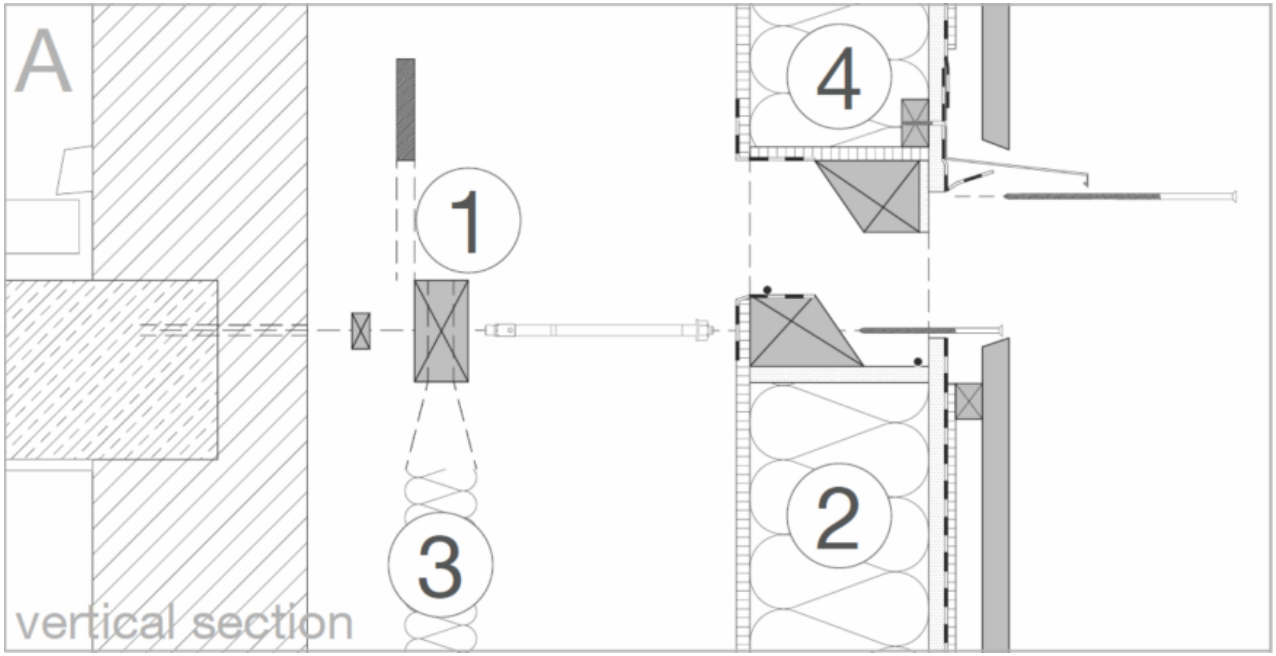
TES EnergyFacade process



1. Prefabricated Timberbased Element System

Construction components of a TES EnergyFacade



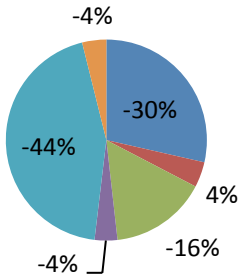


1. Coupling beam
2. 1st element (top edge joint)
3. Adaption layer with insulation
4. 2nd element (low edge joint)

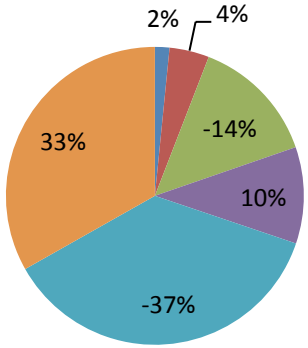
2. Life cycle assessment objectives

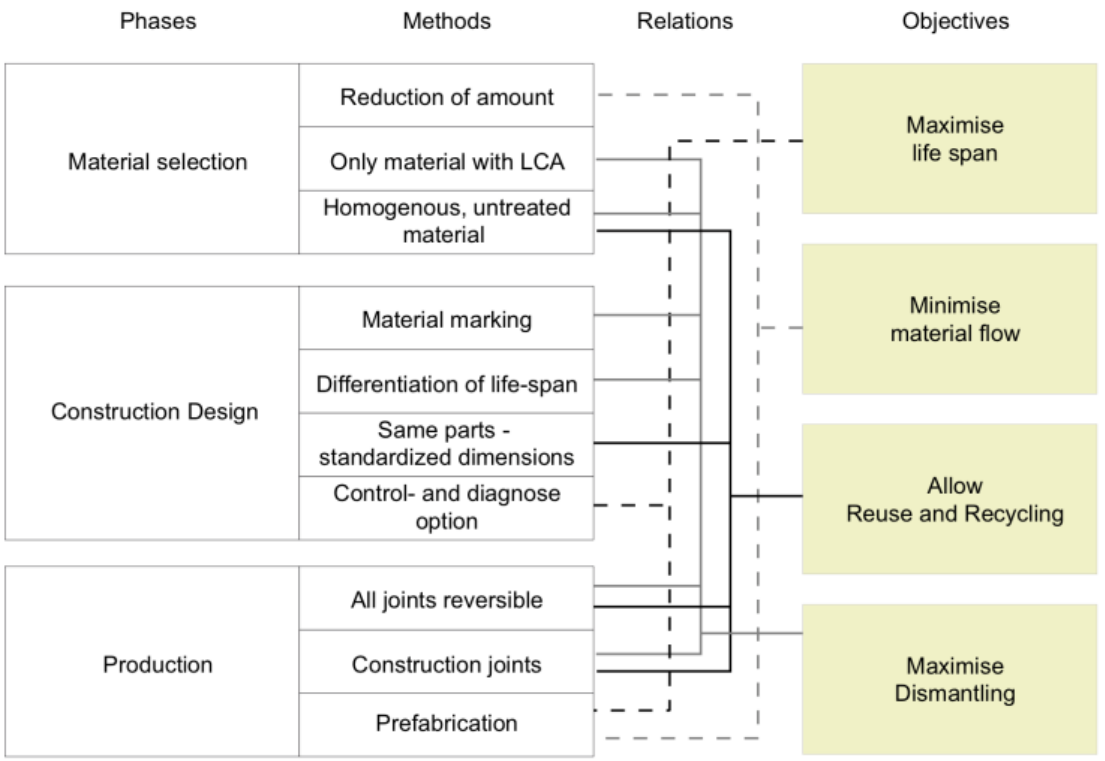
Benchmarking & Product development

GWP [kgCO2eq/m²] of element type C (total GWP -63,5]



GWP [kgCO2eq/m²] of element type D (total GWP -0.43)





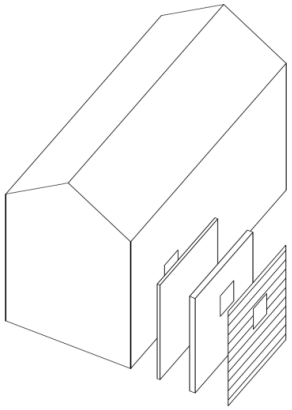
according to König et al.: Life Cycle Analysis of Buildings, München 2009.

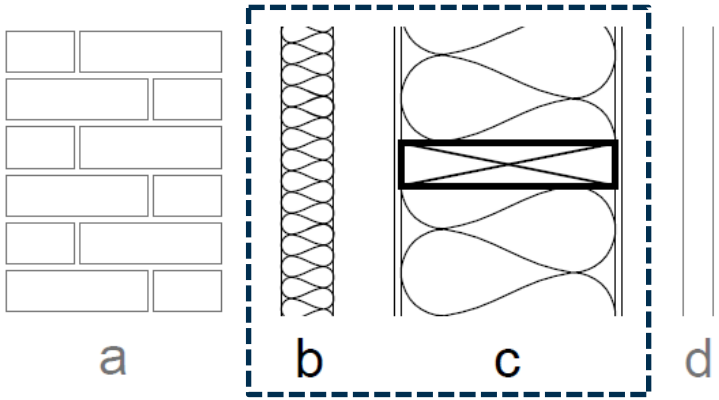
Decision and reasoning
Product information

Industrial ecology
Product optimisation

3. Methodology

Generic system description





Functional unit:

One square meter of facade without cladding

System border:

Cradle to gate, A1-A3 (EN 15804);

A4-A5 & C1 is forthcoming

Allocation method:

a) Raw materials: acc. to database

b) Manufacturing: physical mass allocation

Impact indicators:

a) Inventory = Primary energy non- and renewable

b) Impact = Global warming potential (GWP_{100})

Data and source:

Ökobaudat 2010

Data quality and validation:

a) Raw materials: publicly available database

b) Manufacturing: documentation of planning and production, bill of materials, etc.

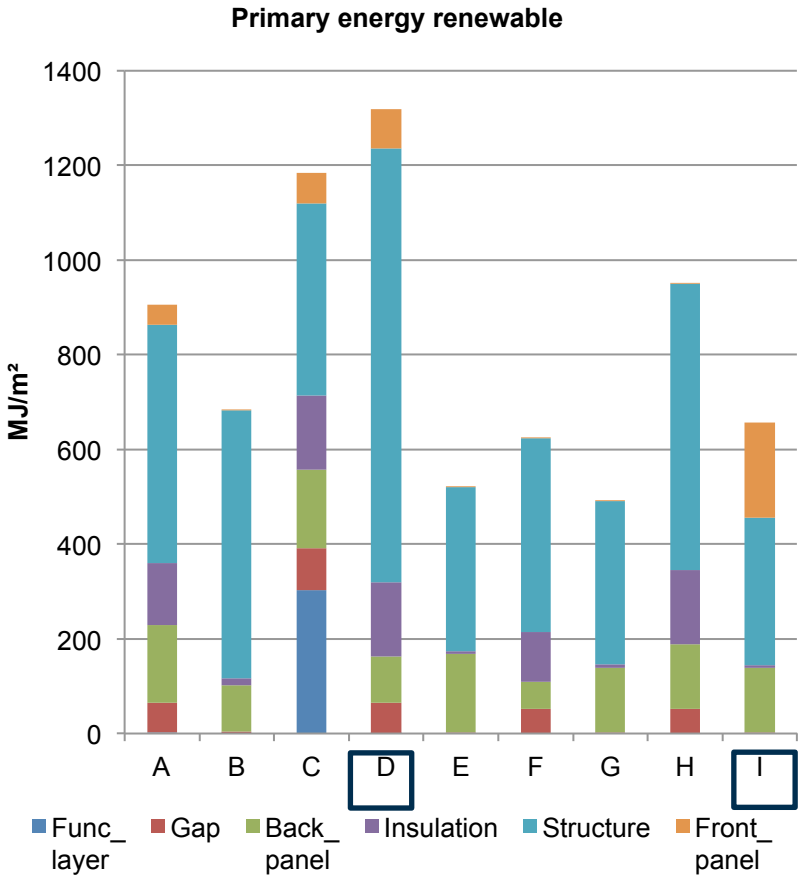
3. Methodology

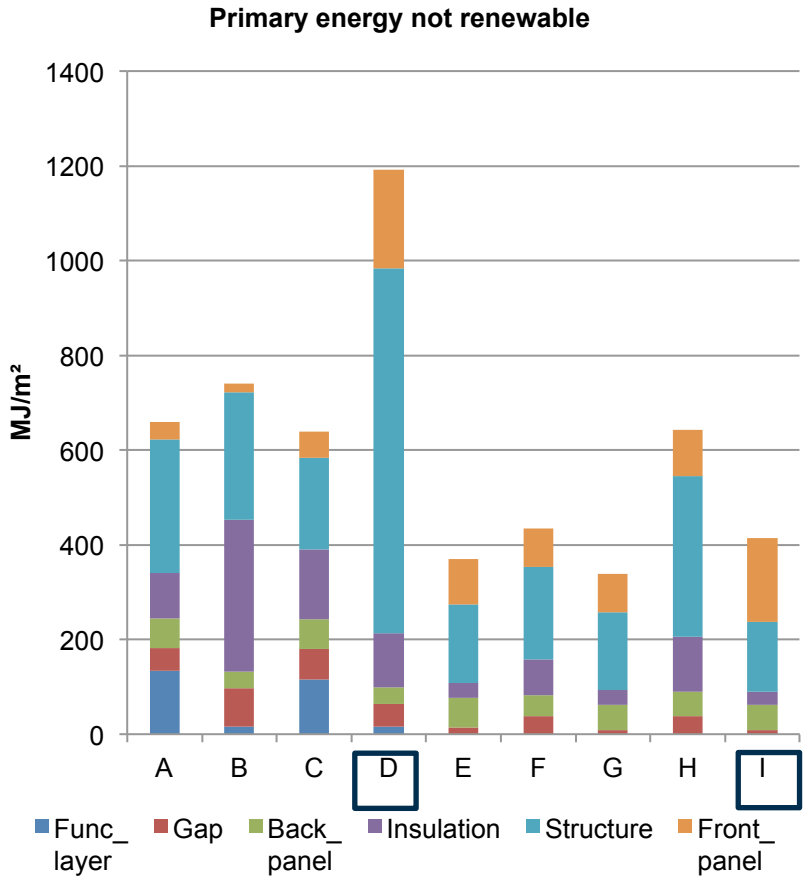
Environmental system description = „high level“ EPD

Functions		Possible implementation (options)	Additional functions in building classes 4 + 5	Possible implementation in building classes 4 + 5
Adaption layer	**Insulation of adaption layer**	loose fill insulation	**with combustible insulation: fire stops around window**	mineral wool strip
Heat protection (core element)	**inner panelling (air tightening)**	wood product panel and fasteners	**only elements with enclosing function: inner panelling non-combustible (encapsulation)**	non-combustible building boards (e.g. gypsum fibre board)
Hygro-thermal protection	**Waterproof layer**	…	…	
Load transfer	**Element struture**	…		
Sealing	**Sealing horizontal joint**			

4. Results of 9 cases

Inventory – Primary Energy (input side)





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Impact Analysis – Global Warming potential (output / emission side)

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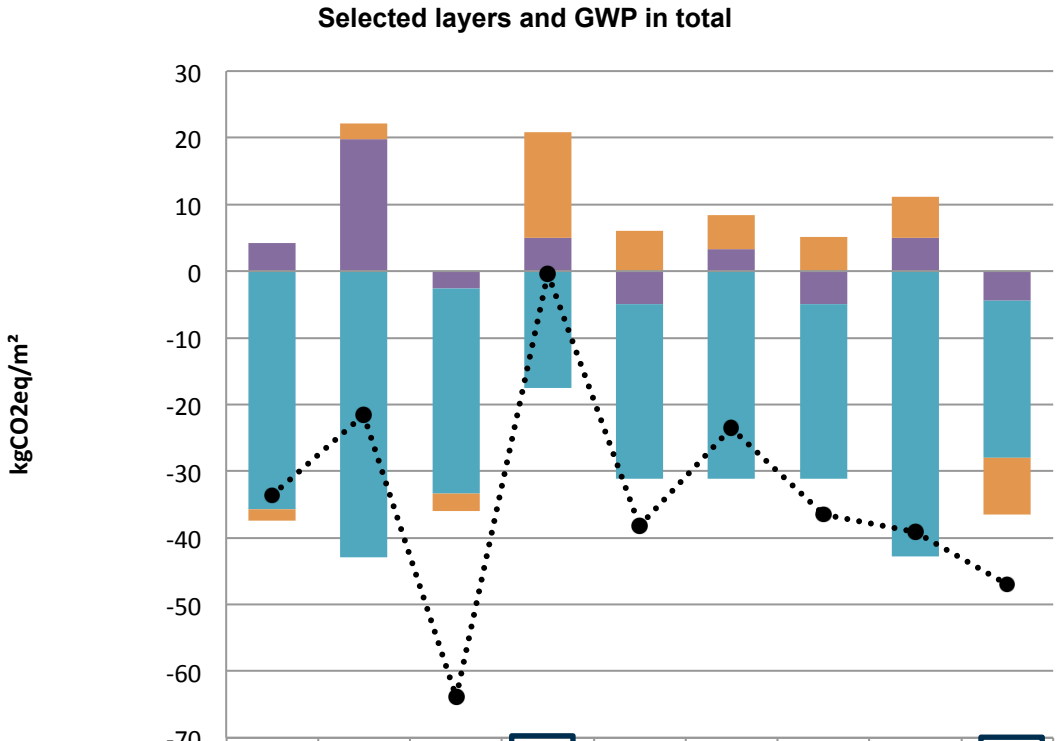
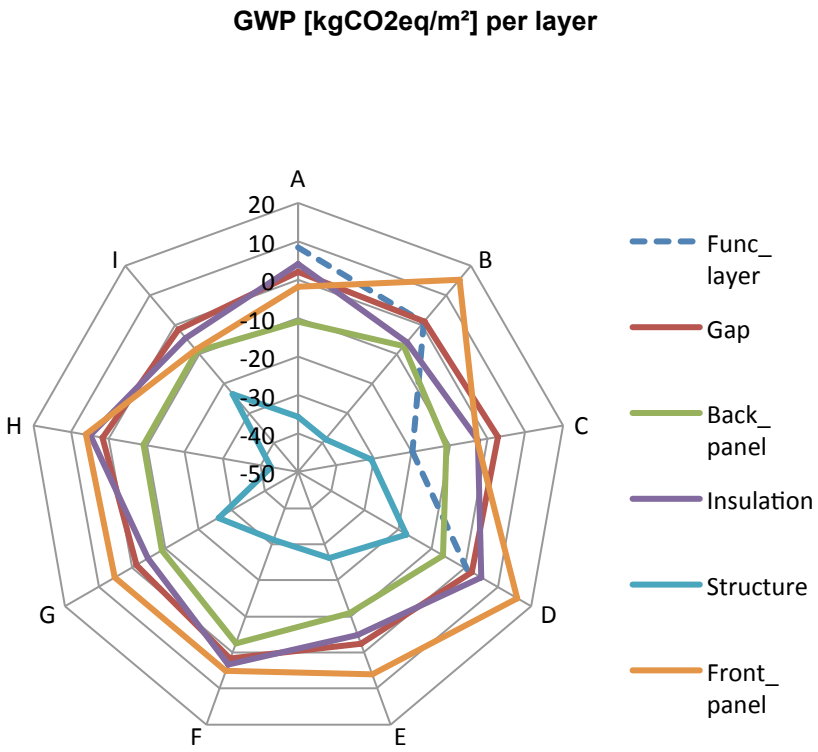
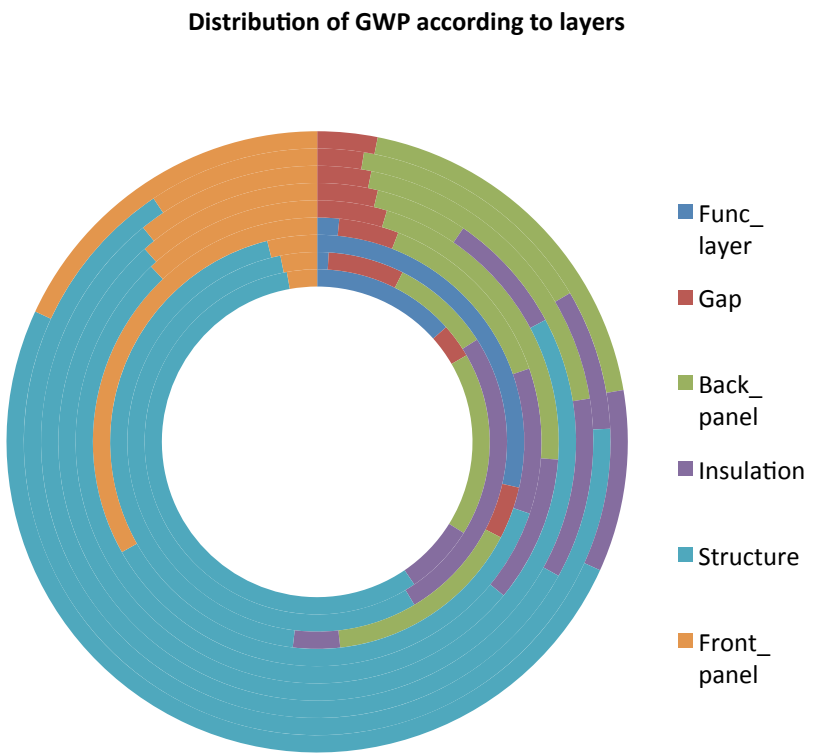


	A	B	C	D	E	F	G	H	I
Front_ panel	-1,77375	2,4057	-2,7	15,85	6,084	5,07	5,07	6,084	-8,514
Structure	-35,6725	-42,945	-30,7724	-17,499	-26,176	-31,084	-26,176	-42,807	-23,5584
Insulation	4,1715	19,75098	2,55004	5,0058	-4,93668	3,3372	-4,93668	5,0058	-4,44301
GWP_sum	-33,6419	-21,6323	-63,8856	-0,43051	-38,2154	-23,5488	-36,5419	-39,0992	-47,0146

4. Summary

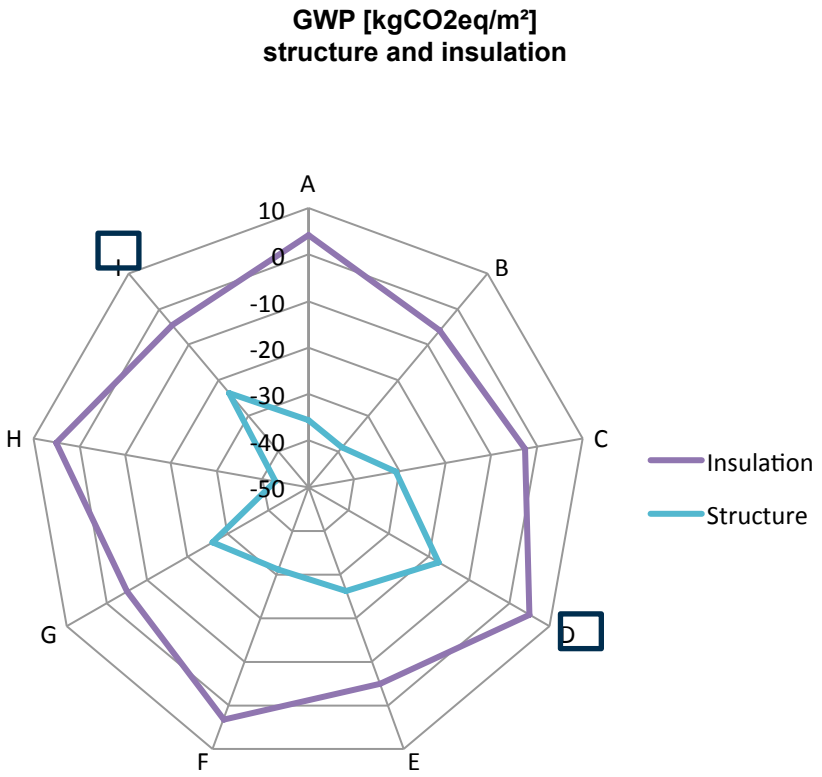
Sensitivity of components

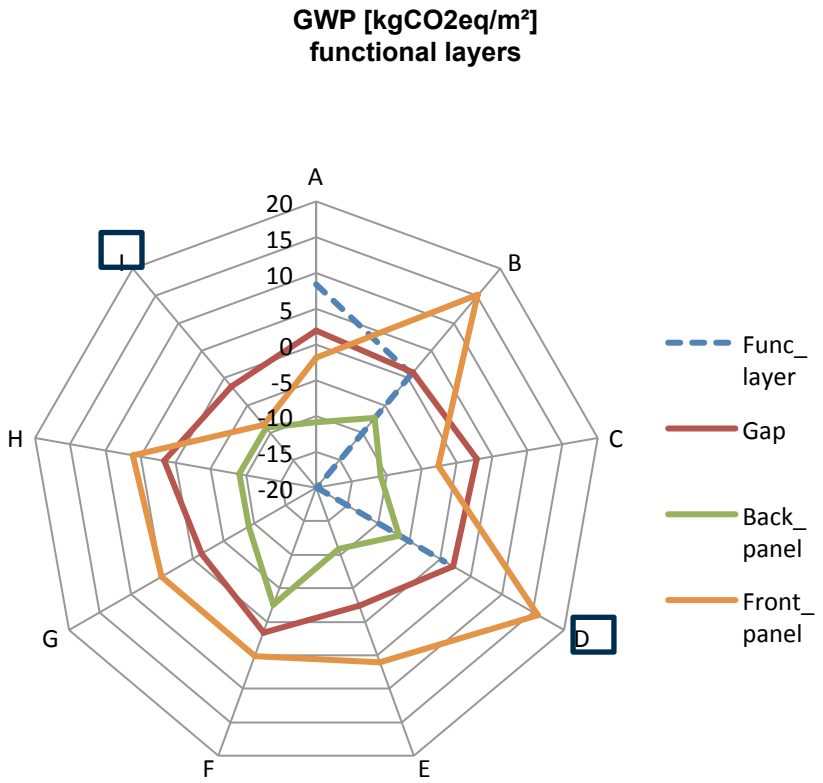




4. Summary

Sensitivity of parts and materials





5. Conclusions

- Same generic system but high deviations in environmental impact of different cases
- Dominant parts are timber framework and heat insulation
- Low environmental impact due to the high amount of material from renewable sources
- Composition needs sensitive selection of materials
- High material consumption requires structural design optimisation
- Further detailed examination on the influence of minor parts is necessary (anchoring screws, staples, sealing tapes, and so on)
- End-of-Life is important when material consumption is high
- Make the best use of material in reuse and recycling
- Robustness can be reached with proper construction design and material selection

Thank you for your attention

Questions?

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