Decarbonization and Circularity Potential of Prefab Building Envelope Components

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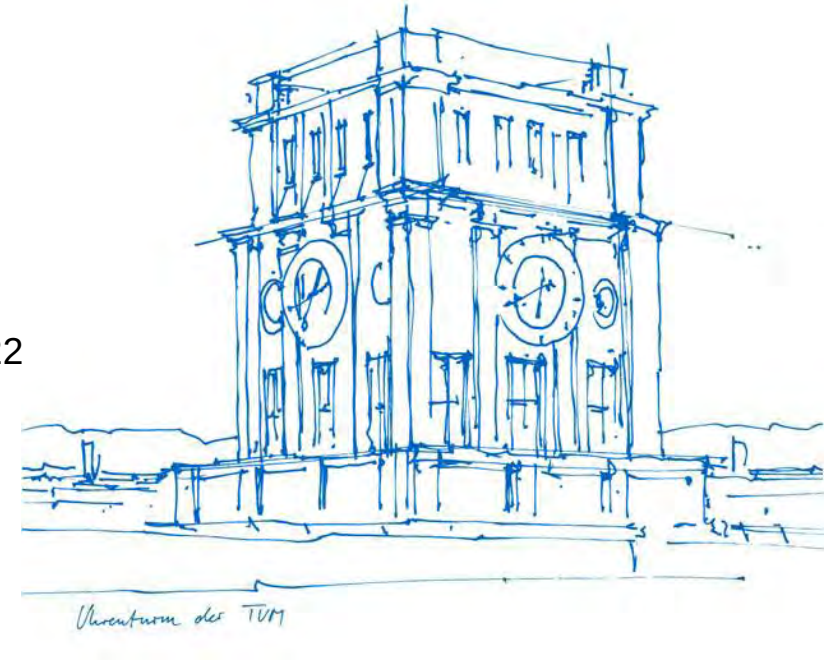
WOODRISE 2022, Portorož, SLO, 06.-09. September 2022



Content

- Serialized Deep Renovation (DR): Yesterday – Today – Tomorrow
- Retrofitting Low-Performing Building Envelopes
- Carbon Footprint of Serialized Deep Renovation Components
- Circularity of Prefab Solutions
- Reflection of Results
- Future Tasks

WOODRISE 2022

RENOVATION, RESTORATION & REHABILITATION
OF URBAN BUILDINGS USING WOOD BASED TECHNOLOGIES

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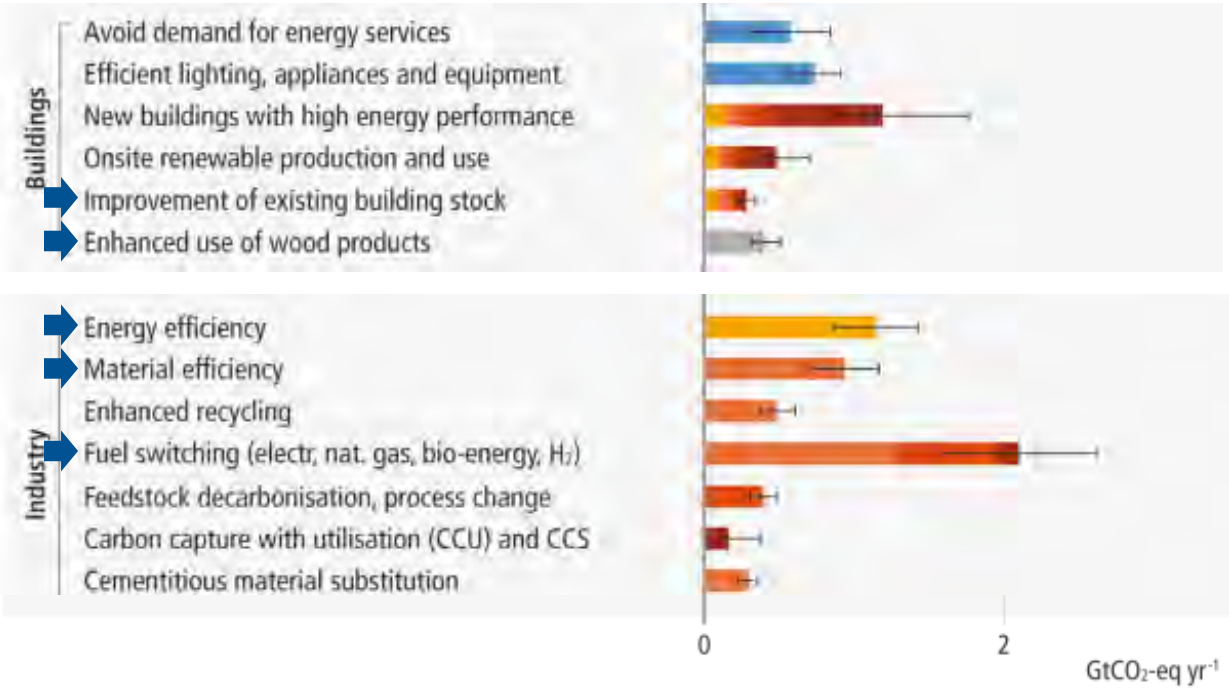
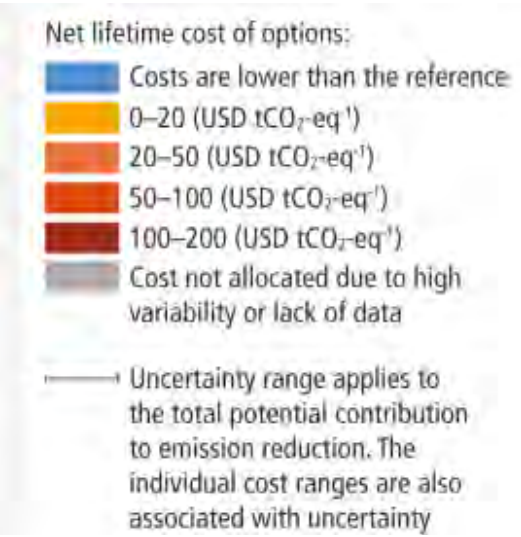
Serialized Deep Renovation Yesterday – Today – Tomorrow





IPCC 6th Assessment Report CC 2022. Mitigation of CC. WGIII TS

Retrofit Building Envelopes

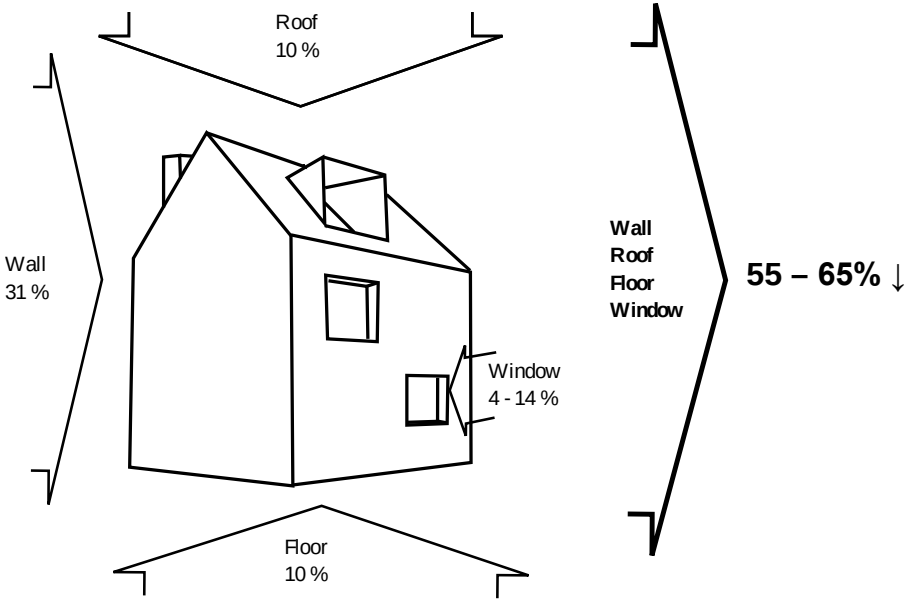
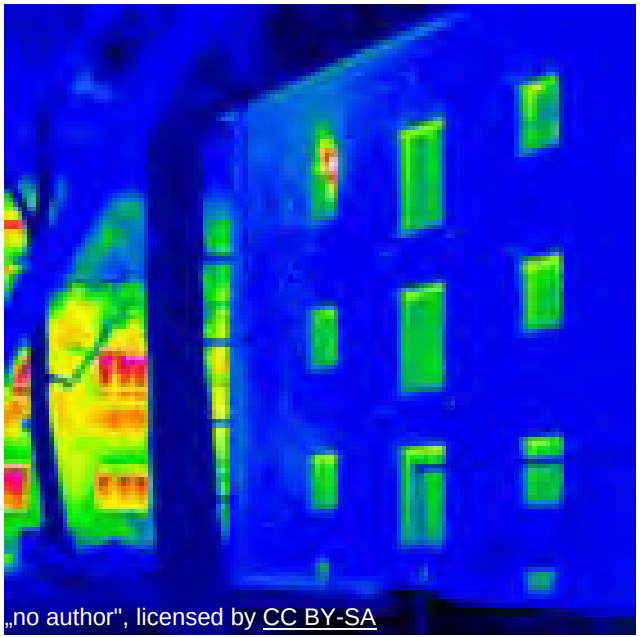
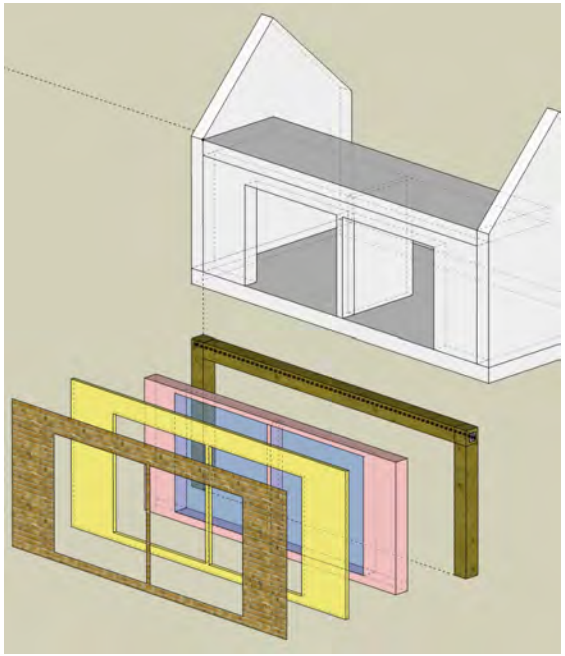
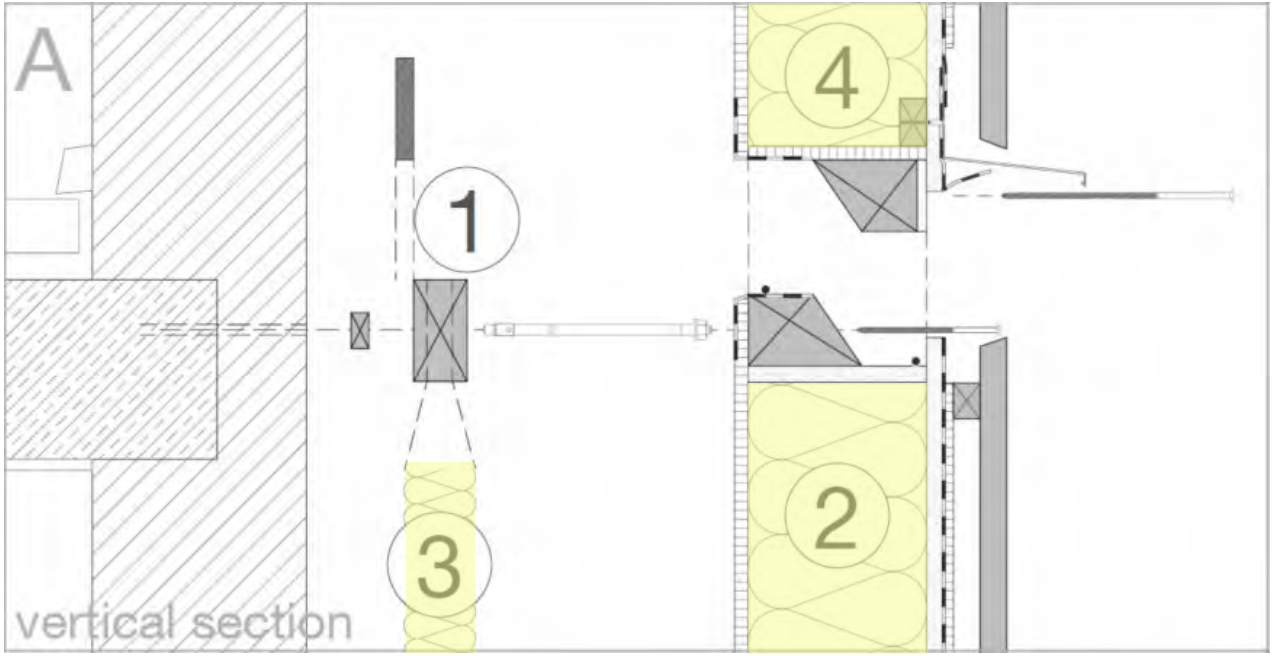


Figure according reference Hegger et al. (2010)



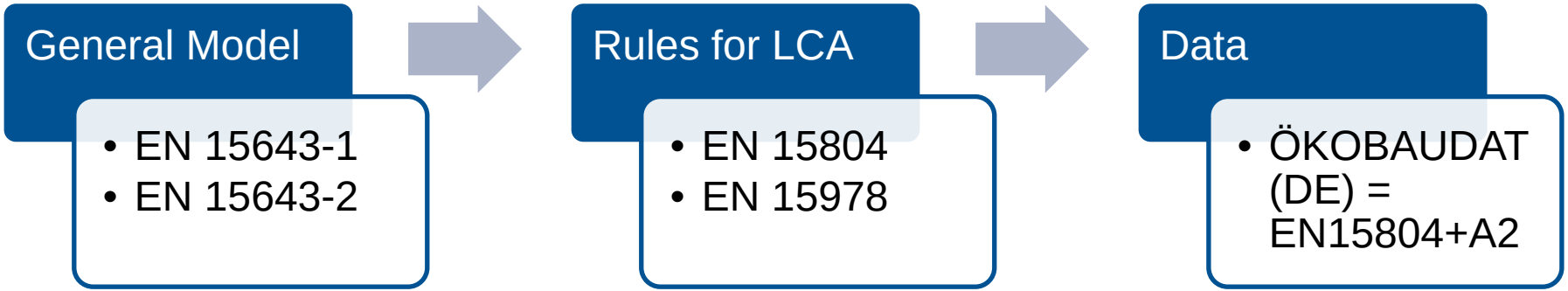
Retrofitting Low-Performing Building Envelopes





Carbon Footprint of Serialized DR Components I

Method

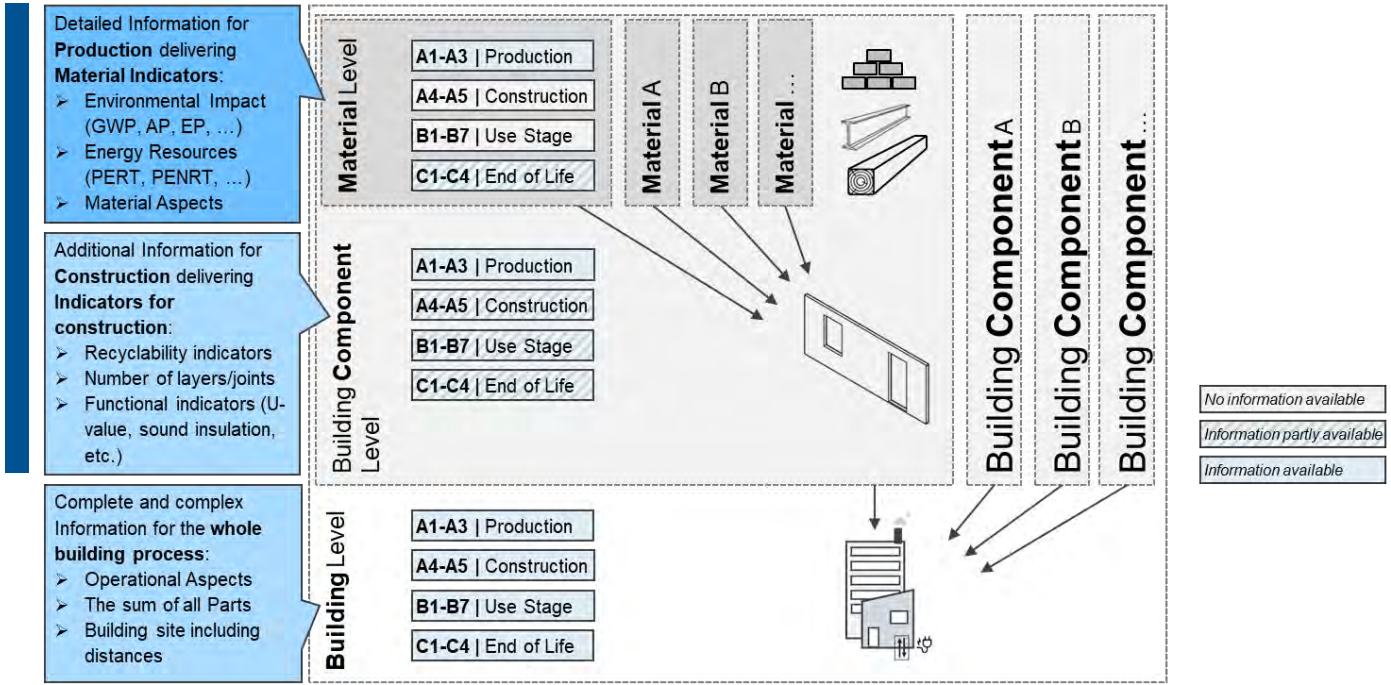


Geometry + Materials gathered according to Exoskeleton Steel or PT-CLT

Functional Unit = 2 single student apartments (about 36 m² of net floor area) plus about 12 m² extension net floor area (3D-exo only)

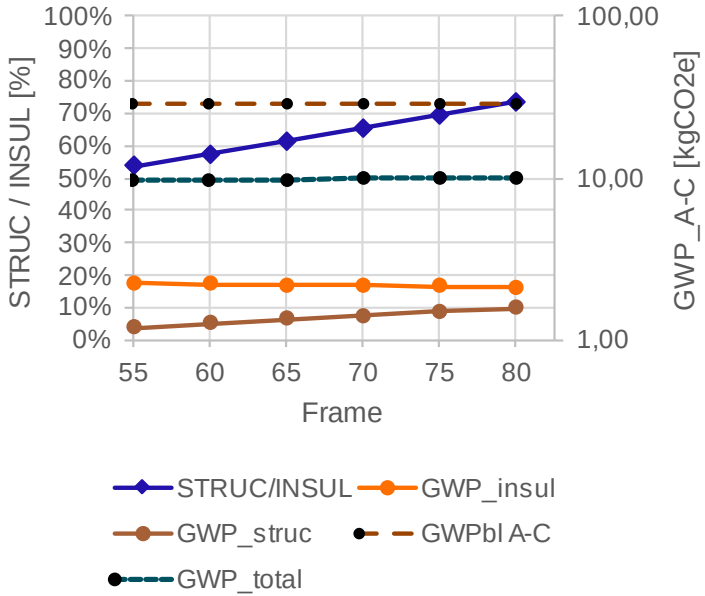
Carbon Footprint of Deep Renovation Components II

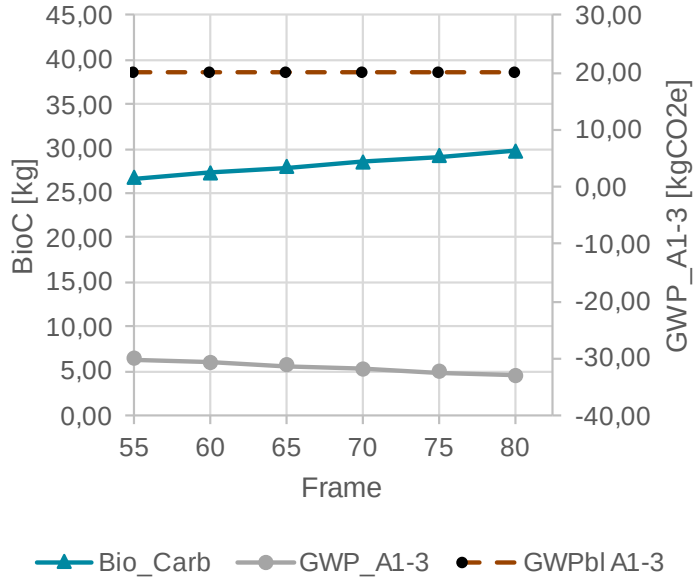
LCA EN 15643-1 & EN 15978 C2G+opt

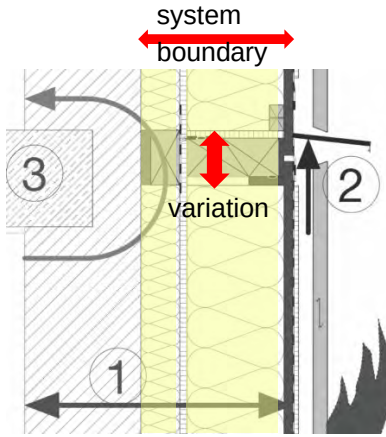


Carbon Footprint of Deep Renovation Components

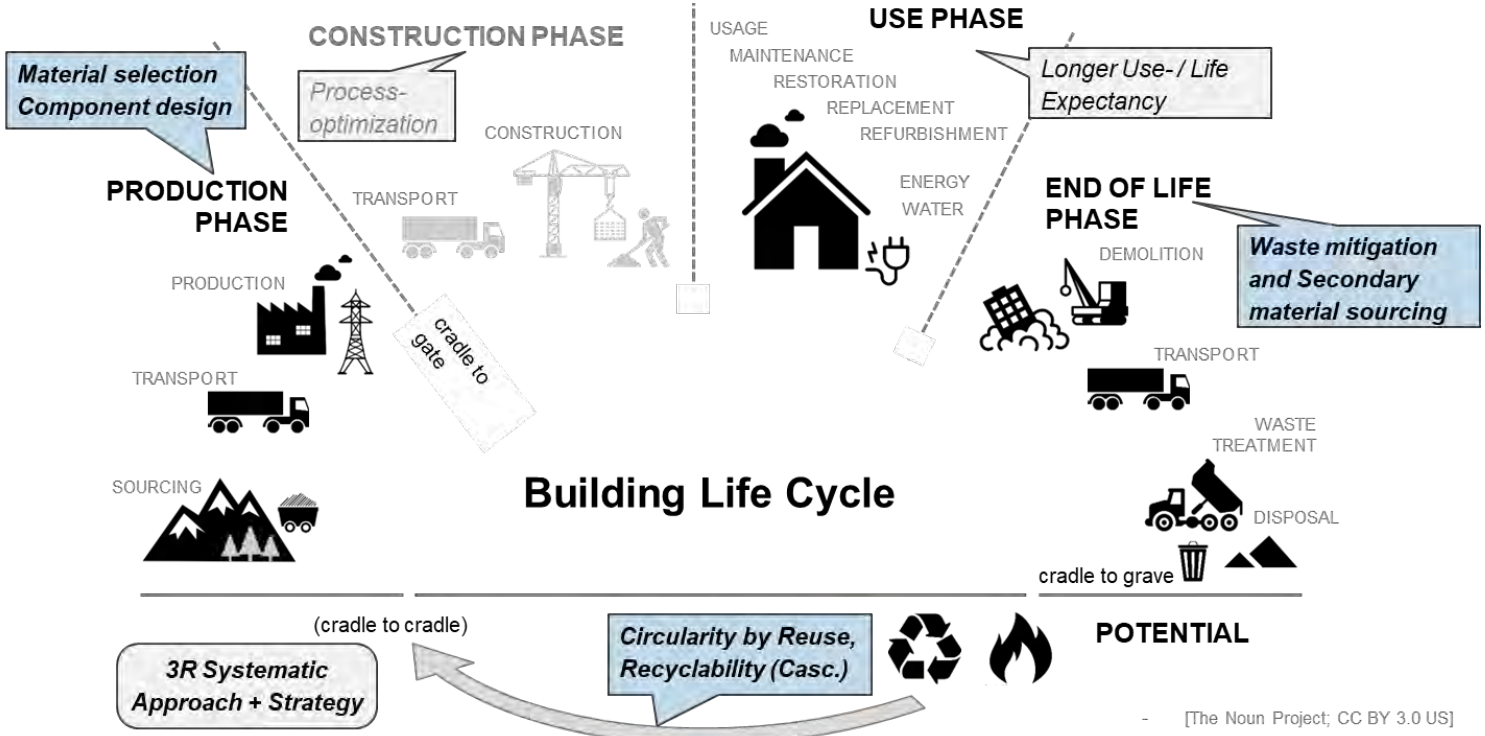
GWP results baseline scenario and sensitivity analysis –
variation frame-insulation ratio in 1 m² facade system (functional equivalent)







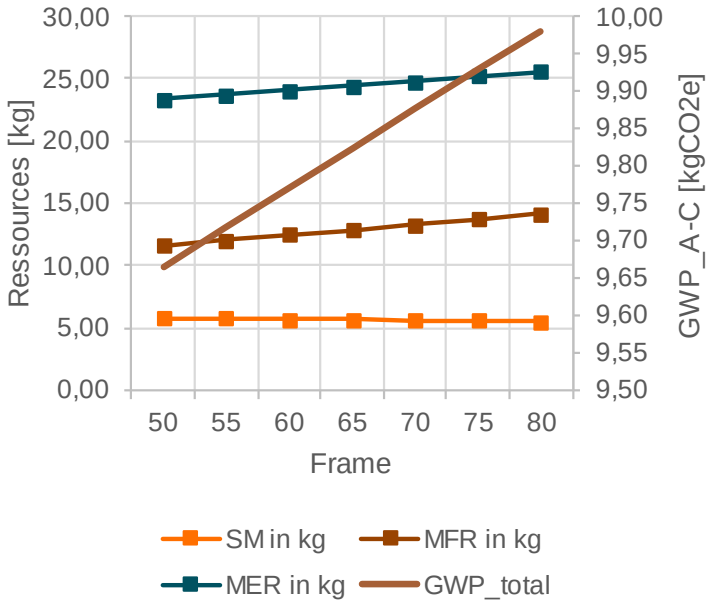
Circularity of Prefab Solutions

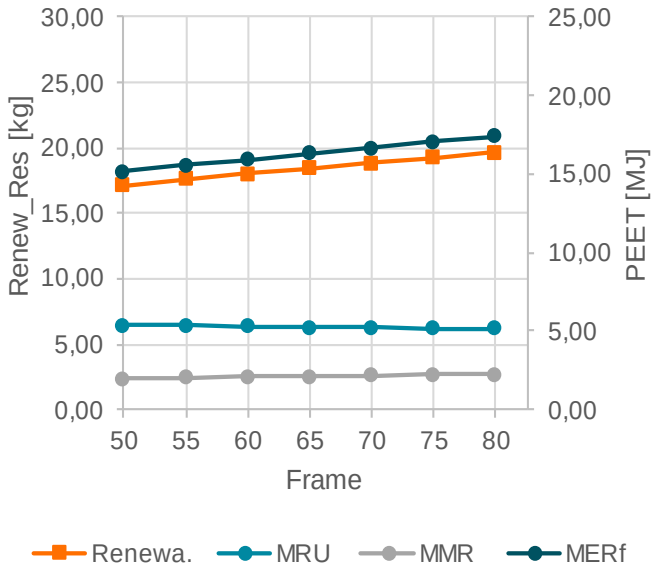


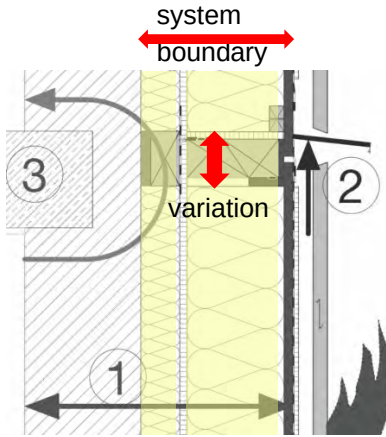
- [The Noun Project; CC BY 3.0 US]

Circularity of Prefab Solutions

Results

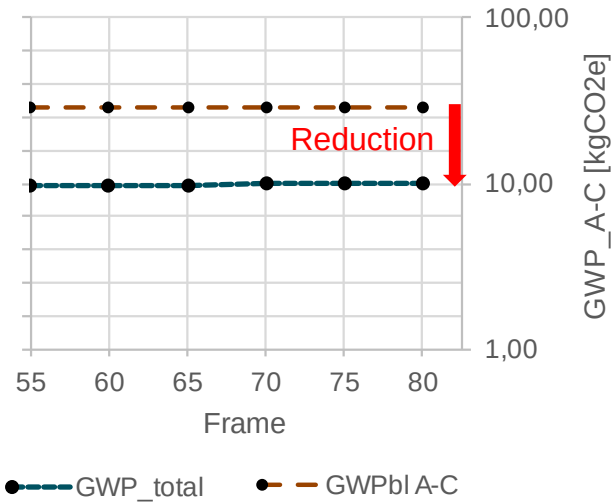






Reflection of Results

Substitution potential



- Technical feasible
- Remarkable impact on GHG-emissions
- Substitution potential:

$$SP_{Component} = \frac{GWP\ 2 - GWP\ 1}{GWP\ 2}$$

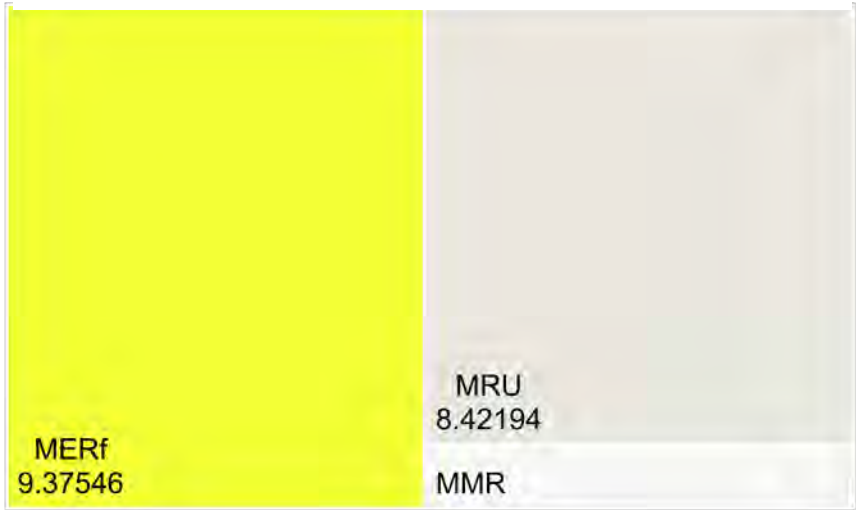
S = 50-10/50 [kg/CO_2e] x 100% = 80 %

Reflection of Results

Changing Connectors

1	MRU	Materials for Re-Use
2	MSM	Material for Secondary Material use (recycling)
3	MMR	Material for Material Recycling (downcycling)
4	MMRf	Material for Material Recovery
5	MERf	Material for Energy Recovery
6	MWD	Material for Waste Disposal (landfill / thermal disp.)

Scenario 1 uses staples



Main Conclusion

Ecologic transformation for a product can make a difference!

80% GHG-emissions related to renovation avoided per year

- given low renovation rate of: 1% per year *
- only housing: 3.800.000.000 m² x 1 % = 38.000.000 m² renovated and heated floor space *
- estimation of 70.000 m² of low-performing building envelopes renovated per year
- **traditional GHG-emitting insulation systems:** release **3.5 million** kg/CO_2ea, LC-phases A-C
- **innovative Low-carbon serialized renovation systems:** only **0.7 million** kg/CO_2ea, LC-phases A-C.

Conclusions

it makes a huge difference, if:

- a product type is transformed with special attention to environmental performance,
- reduction of MERf or total absence of waste at EoL is achieved,
- circularity aspects of material choice and connectors get special attention,
- in production phase secondary material is considered,
- not all wood is burnt at EoL – this scenario is too simplistic and wrong,
- reuse and cascading of wood products is enhanced by material and component design.

Future Tasks

There are still things to improve, therefore we will not stop:

- develop innovative options of material choice and connectors,
- analyse and develop production + fabrication,
- conceptualize and experiment automation and digitalization in logistics + assembly,
- for lower carbon footprint and increased circularity.

ProGETonE

Proactive synergy of inte**G**rated **E**fficient **T**echnologies **on** buildings' **E**nvelopes

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The communication reflects only the author's view and the Research Executive Agency for SMEs is not responsible for any use that may be made of the information it contains.

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