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Towards a model for circular renovation of the existing building stock: a preliminary study on the potential for CO_2 reduction of bio-based insulation materials

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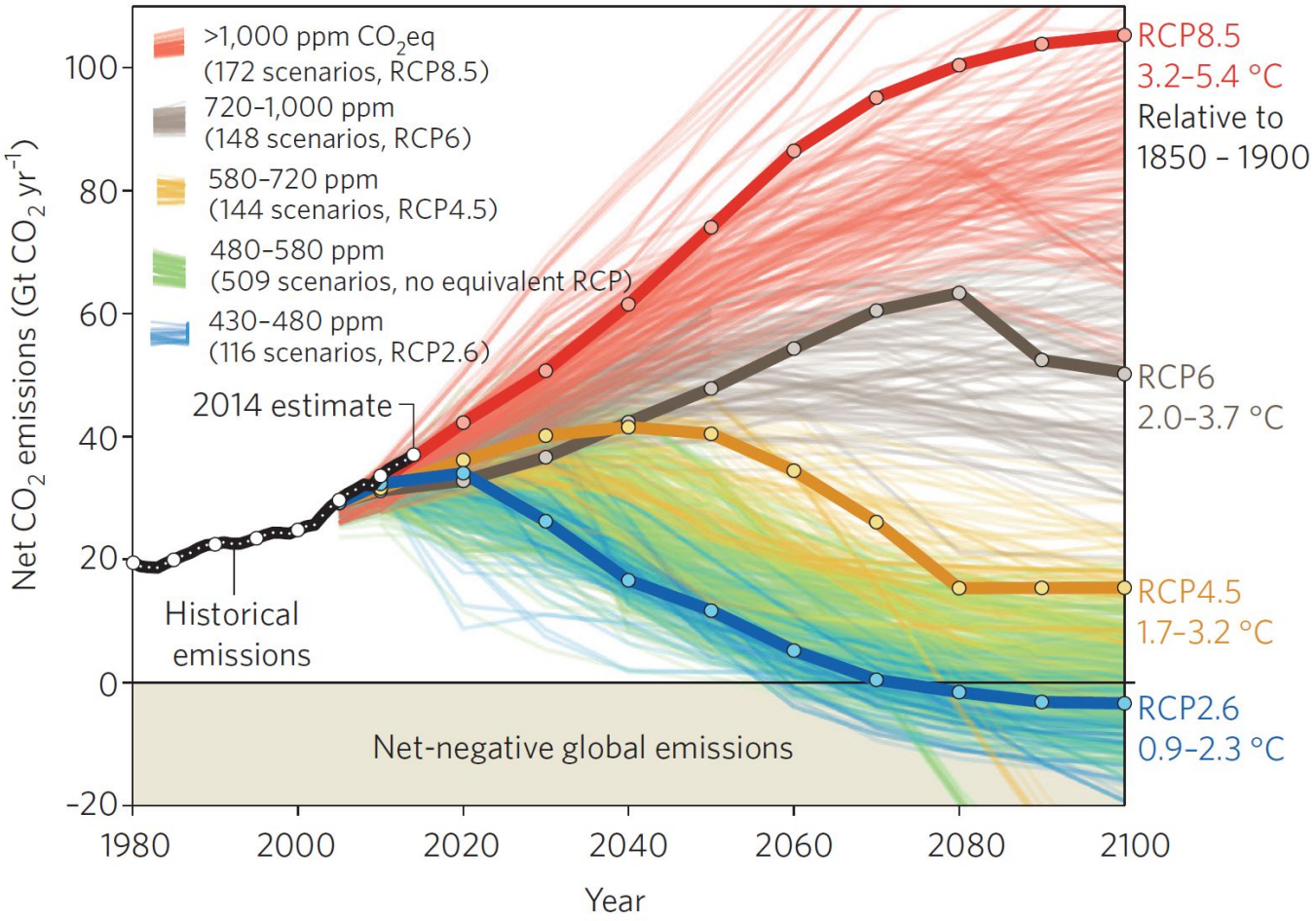
Global fossil carbon emisisons

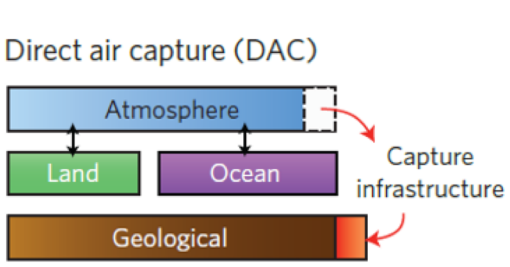


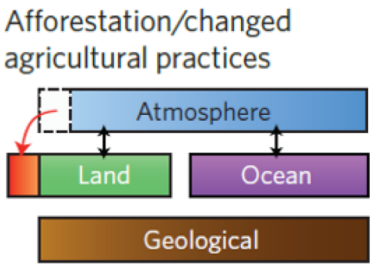
Reduction of fossil emissions is not sufficient to achieve 2050 targets

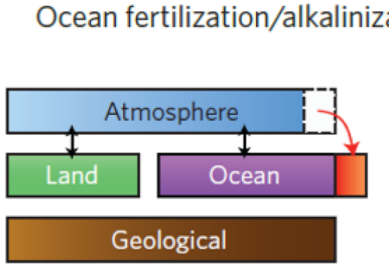
Negative carbon technologies for CO_2 removal are urgently needed!

Source: IPCC Special Report on Global Warming of 1.5°C (2018)

2nd step: promote carbon removal technologies



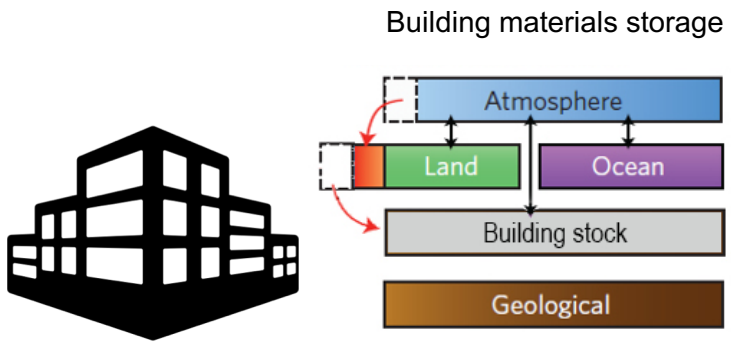




CRITICAL ISSUES:

- Technologies are not ready
- Costs way too high (at the moment)
- Space limited (afforestation related issue)

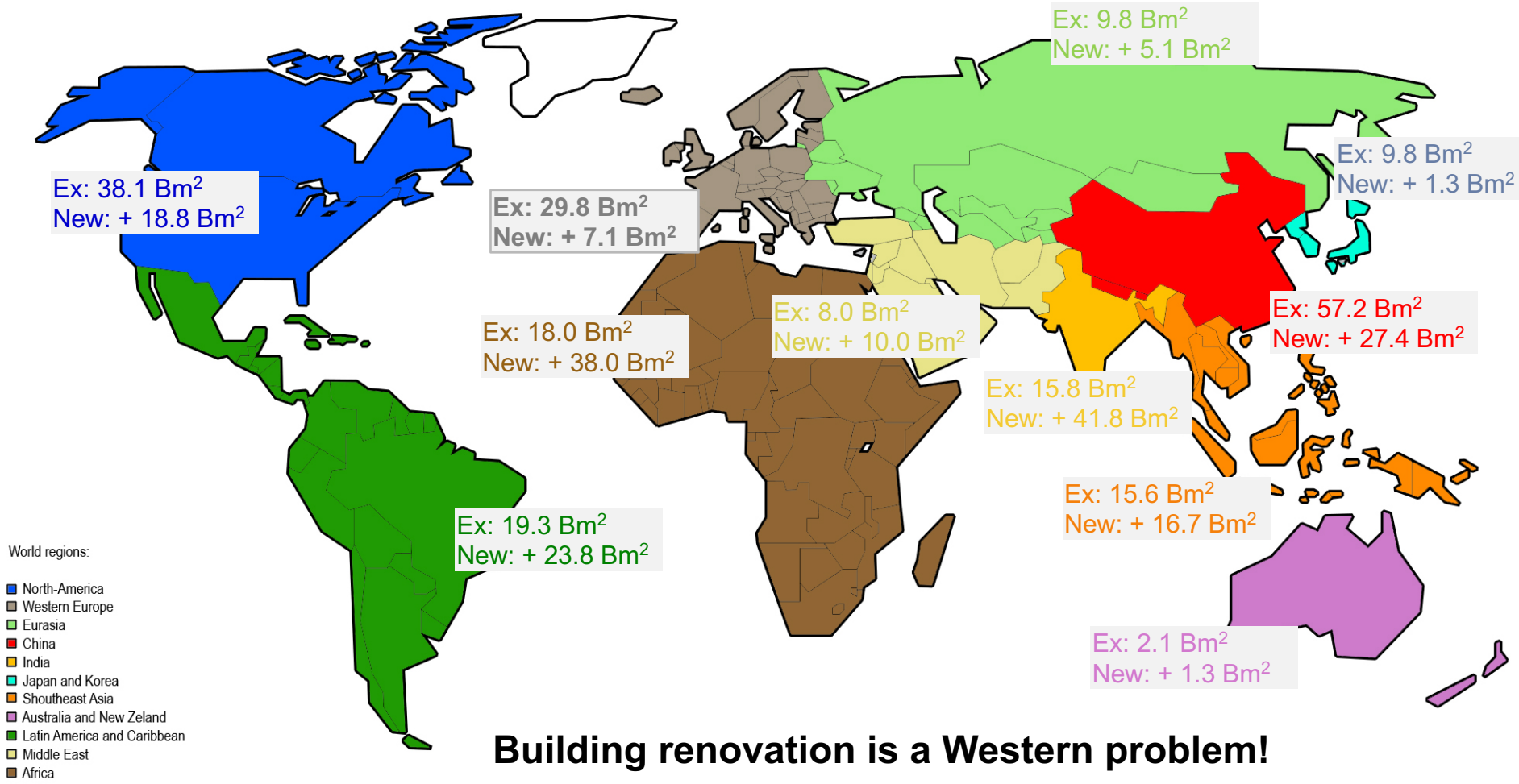
Alternative: carbon storage in buildings



ADVANTAGES:

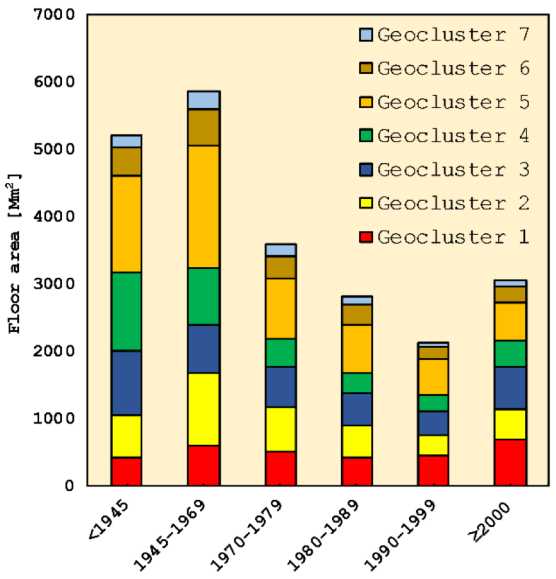
- Biobased technologies are already available in the market
- Costs are competitive compared to traditional systems (non biobased)
- We have a large demand of construction materials all over the world

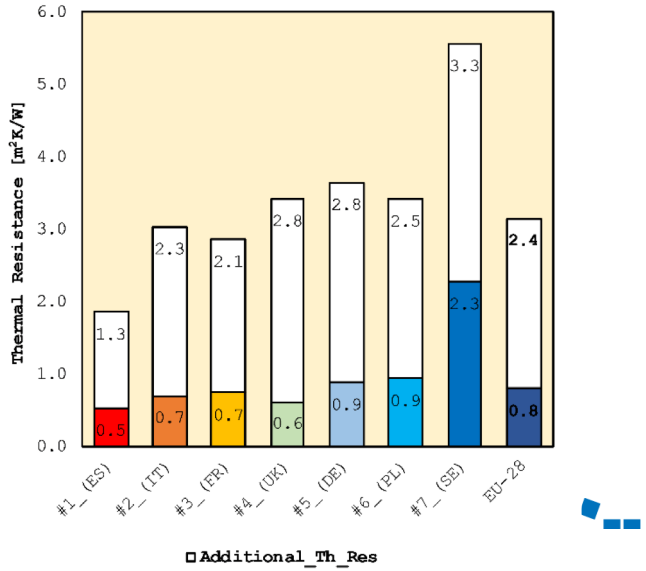
Evolution of the Built Environment in the World

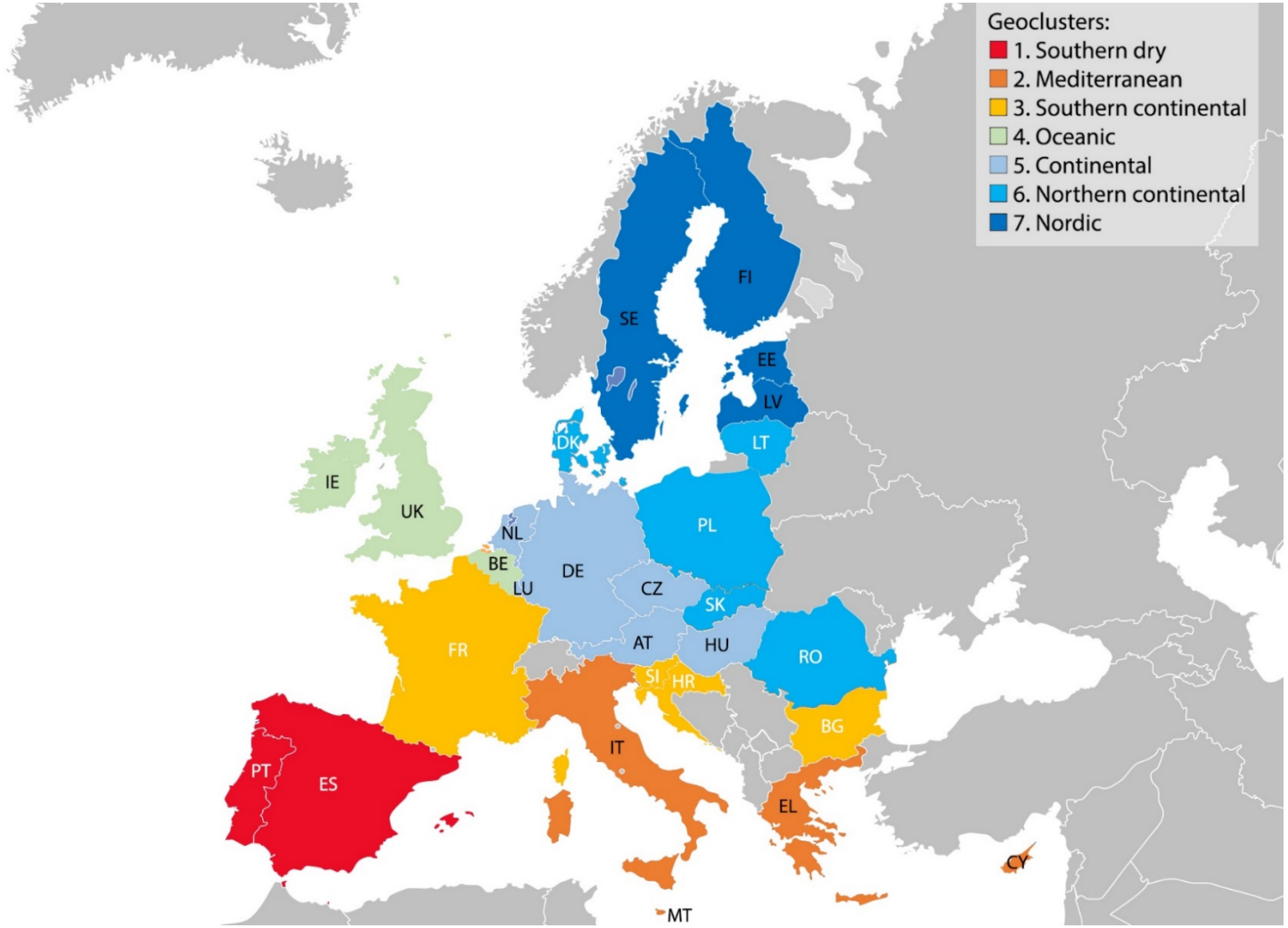


Building renovation is a Western problem!

Building renovation in EU







Sce: Pittau et al. 2018

Carbon negative bio-based technologies for renovation

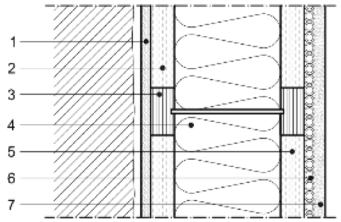
Standard ETICS system

Bio-based (fast-growing) systems

Bio-based technologies for renovation

OFF SITE PREASSEMBLED

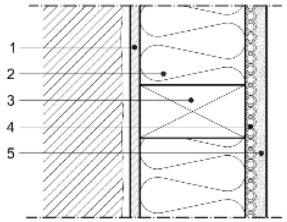
STR



BIO

I-joist frame with pressed straw

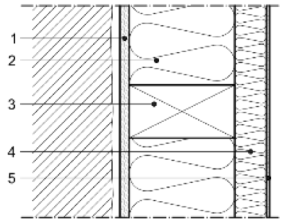
HCF



BIO

Timber frame with injected hempcrete

TIM

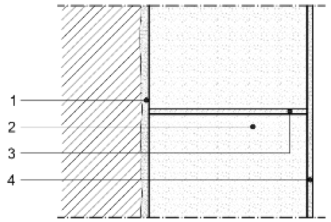


MIN + BIO

Timber frame with mineral insulation

ON SITE ASSEMBLED

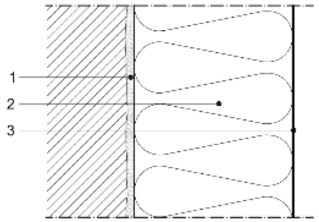
HCB



BIO

Hempcrete block external insulation

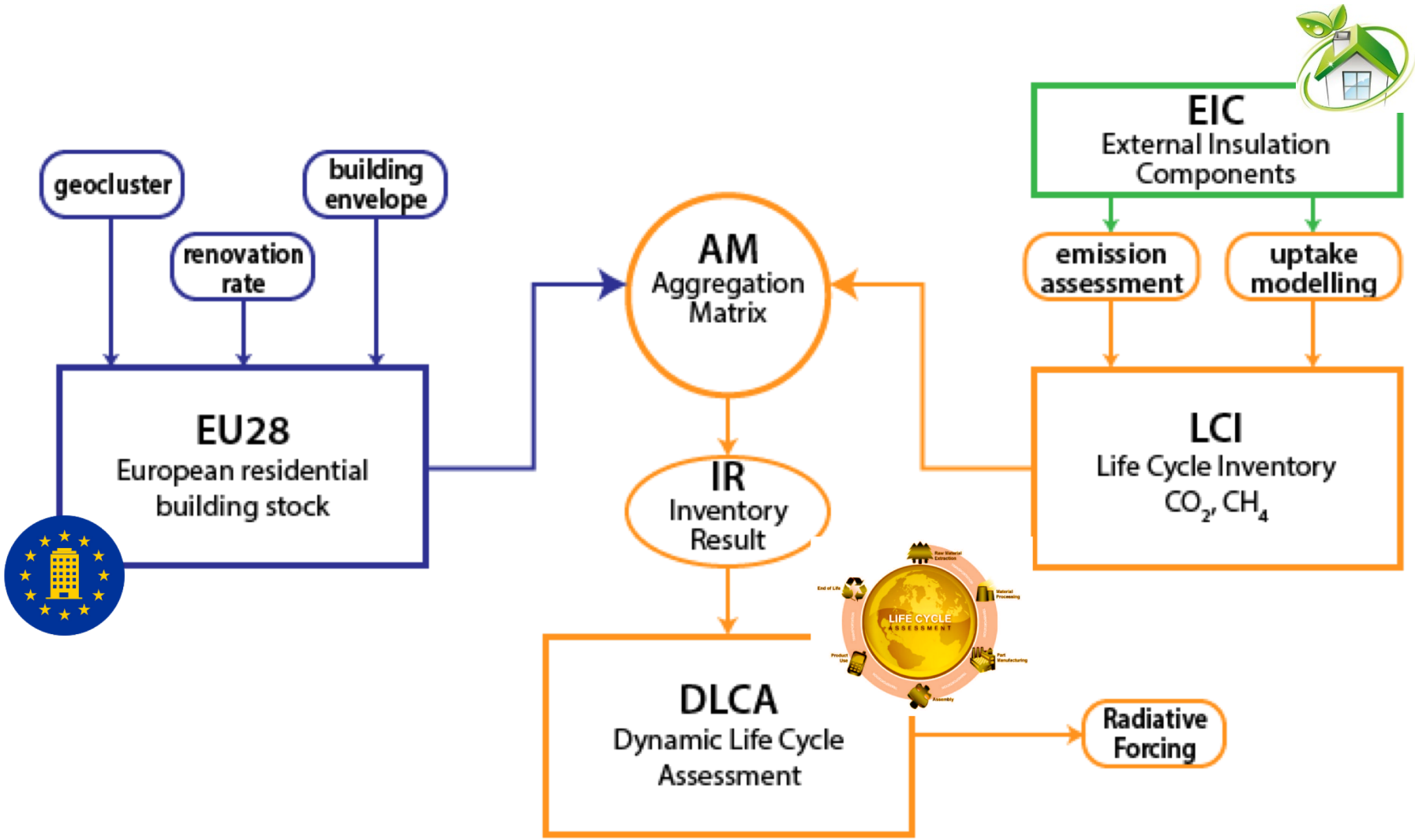
EPS



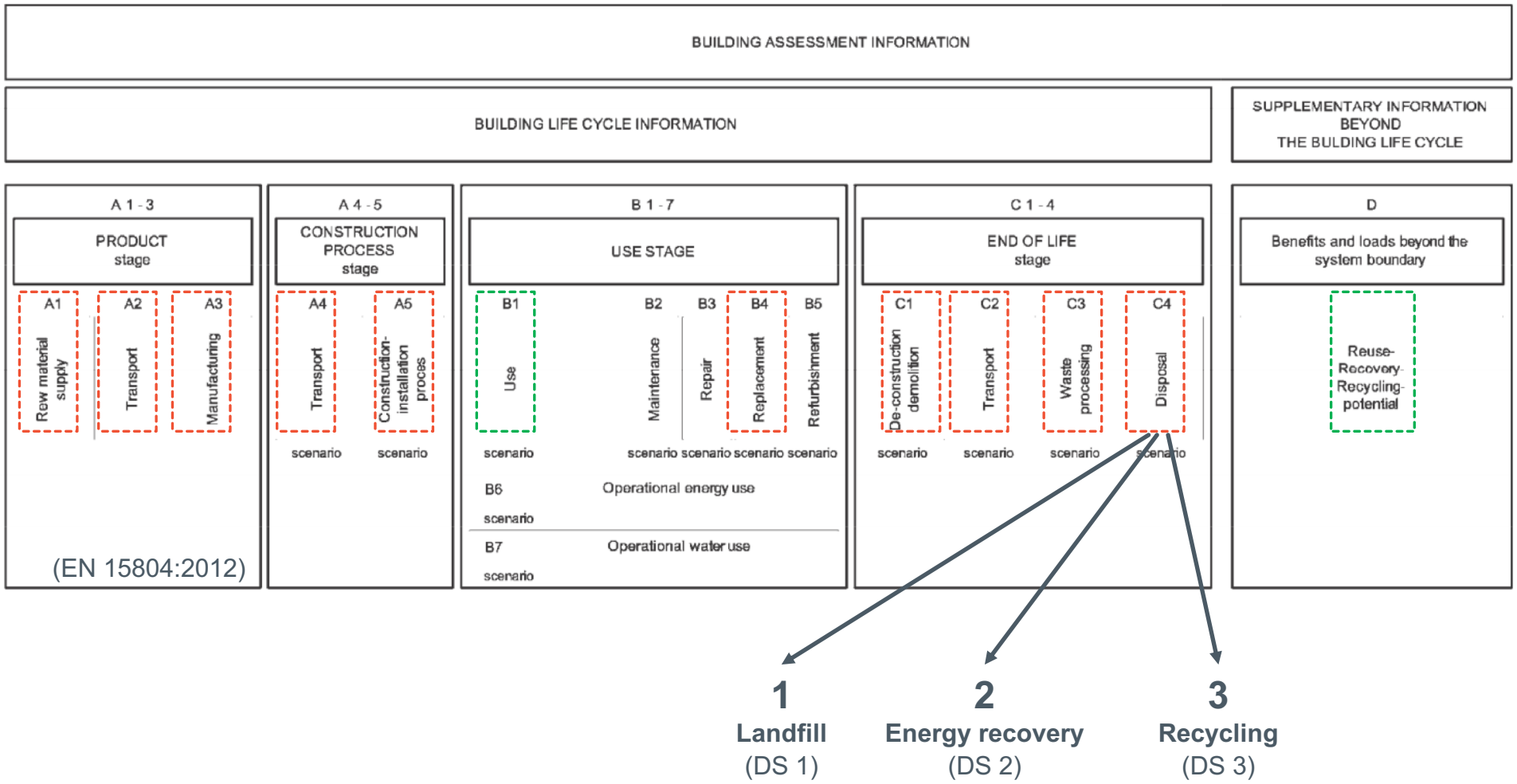
SYN

Expanded polystyrene external insulation

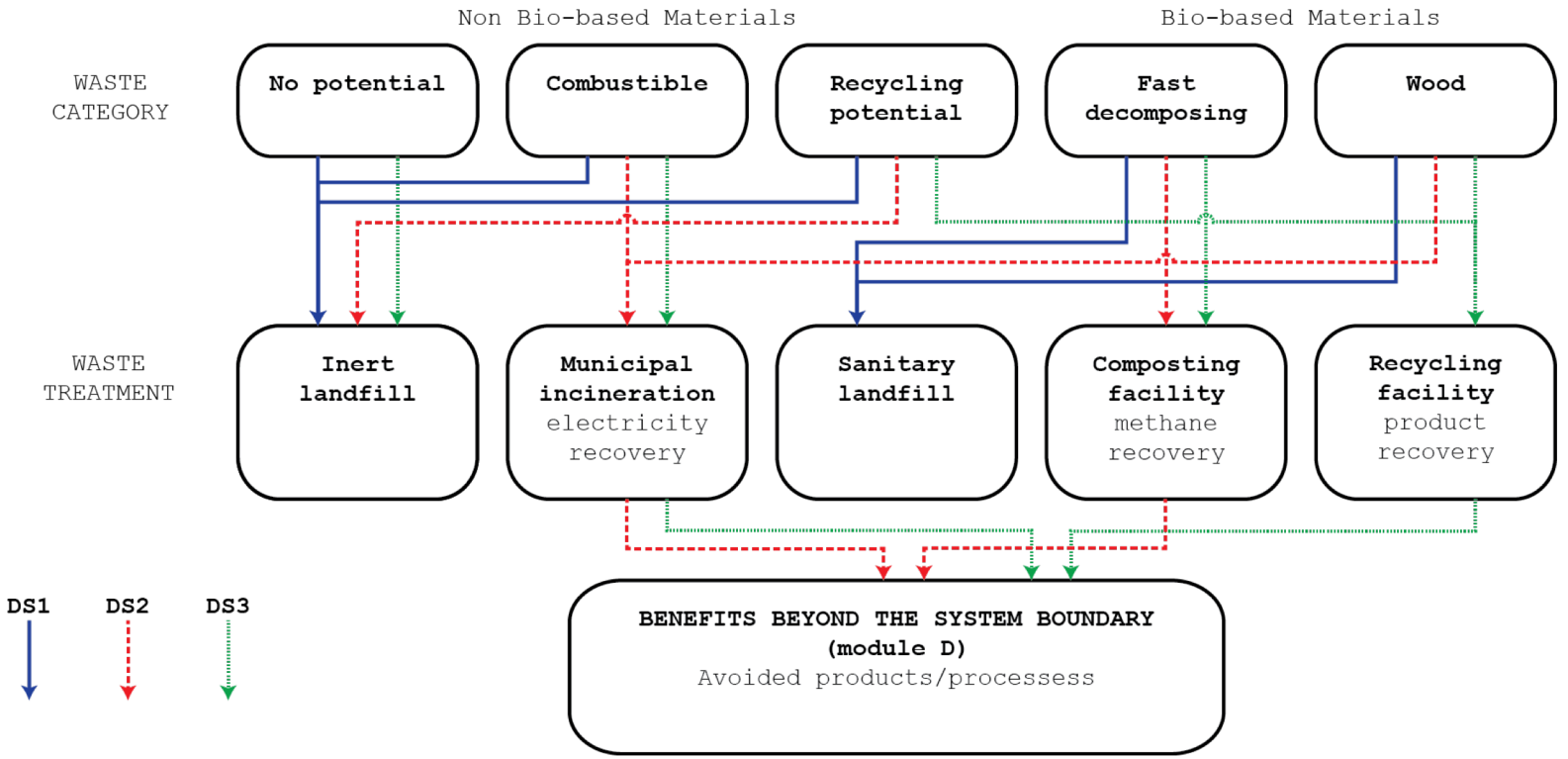
Methodology: MFA + DLCA based model



System boundaries



End of life and waste treatment scenarios

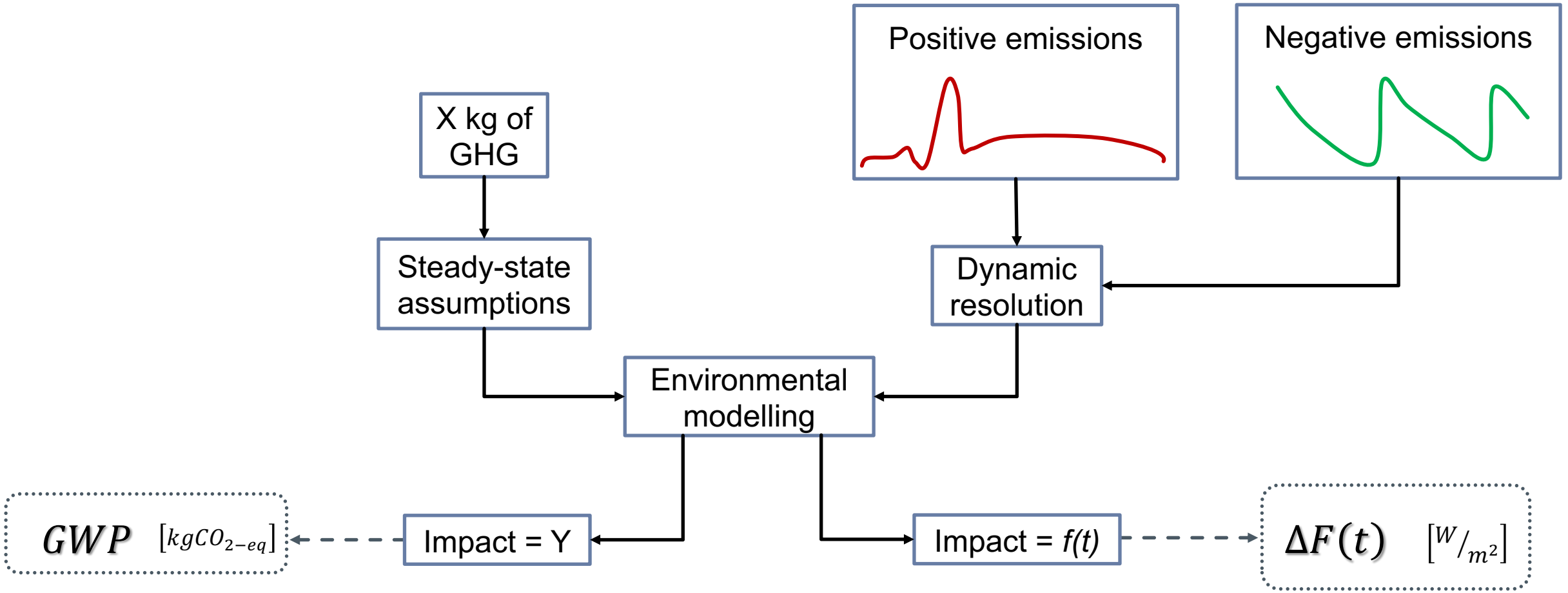


Pittau F., Krause F., Lumia G., Habert G. 2018. Retrofit as a carbon sink: the carbon storage potentials of the EU housing stock. *Journal of Cleaner Production*, 214, 365-376

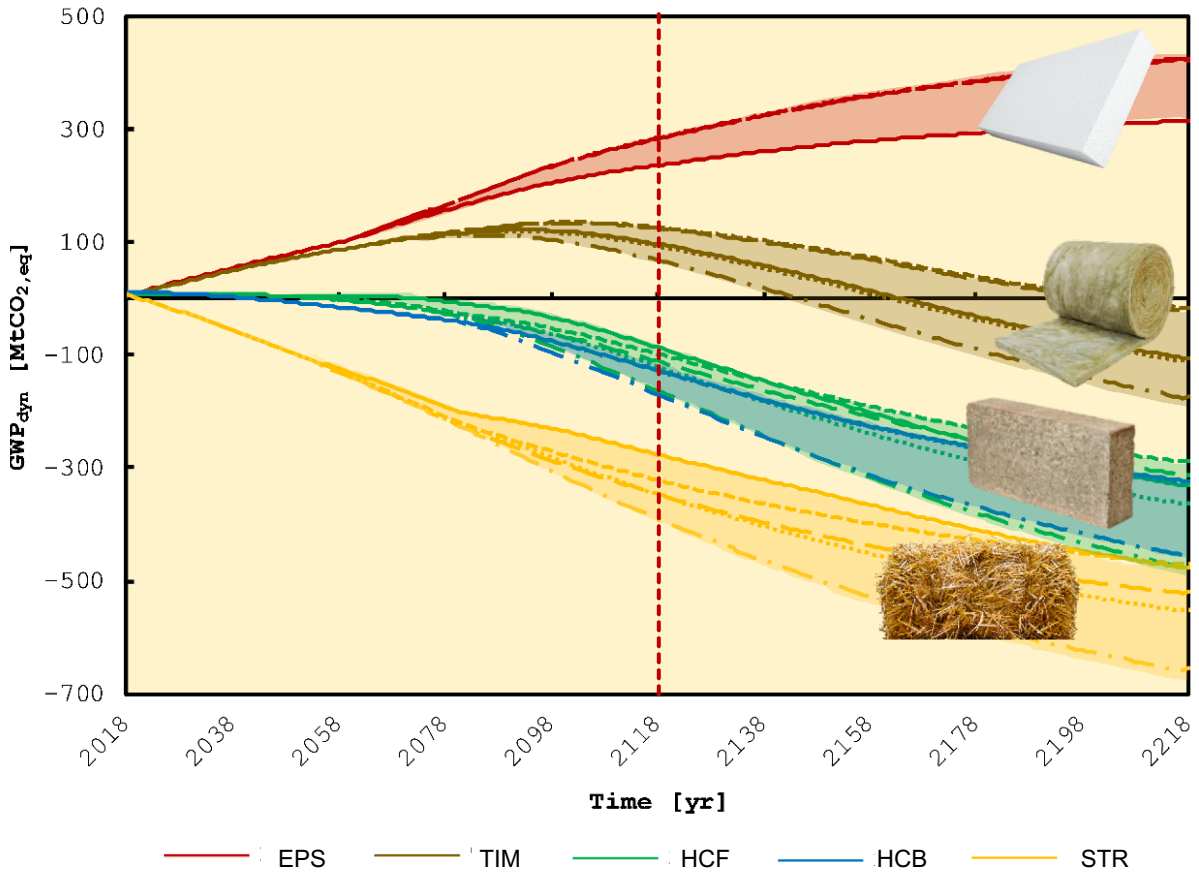
Critical issues of IPCC assessment method

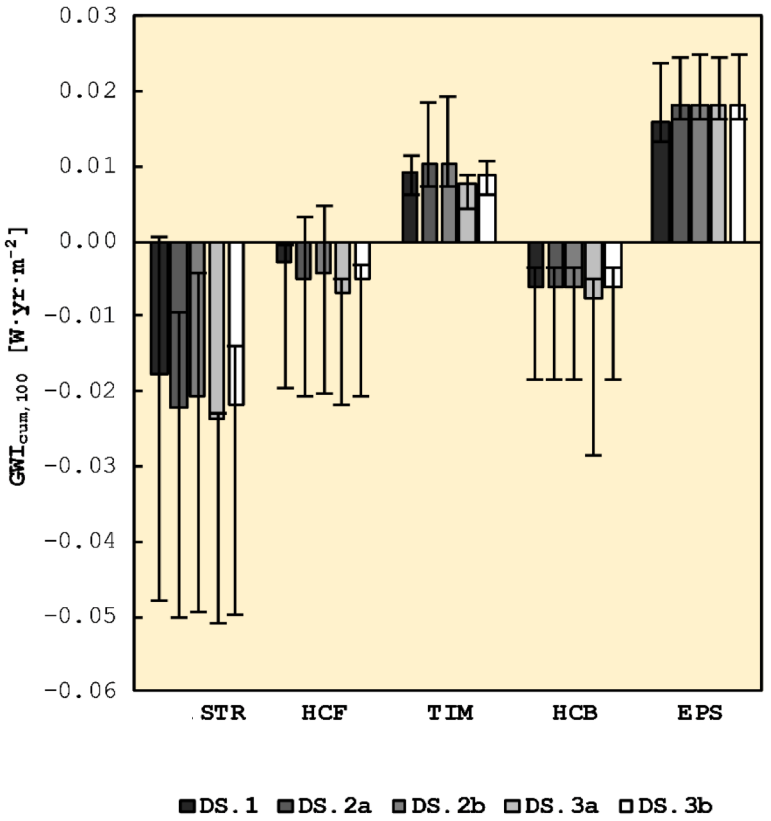
- Biogenic carbon emissions are not taken into account in the GWP.
- Emissions are all considered as impulse at time 0 and GWP evaluated at time fixed time horizon (usually 100 years).
- Timing of emissions is not accounted for.
- Carbon storage in products and uptake are not included in the boundaries (no benefits).

Dynamic LCA principles



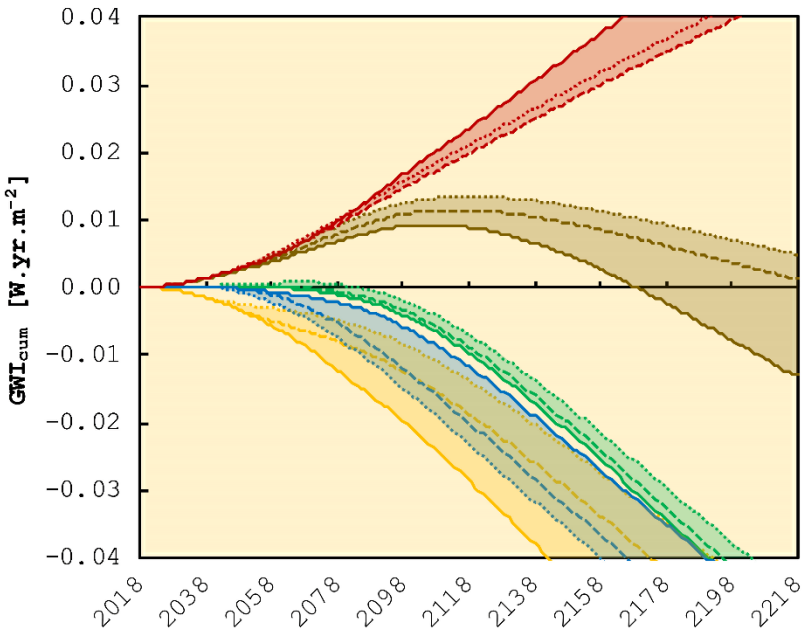
Results – Cumulative GHG emissions





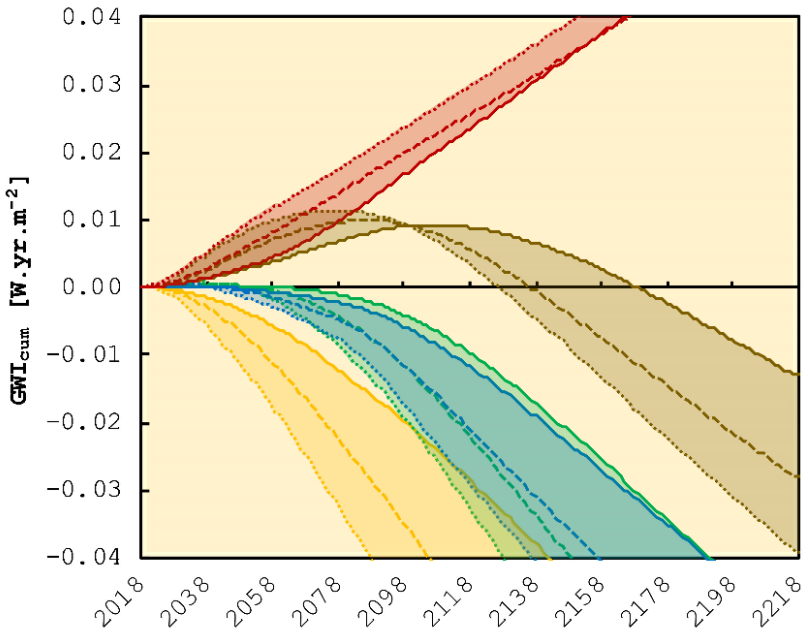
Sensitivity of the results

EPS TIM HCF HCB STR



RBSL:

60y 40y 30y



Renovation rate:

1% 2% 4%

Final remarks and conclusions

→ **Building renovation** in EU-28 is urgently needed and impacts from material production - mainly insulation - **is not negligible** and can slow down the transition to zero carbon society.

→ **Bio-based materials** can contribute to **remove carbon** from the atmosphere and its large use in construction due to additional insulation required for existing facades is a valuable opportunity that **should not be wasted**.

→ **Fast-growing materials**, such as straw, hemp, etc., regrow fast in the crops and, contrarily to wood, are able to provide the **carbon sequestration** in a very short time.

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Thank you very much for your attention!