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Embodied Carbon – Still our blind spot

Dr. Anne Holsten

27.5.2024 - UNFCCC - Third Global Dialogue
and Investment-focused Event

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Bauhaus Earth: Integrated way of working

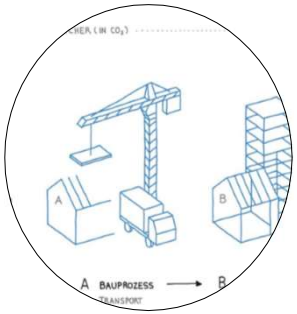
make-tank

Technical & Material-innovation

Demonstration & Experimentation

Education & Learning

Policy Advisory



Scientific research

think-tank

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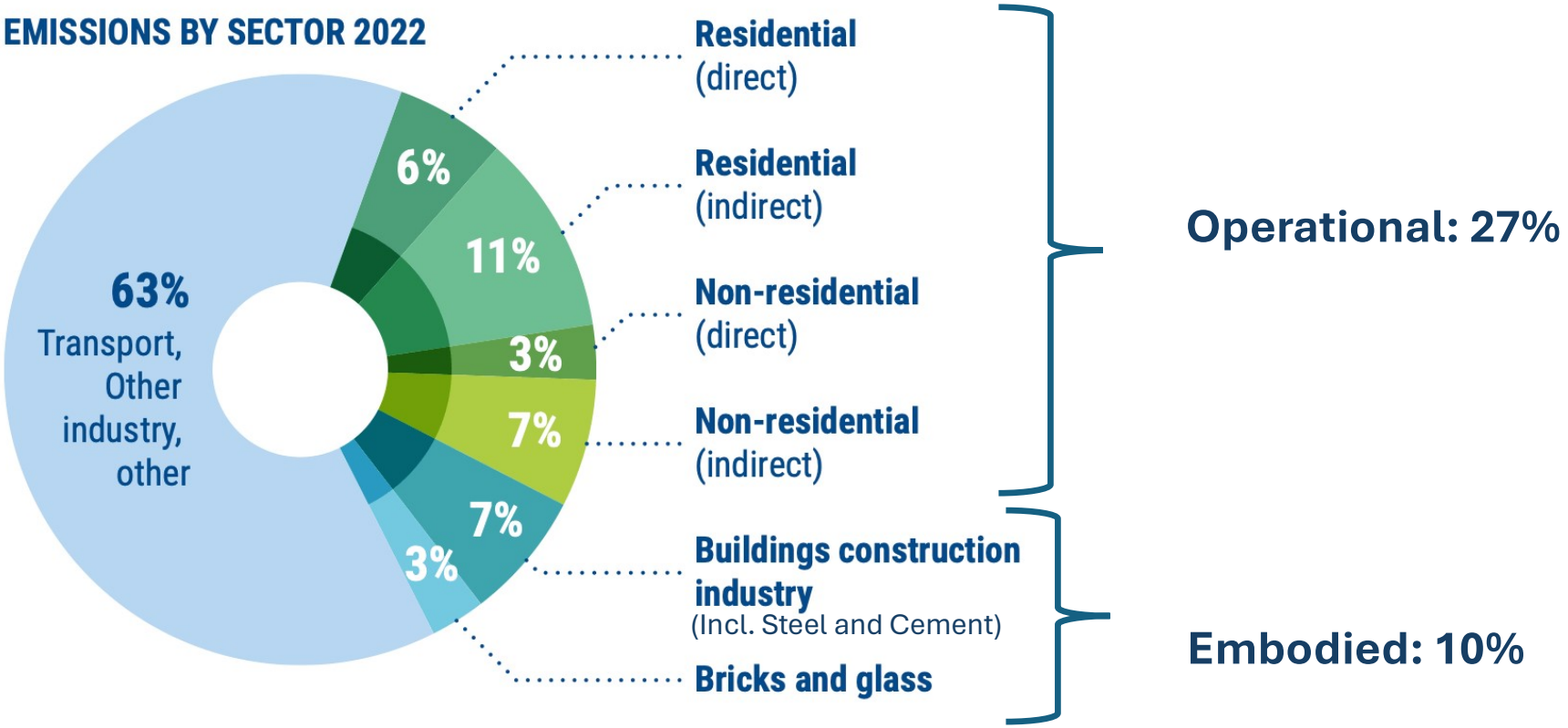
The challenge

In 2022, buildings were responsible for 37 per cent of energy and process-related carbon dioxide (CO_2) emissions.



Adapted from: UNEP, 2023: Global Status Report for Buildings and Construction

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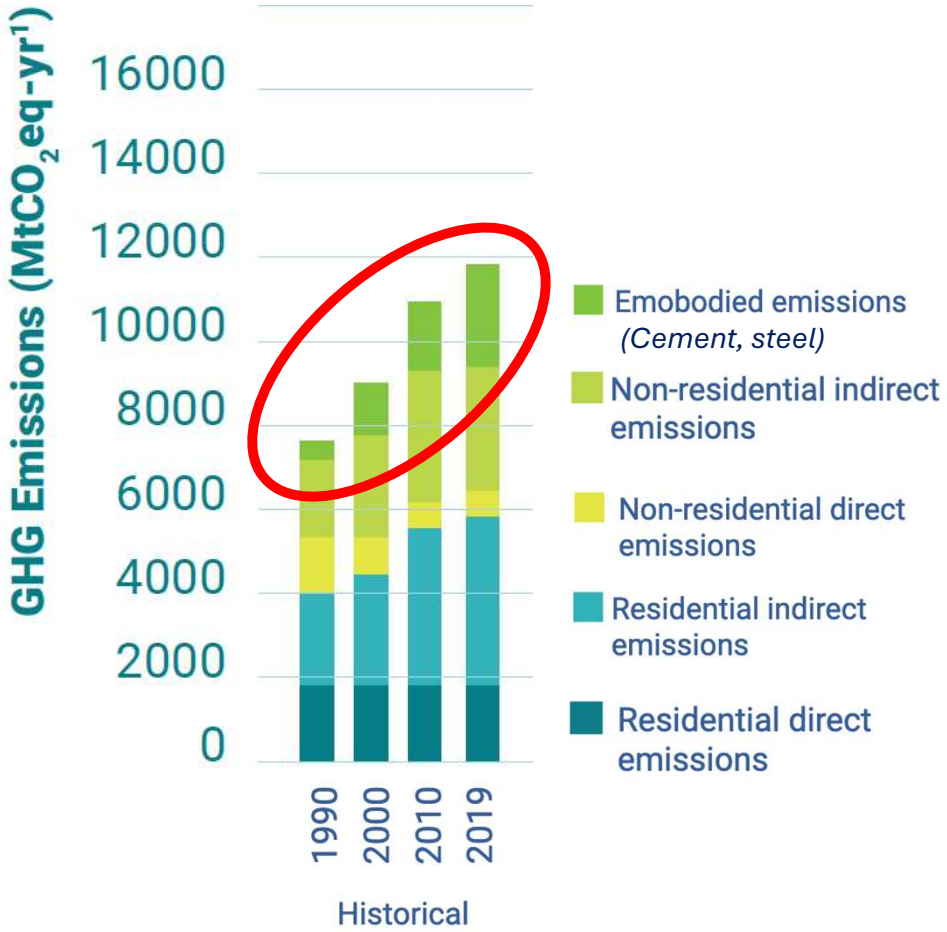
The challenge grows



Relevance of embodied emissions is increasing

Timing matters:

- “Upfront emissions” – very relevant for climate mitigation goals
- Floor area expected to double until 2050 (IEA 2022)

UNEP /Global Alliance for Buildings and Construction 2022, from IPCC AR6, WG3, data: IEA

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The big levers for building materials

PEEP 2021: Embodied Carbon. A hidden heavyweight for the climate

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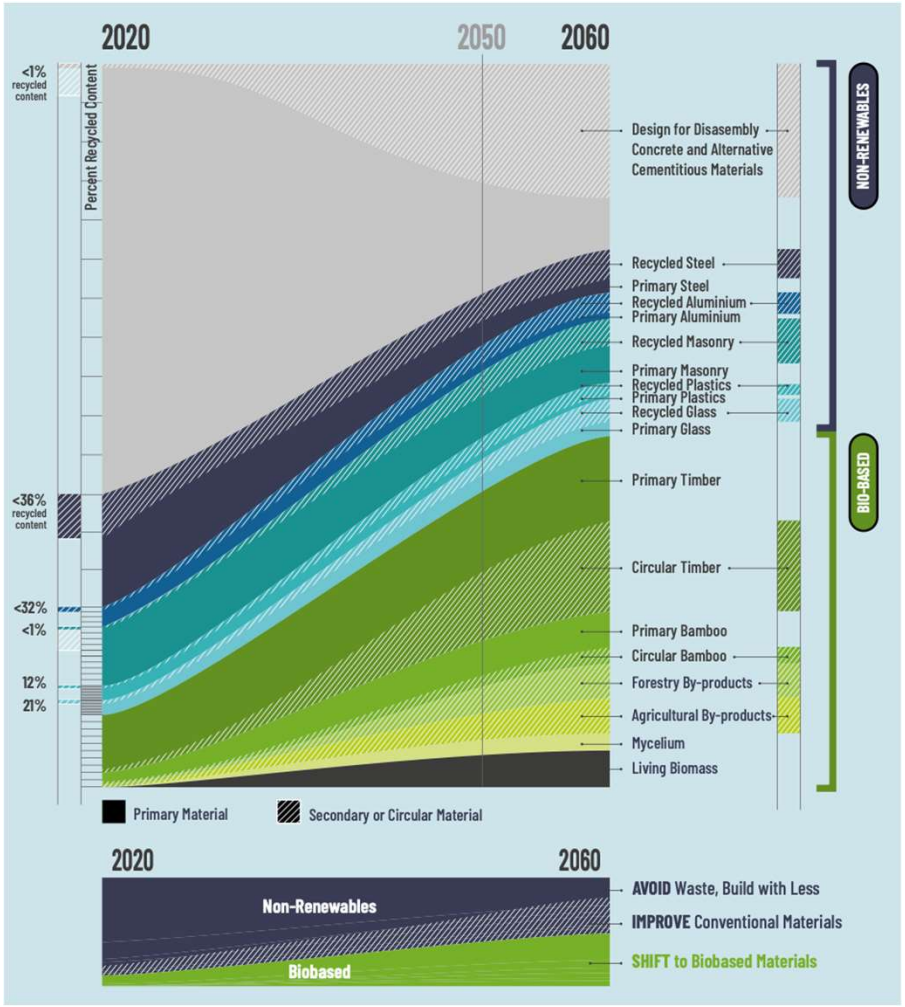
The big levers rolled out



Avoid / Shift / Improve Actions can lead to a low-carbon future.

Key actions:

- Broadening of the bio-based material range
- Intensive use of secondary materials (shaded in figure), including design for disassembly

UNEP/Yale 2023: Building Materials And The Climate

based on: : Ciardullo, Reck and Dyson 2023. Current GHG Emissions: Zhong et al. 2021; OECD 2022a. Material mass and recycling rates from: Miatto et al. 2017 (cement); Cullen, Allwood and Bambach 2012, Reck 2022 (steel); International Aluminium Institute [IAI] 2020 (aluminium); Westbroek et al. 2021 (glass); Miatto et al. 2017, Miatto et al. 2022 (masonry); DI et al 2021, Geyer, Jambeck and Law 2017 (plastics); Food and Agriculture Organisation of the United Nations [FAO] 2020 (timber).

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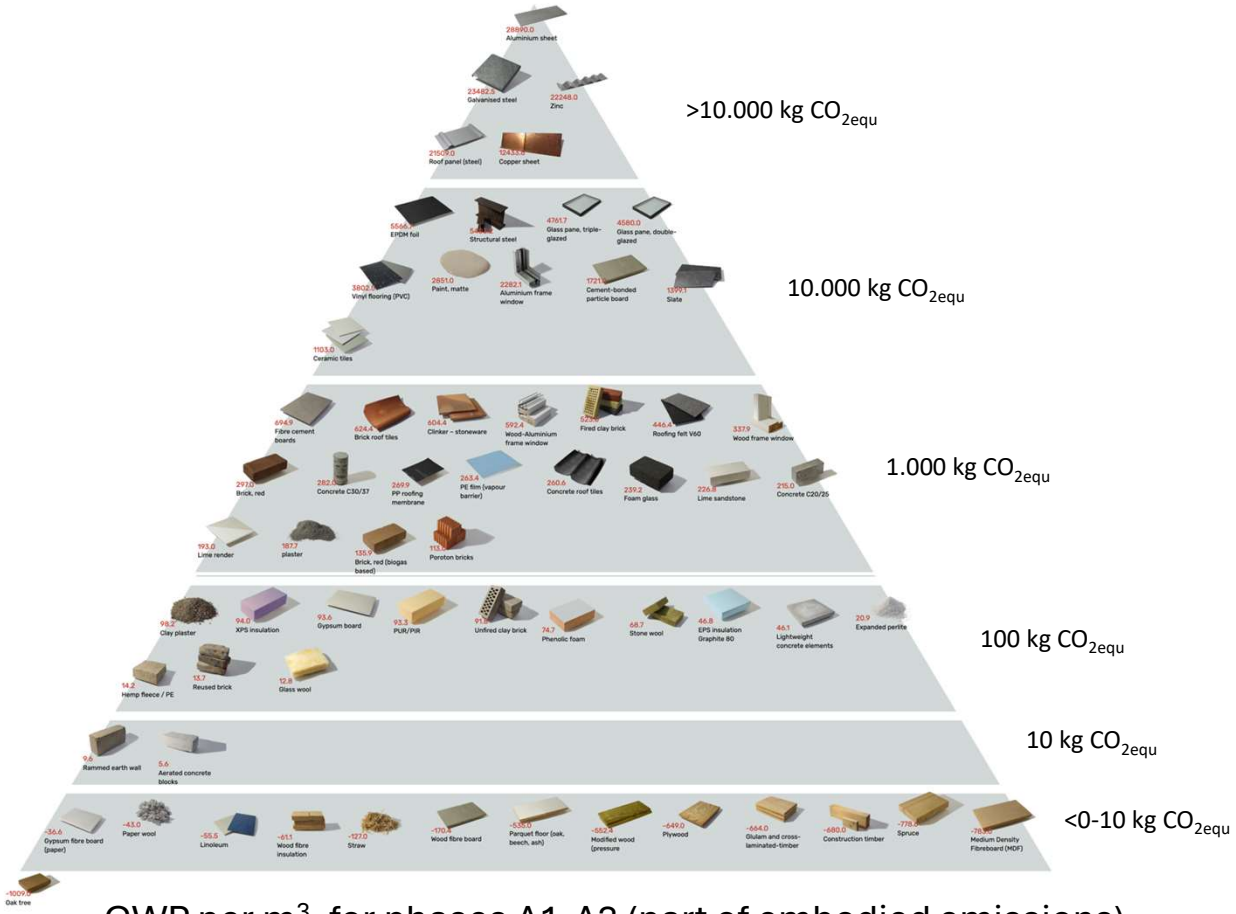
Choose your material diet



GWP per m^3, for phases A1-A3 (part of embodied emissions)

metallic

mineral-based / synthetic

bio-based

materialepyramiden.dk

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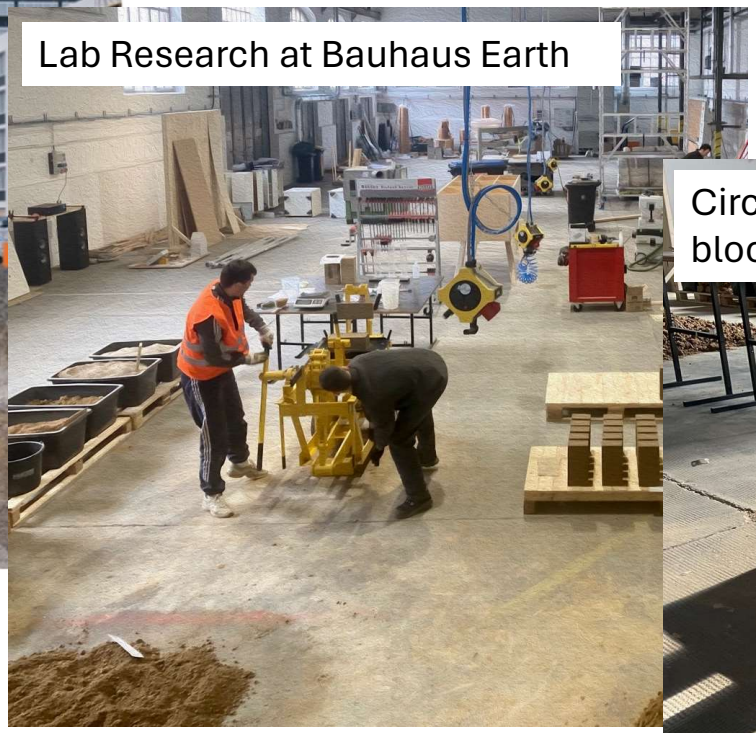
Going circular: Earth Blocks



Bauhaus Earth, Gäth, Kretschmann; Gepresste Lehmsteine – Perspektiven für eine post-fossile Erde

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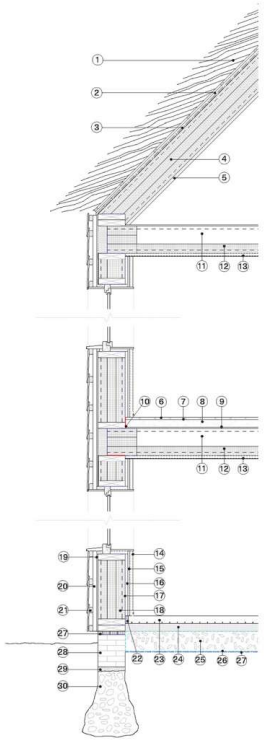
Paludicultures: a triple win

Synergies between material use, climate change mitigation and nature conservation



75%
of Brandenburg's peatlands are used for agriculture

25%
reduction in emissions by rewetting only 3% of the EU's land drained for agriculture

1.2 ha
of cultivated reed

1 ⌂
insulated with rigid reed panels + clad with thatch roof

Material Cultures, Bauhaus Earth, Experimental (2023): Wetlands and Construction: An opportunity for Berlin-Brandenburg

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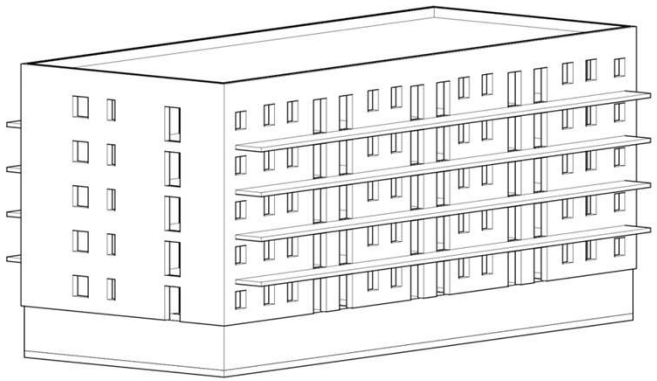
Materials and type of construction matter

- 50 % GWP per m^2

(nature-based construction vs. conventional

Berlin Brandenburg | Germany



Multi family residential building

5 storeys + basement
40 units à 1-3 people
80-120 inhabitants
50m x 8m x 19m

Paro Timphu | Bhutan

Multi family residential building

4 storeys
16 units à 2-4 people
30-60 inhabitants

- 60 % GWP per m^2

(nature-based construction vs. conventional)

Schneider / Friedel in prep., Bauhaus Earth ReBuilt project, funded by BMUV
Based on modules A1-A3, B4, C3, C4, data: Ökobaudat

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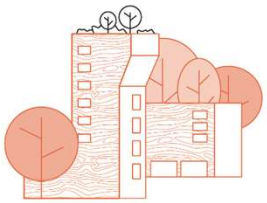
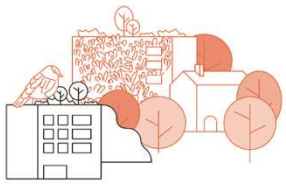
Beyond the material lense



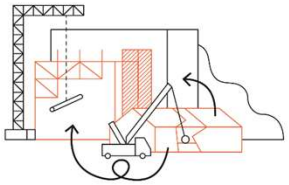
Nature-based and climate positive

Replacing carbon-intensive building materials such as cement or steel with natural materials can not only reduce greenhouse gas emissions, but also store the carbon dioxide that is removed from the atmosphere as trees or plants grow.



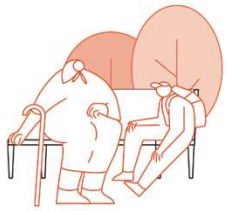
Nature-based Solutions

Green infrastructure, such as green walls, green roofs, rain gardens, trees, or green spaces, are incorporated into existing or new buildings and infrastructure. In addition to sequestering carbon and acting as a natural carbon sink, nature-based solutions provide socio-economic and health benefits, such as improving air quality, mitigating urban heat islands, and creating high quality recreational spaces.



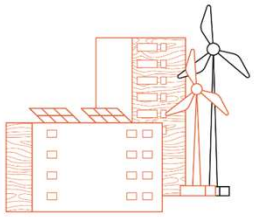
Circularity

The linear use of building materials, based on material extraction, use, and disposal, is replaced with practices that extend the life cycle of building materials, ensuring they remain in circulation for as long as possible. New buildings are designed so that individual components can be easily removed and reused, while materials from the existing building stock are recovered, repaired, or recycled.



Inclusivity and Cohesiveness

Buildings and infrastructure should respond to the need for affordable, safe, and accessible housing, equal access to basic services, and safe public spaces that facilitate social interaction and participation.

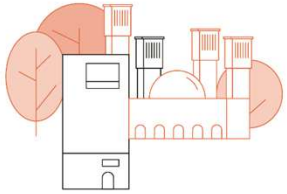


Energy Efficiency

The transition to a positive energy building stock can be achieved by powering buildings with renewable energy sources such as solar and wind, minimising their overall energy demand through optimised building envelopes, and using technologies such as photovoltaics (PV) that enable buildings to produce more energy than they consume.

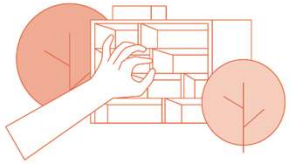
Polycentric, compact, and mixed-use

Neighbourhoods and cities are planned and (re)designed so that basic urban services such as work, education, health, culture, leisure, and housing are accessible in close proximity. Emphasis is placed on ensuring walkability, cycleability, safe and inclusive public spaces, and access to public transport.



Local and Traditional

Rather than producing buildings that all look the same and have little local identity, architectural design draws on traditional building methods and local building culture, and embraces different forms of knowledge, while satisfying the desire for modernity and the need for urban density.



Adaptability and Multi-functionality.

Buildings and infrastructure are designed to be as flexible and adaptable as possible so that they maximise their potential to respond to societal changes and technological advances. This increases building occupancy and street vibrancy, extends the building's life span, and reduces costs over its life cycle.

Principles of a Regenerative Built Environment

Graphics by Mule Studio; Bauhaus Earth (2023). Building for the Future: https://www.bauhauserde.org/initiatives/building-for-the-future-knowledge-products

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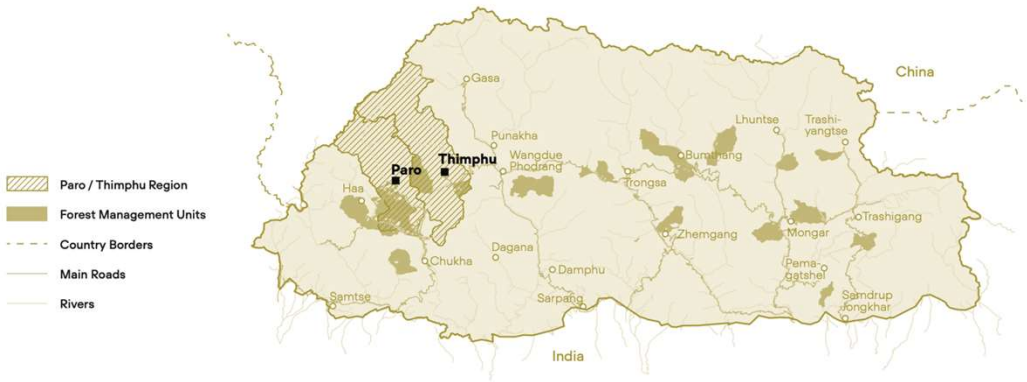
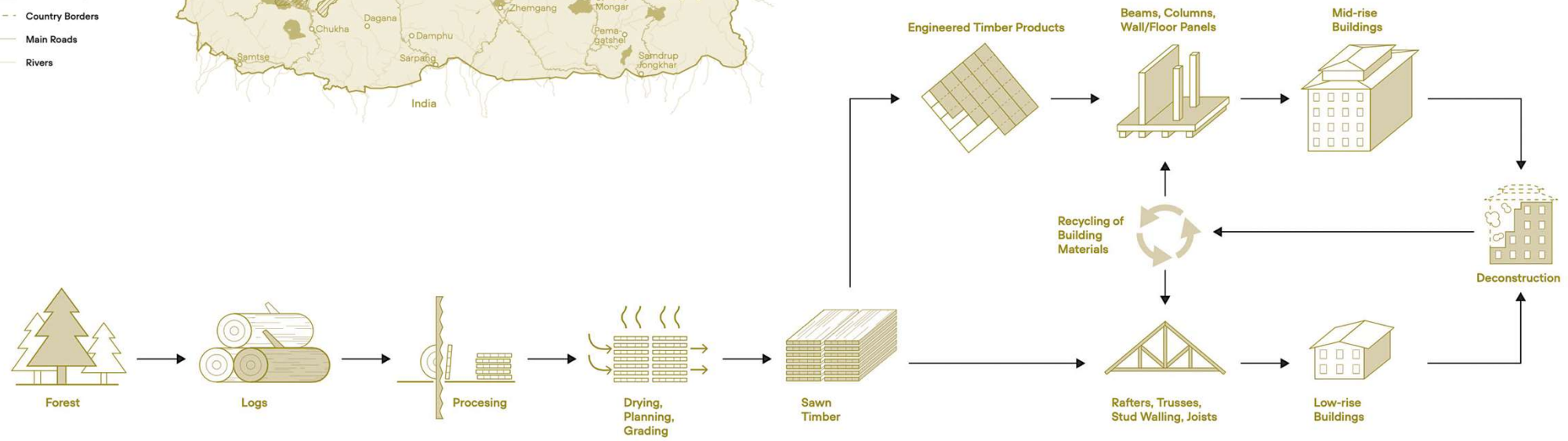
From Forest to Cities



Feasibility study of regional supply chains for bio-based construction in Bhutan



Bauhaus Earth, ReBuilt project, funded by BMUV

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Thank you for your attention!

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