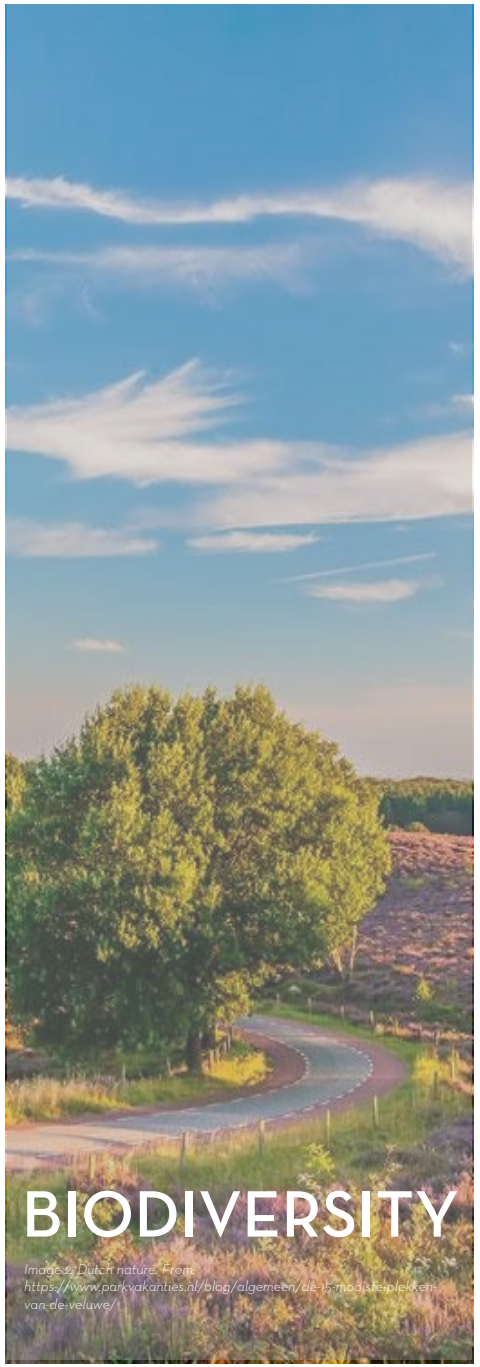
100 000 BIOBASED TOP-UPS

Quickest route to Paris Proof housing?

Frank Vahstal

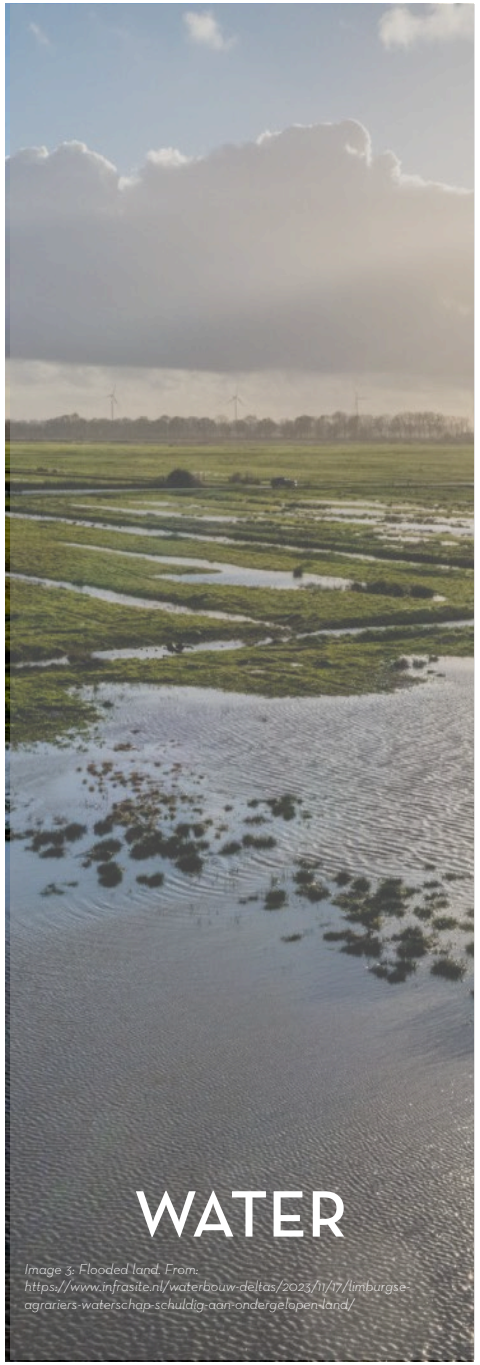
NITROGEN

Image 1: Livestock farming. From: https://www.foodlog.nl/artikel/nederland-goed-voor-05-biologisch-eu-areaal/



BIODIVERSITY

Image 2: Dutch nature. From: https://www.parkvakanties.nl/blog/algemeen/de-15-mooiste-plekken-van-de-veluwe/1



WATER

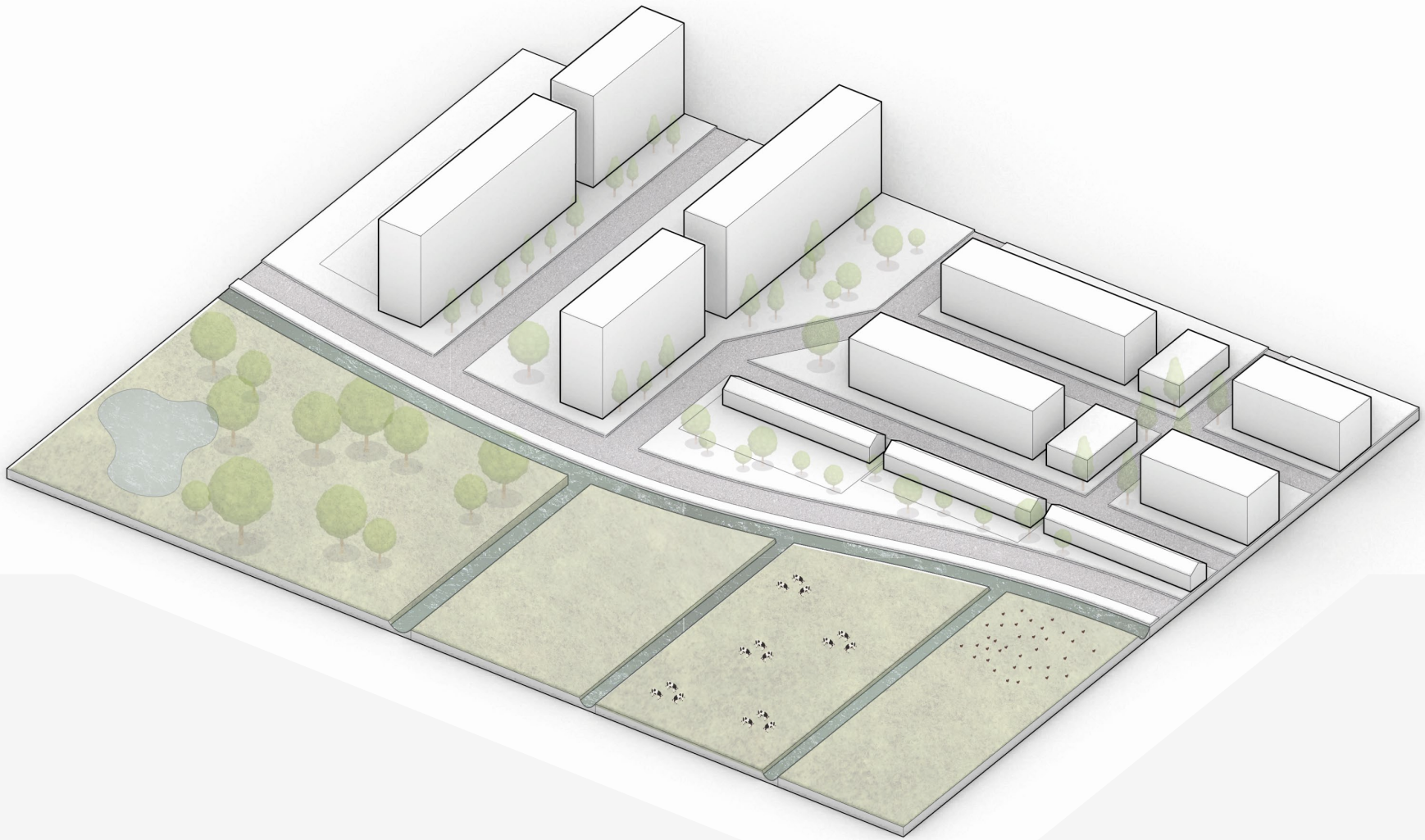
Image 3: Flooded land. From: https://www.infrasite.nl/waterbouw-deltas/2023/11/17/limburgse-agrariers-waterschap-schuldig-aan-ondergelopen-land/

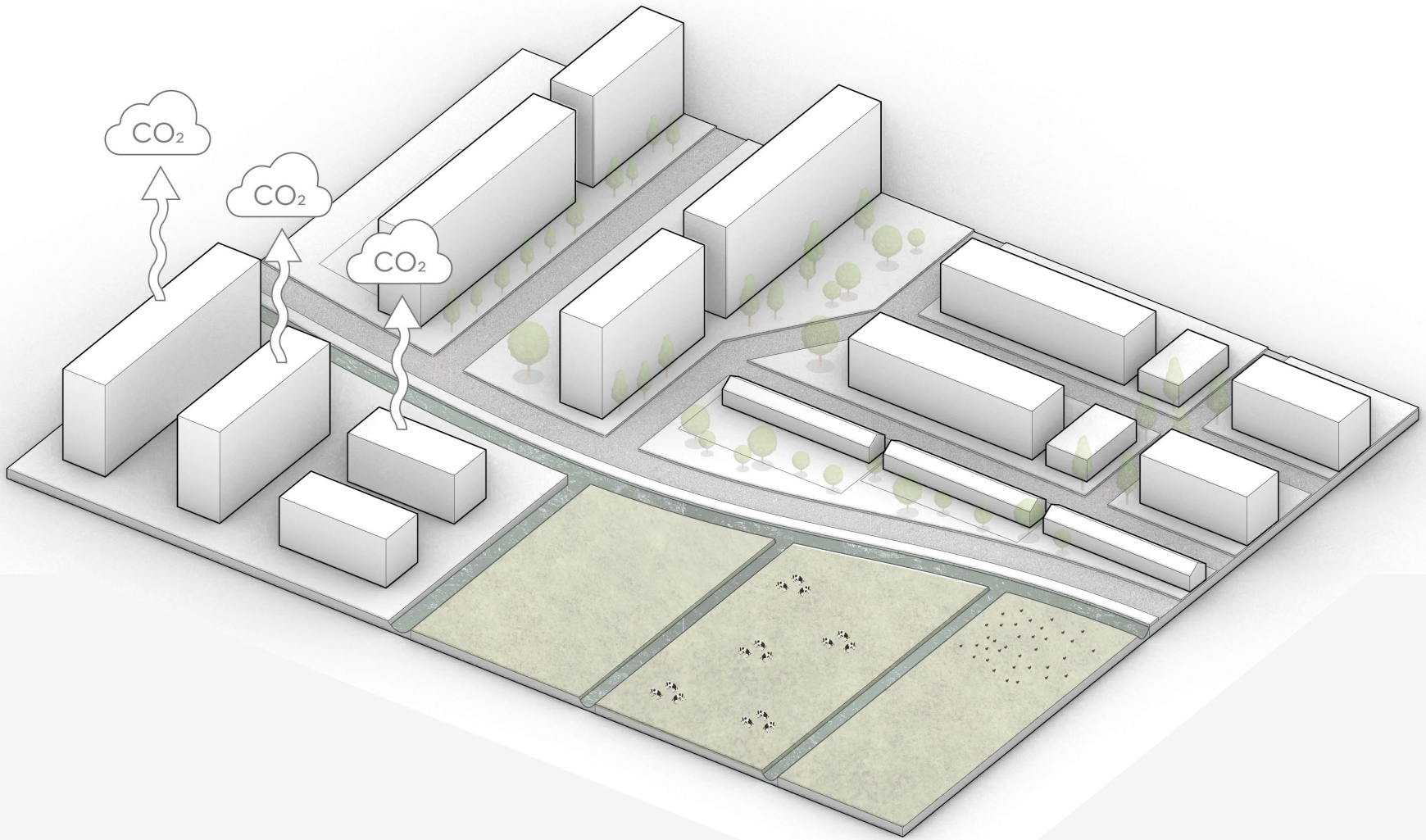
HOUSING

Image 4: Housing market. From: https://www.nu.nl/economie/6234080/beleggers-kopen-steeds-minder-huizen-op-in-grote-steden.html

CARBON

Image 5: Steel factory. From: https://www.parool.nl/nederland/zweden-bevestigen-gesprekken-over-overname-tata-steel-ijmuiden-bb770acd/

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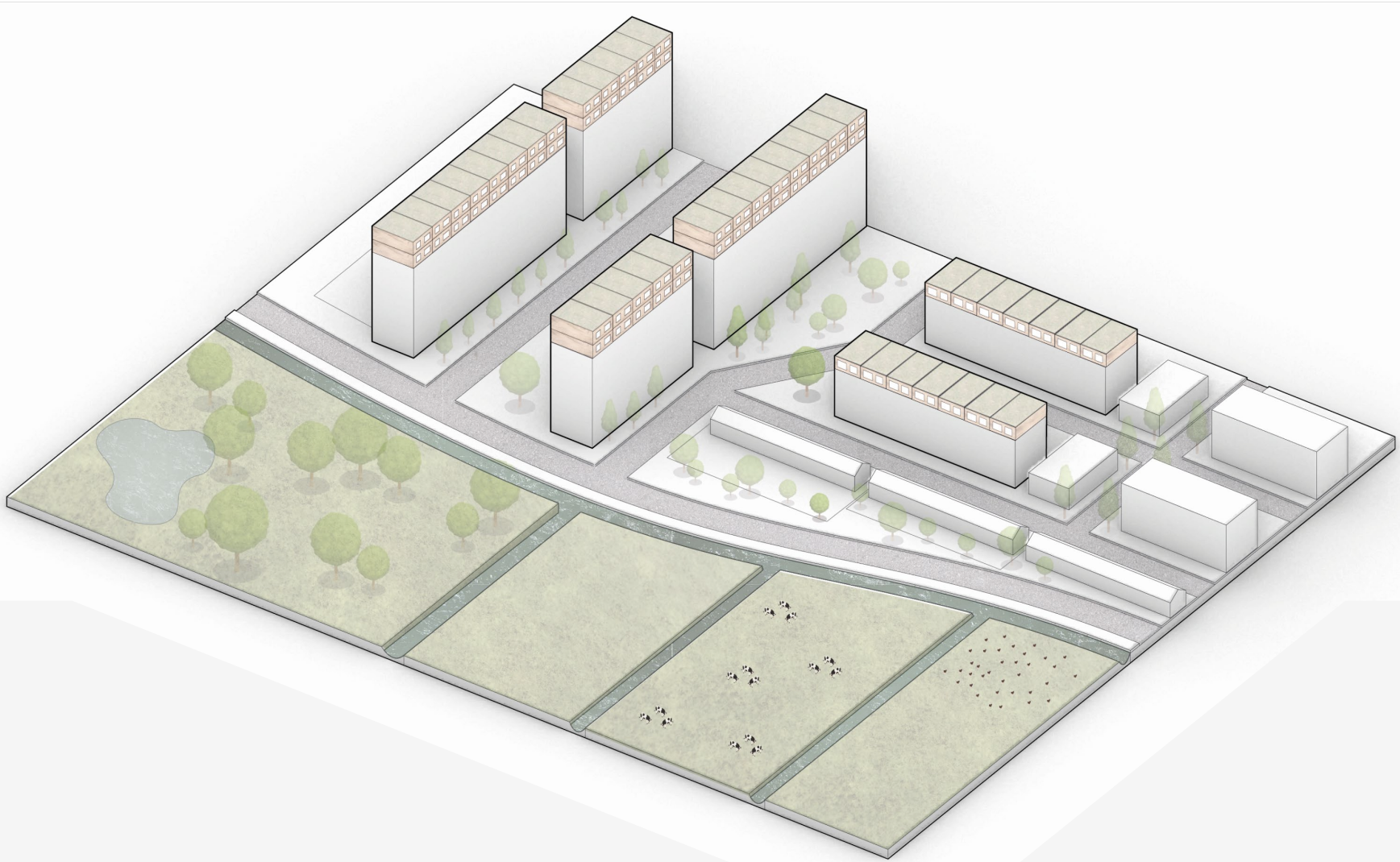

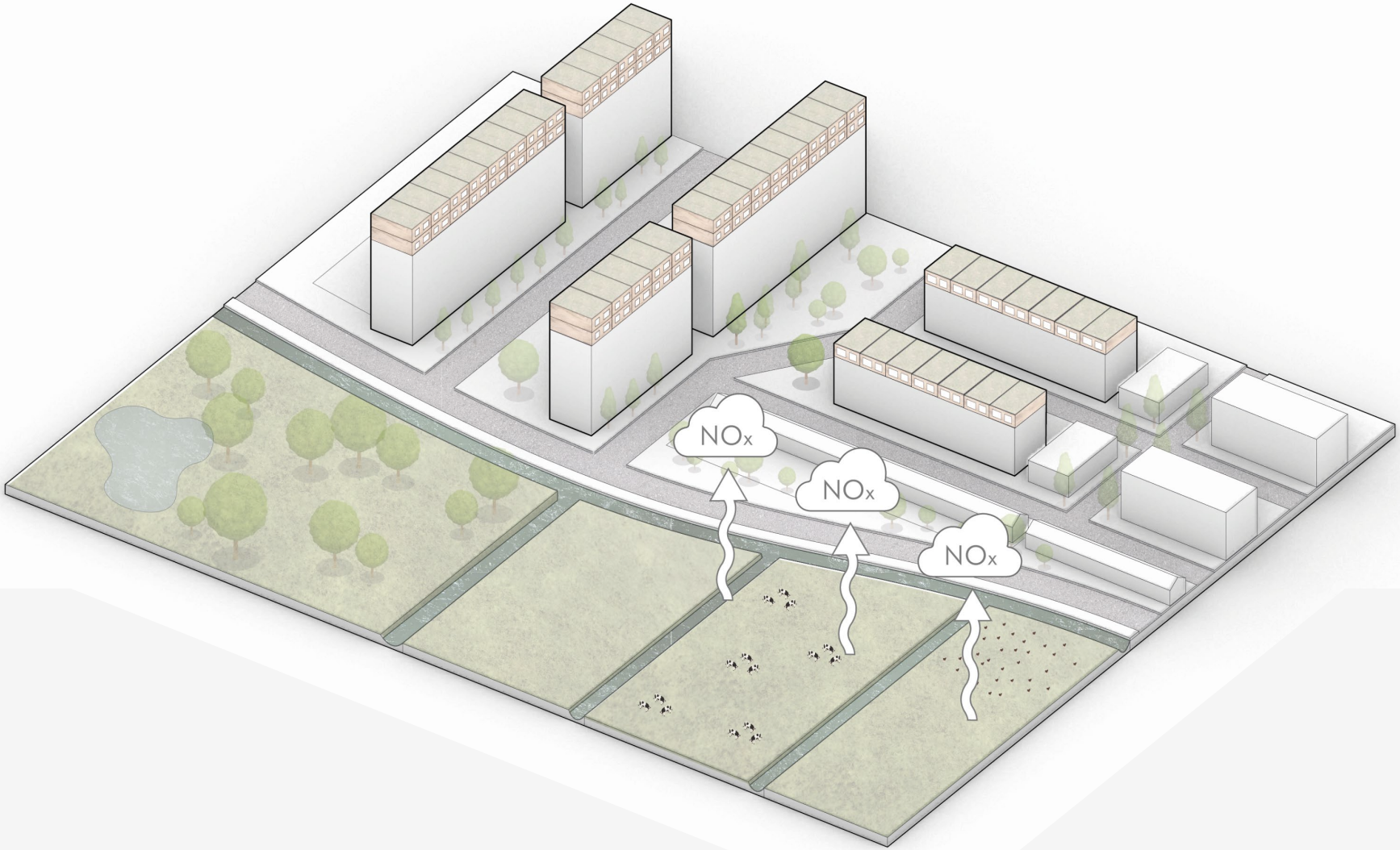
NOx
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Image 6 Miscanthuscultivation, by Universität Hohenheim (n.d). Retrieved from Innovationsorigins.com


Image 7: Flax cultivation, by Faay(n.d). Retrieved from faa


Image 8: Straw cultivation, by Hengelo's Weekblad(2022). Retrieved from https://www.hengelosweekblad.nl/nieuws/algemeen/97487/oogstdagen-bij-wendezoele


Image 9: Duitch forestry, by WUR(2019). Retrieved from www.wur.nl/nl/nieuws/resultaten-particuliere-bosbouw-verder-omlaag.htm

Image 6 Miscanthuscultivation, by Universität Hohenheim (n.d). Retrieved from Innovationsorigins.com

Image 7: Flax cultivation, by Faay(n.d). Retrieved from faa

100 000 TOP-UPS

*With **local biobased** material?*

Image 8: Straw cultivation, by Hengelo's Weekblad(2022). Retrieved from https://www.hengelosweekblad.nl/nieuws/algemeen/97487/oogstdagen-bij-wendezoele

Image 9: Duitch forestry, by WUR(2019). Retrieved from www.wur.nl/nl/nieuws/resultaten-particuliere-bosbouw-verder-omlaag.htm

RESEARCH QUESTIONS

MAIN RESEARCH QUESTION

- How can locally sourced biobased building materials be used in constructing top-ups in The Netherlands?

SUB QUESTIONS

1. The Potential

Why should we build the 100 000 required top-ups with biobased materials?

2. The Resources

What kind of biobased materials can be sourced in The Netherlands?

3. The Scale-up

Can the production of these materials be scaled-up to contribute to the construction of the 100 000 required top-ups?

4. The Benefit

Does using locally sourced biobased building materials reduce the embodied emissions compared to the conventional material choices?

DESIGN QUESTIONS

5. The Design

How can locally sourced biobased materials help inform the design for the top-up of Smits Vastgoedzorg?

HYPOTHESIS

MAIN RESEARCH QUESTION

- How can locally sourced biobased building materials be used in constructing top-ups in The Netherlands?

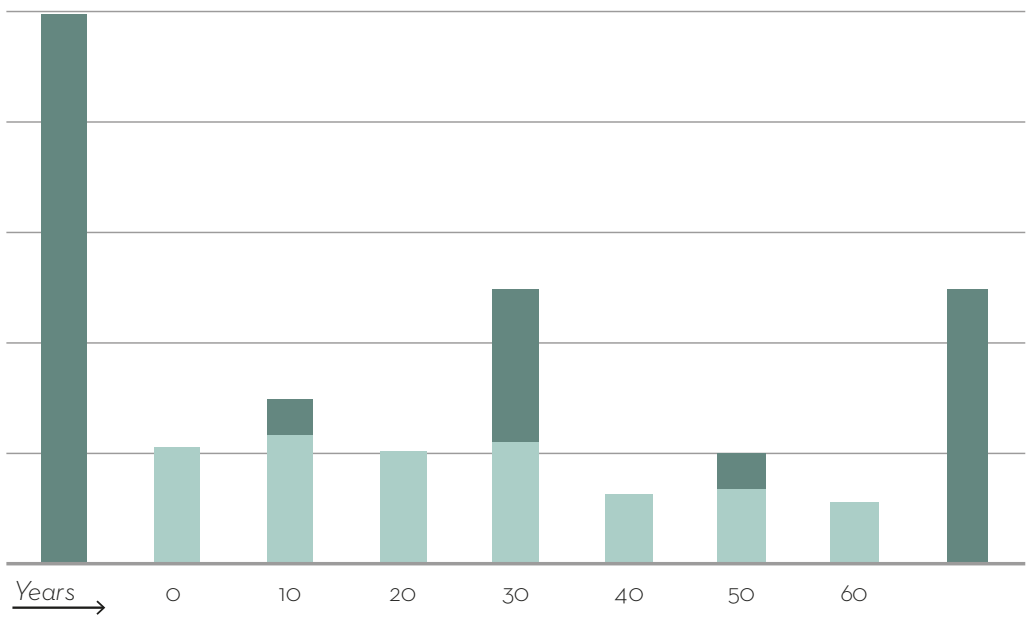
HYPOTHESIS

- The 100 000 required top-ups could be constructed with locally sourced biobased materials.
- By doing so the embodied emissions will be reduced.

THE POTENTIAL

POTENTIAL WHY TOP-UP?

OPERATIONAL VS EMBODIED EMISSIONS

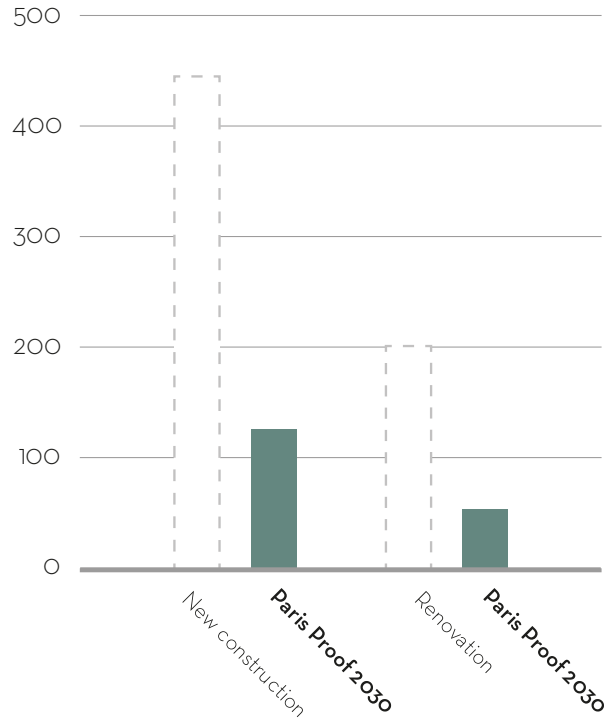


Operational emission (Kg CO_2)

Embodied emission (Kg CO_2)

Fig. 1: Embodied vs Operational, adapted from: Dutch Green Building Council. (2021).

Paris Proof Housing 2030



Embodied emission (Kg CO_2/m^2)

Fig. 2: Paris Proof housing, adapted from: Dutch Green Building Council. (2020).

POTENTIAL WHY BIOBASED?

REASONS TO CHOOSE FOR BIOBASED

- Scarcity of resources
- Carbon capture
- Regenerative
- Health and comfort
- Less transport
- Less waste

Image 10: Iron ore mine. from citicpacificmining.com/our-operation

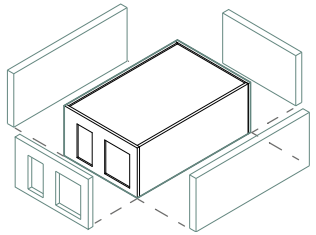
POTENTIAL WHY BIOBASED?

A CRITICAL NOTE ON BIOBASED

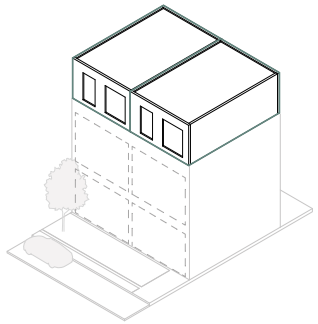
- Responsible cultivation
- Displacement concerns
- Growth location
- Manufactering process
- The percentage of biomass
- Using biomass for energy

Image 11: Biomass energy. Retrieved from parool.nl/amsterdam/biomassacentrale-diemen-krijgt-groen-licht-van-rechter

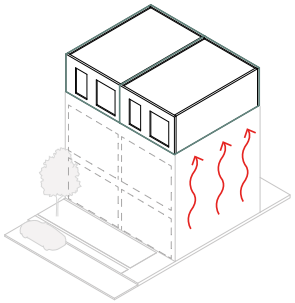
POTENTIAL WHY BIOBASED TOP-UP?



PREFABRICATION

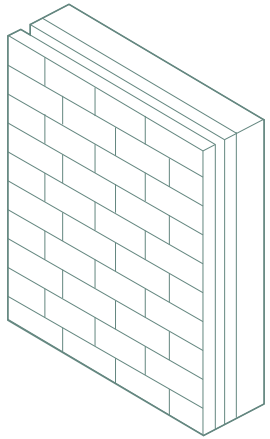


LIGHTWEIGHT



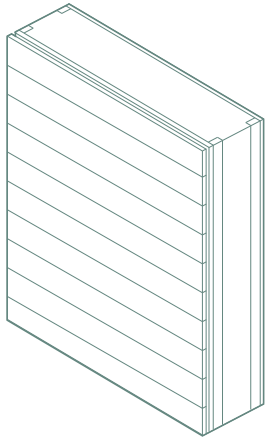
COMFORT

440 kg



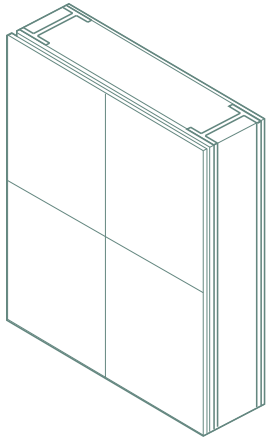
Concrete
PIR
Brick

120 kg



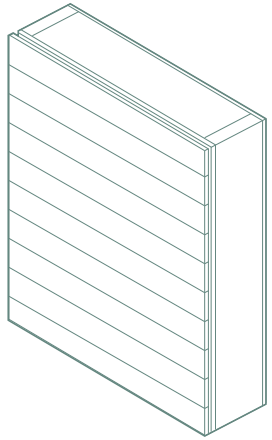
Timber
Hempcrete
Timber cladding

50 kg



Steel structure
Rockwool insulation
Composite cladding

46 kg

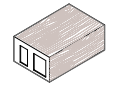
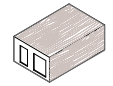
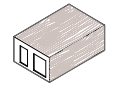
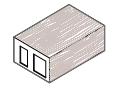


Timber
Flax insulation
Timber cladding

Fig. 3: Lightweight biobased structures, adapted from: Platform m3. (2020).

THE RESOURCES

RESOURCES

MATERIAL	ANNUAL YIELD	APPLICATION	#TOP-UPS
 WOOD (Stora Enso, n.d.)	 390 000 m3 *(Probos, n.d.)*	Structure Insulation Finish	 7 400
 FLAX (Isovlas, n.d.)	 151 710 m3 *(CBS, 2023)*	Insulation Finish	 4 322
 HEMP (Hempflax, n.d.)	 84 852 m3 *(CBS, 2023)*	Structure Insulation Finish	 2 417
 STRAW (Ecococon, 2022)	 600 000 tonnes *(CBS, 2023)*	Structure Insulation	 155 844
 MISCANTHUS (Linex, n.d.)	 10 000 tonnes *(Boosten & Oldenburg, 2014)*	Structure Insulation Finish	-
 CATTAIL (Bedd, n.d.)		Insulation Finish	-
 SEAWEED (Blueblocks, n.d.)		Insulation Finish	-

THE SCALE-UP

THE SCALE-UP
NATIONAL APPROACH

GOALS 2030

- 50 000 hectares of fiber cultivation
- 400 000 tons annual yield of fibers
- At least 30% of new residential buildings are constructed using 30% biobased materials

Image 12: Livestock farming. From: https://www.foodlog.nl/artikel/nederland-goed-voor-05-biologisch-eu-areaal/

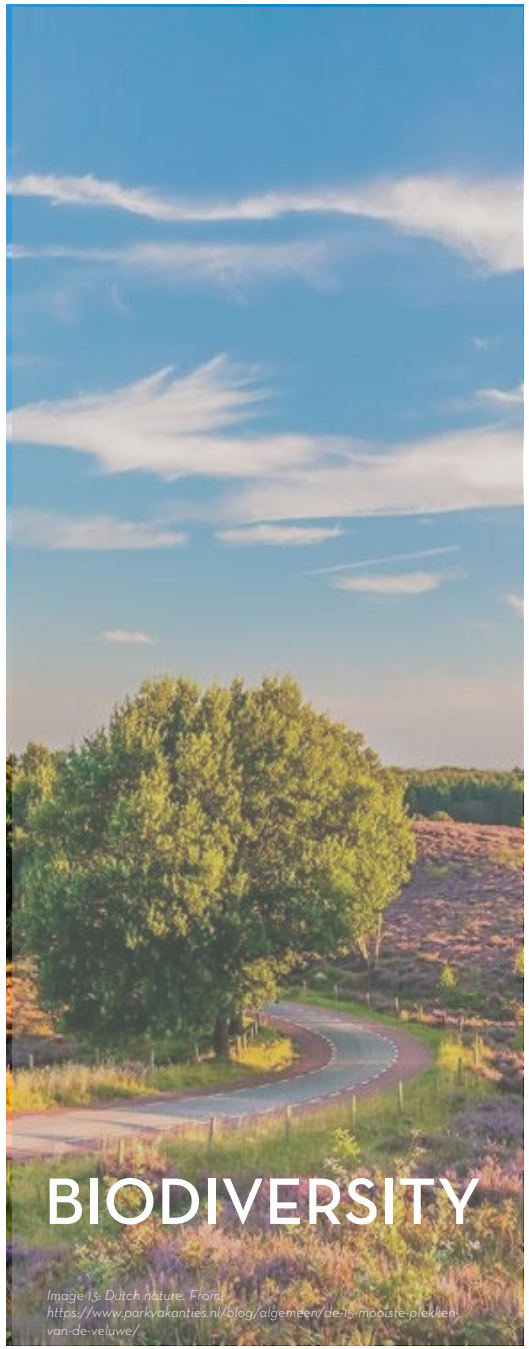


Image 13: Dutch nature. From: https://www.parkvakanties.nl/blog/algemeen/de-15-mooiste-plekken-van-de-veluwe/

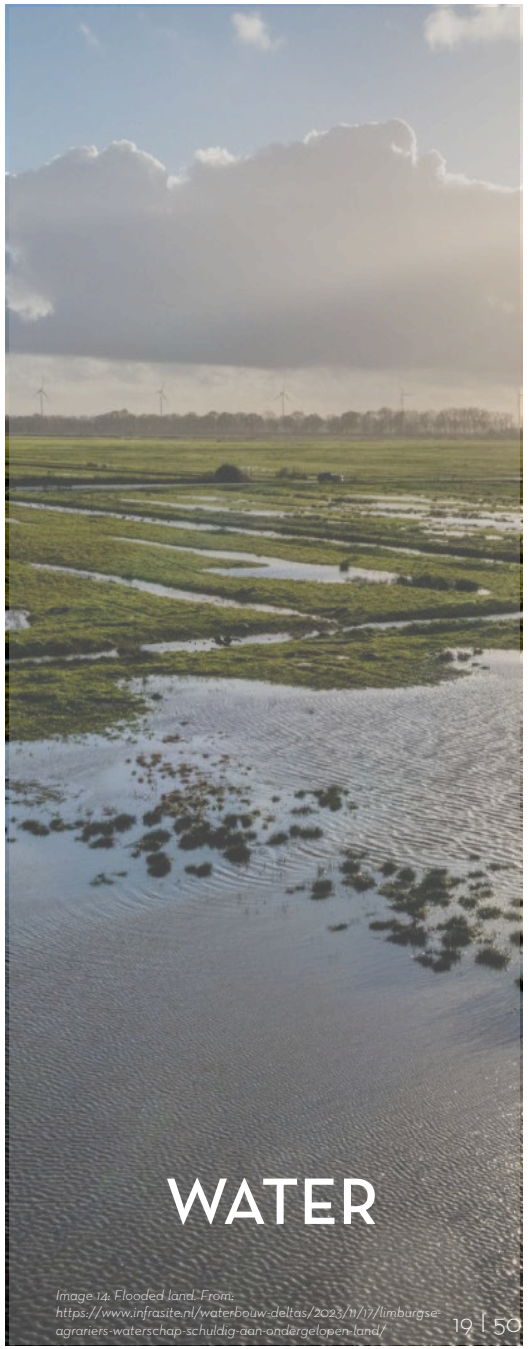


Image 14: Flooded land. From: https://www.infrasite.nl/waterbouw-deltas/2023/11/17/limburgse-agrariers-waterschap-schuldig-aan-ondergelopen-land/

THE SCALE-UP
REGIONAL APPROACH

The region of Zuid-Holland has three types of landscapes

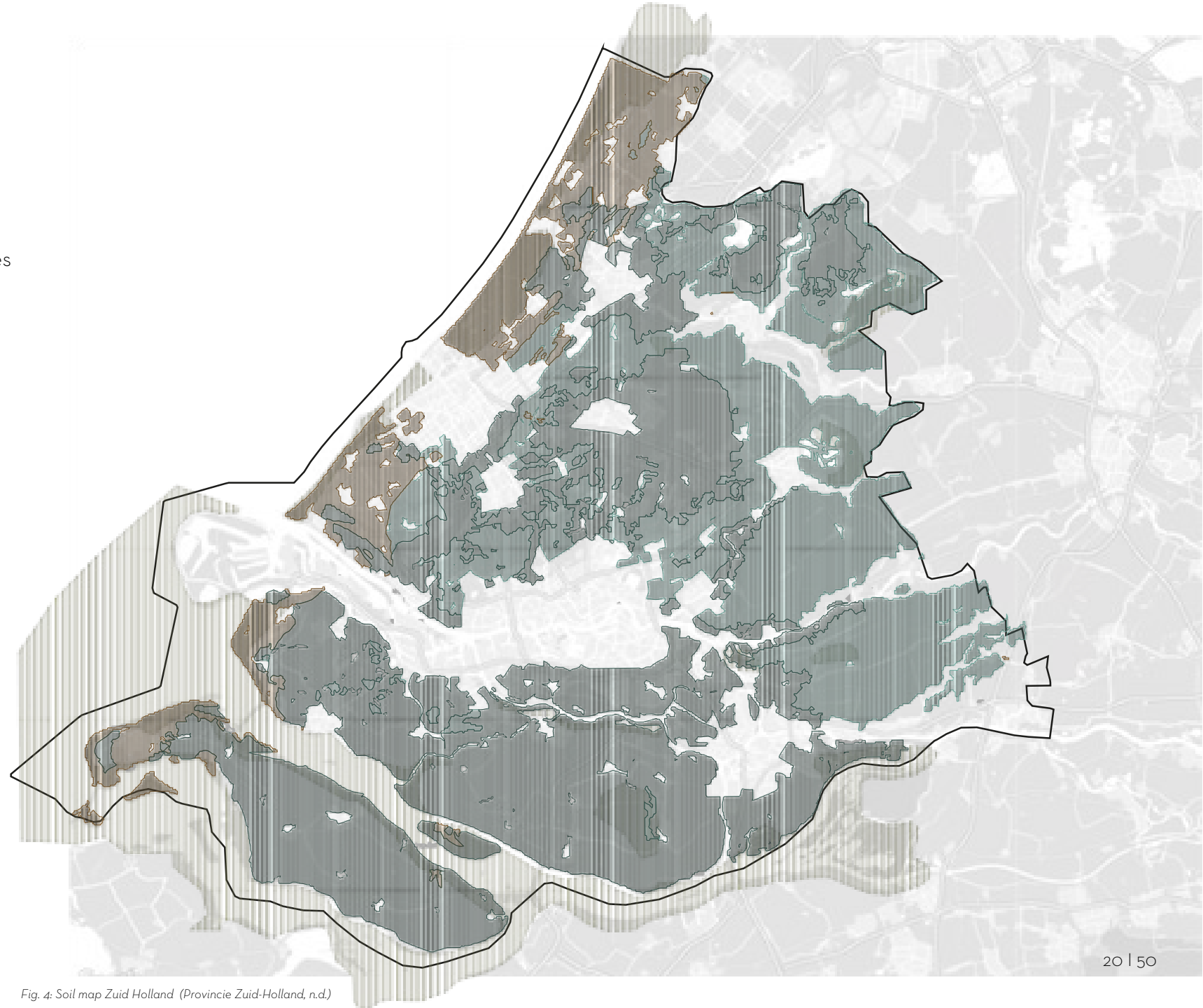


Fig. 4: Soil map Zuid Holland (Provincie Zuid-Holland, n.d.)

THE SCALE-UP

REGIONAL APPROACH

Image 15: Dutch landscape

THE SCALE-UP

CLAY LANDSCAPE

- Salinization
- Soil depletion due to current intensive agriculture

Image 16: Clay landscape

THE SCALE-UP

PEAT LANDSCAPE

- Oxidation of the peat soil causing CO_2 exhaust
- Subsidization

Image 17: Peat landscape

THE SCALE-UP

REGIONAL APPROACH

SAND LANDSCAPE

- Soil and water pollution
- Pressing nitrogen crisis

Image 18: Sand landscape

THE SCALE-UP

REGIONAL APPROACH

Image 19: Topping-up on location

THE SCALE-UP RESOURCE APPROACH

MATERIAL		APPROACH
	→	The annual yield of wood from the Dutch forestry is and will always be very limited.
	→	Flax is a rotation crop which is cultivated every 7 years, and will help improve the soil qualitiy.
	→	Hemp is a rotation crop which is cultivated every 5 years, and will help improve the soil qualitiy.
	→	Straw is a residual and abbundantly available.
	→	Miscanthus has minimal requirements and could grow on any soil.
	→	Cattail grows along the more and more present water bodies.
	→	Seaweed require minimal land.

THE BENEFIT

THE BENEFIT

GLOBAL WARMING POTENTIAL

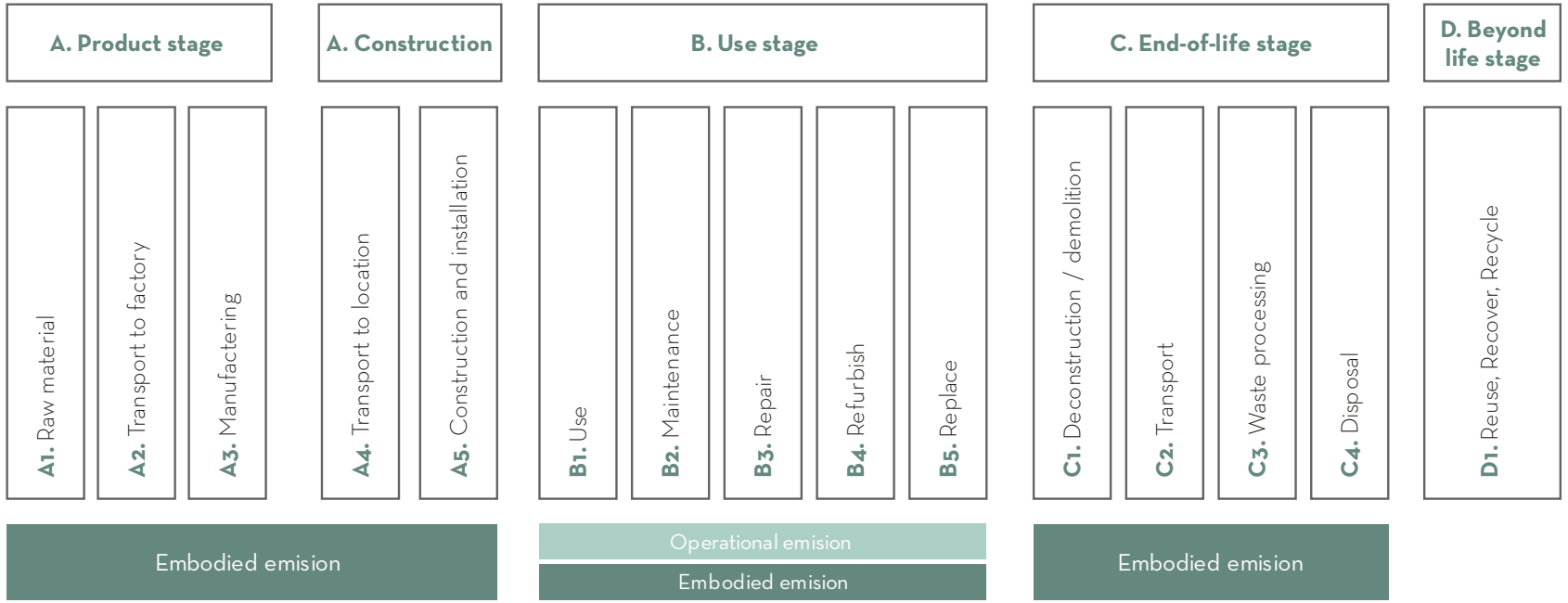


Fig. 5: Schematic representation of Life Cycle Assessment (EN 15804, 2012 + A2:2019)

THE BENEFIT

GLOBAL WARMING POTENTIAL

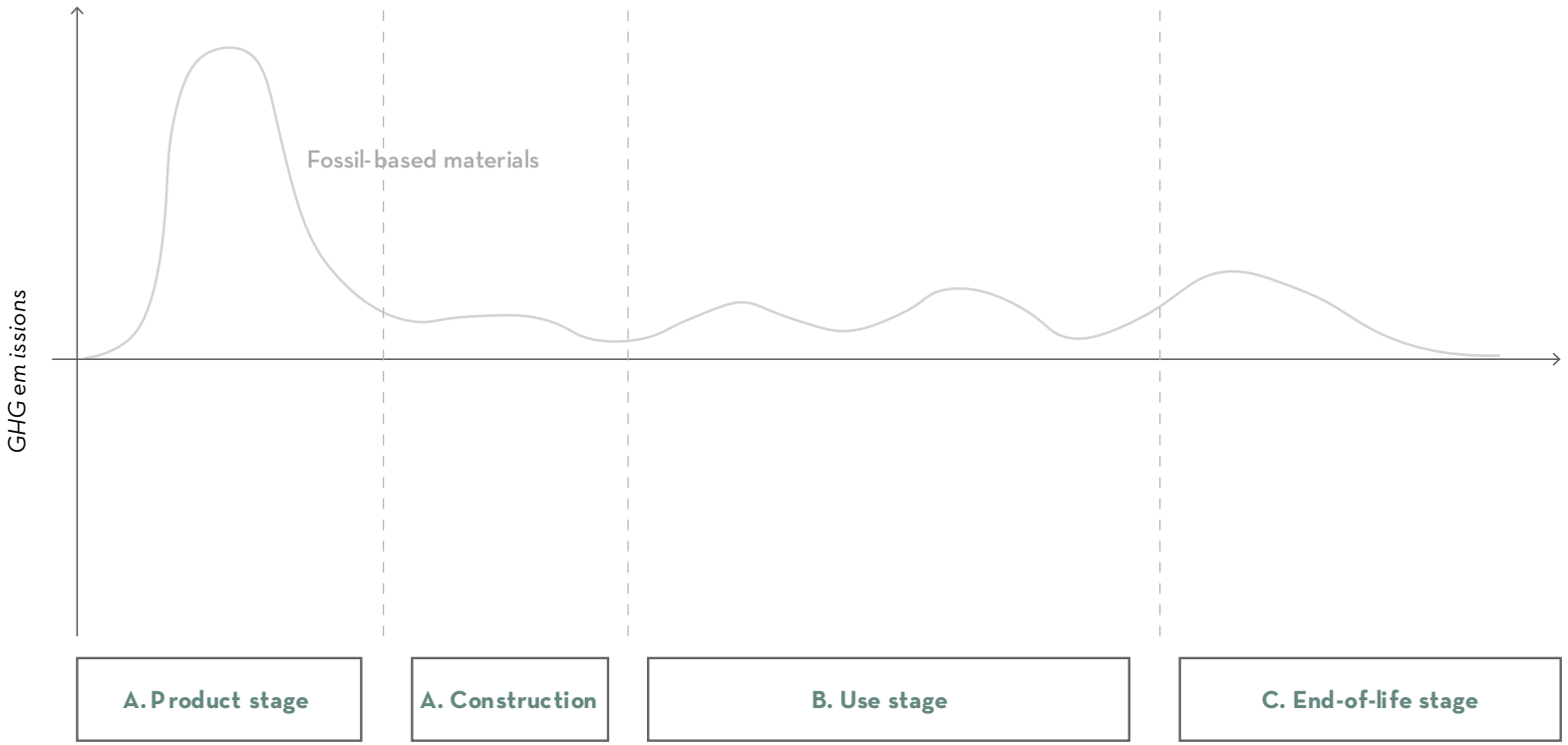


Fig. 6: GHG emissions in a life cycle (Gobbo et al., 2021)

THE BENEFIT

GLOBAL WARMING POTENTIAL

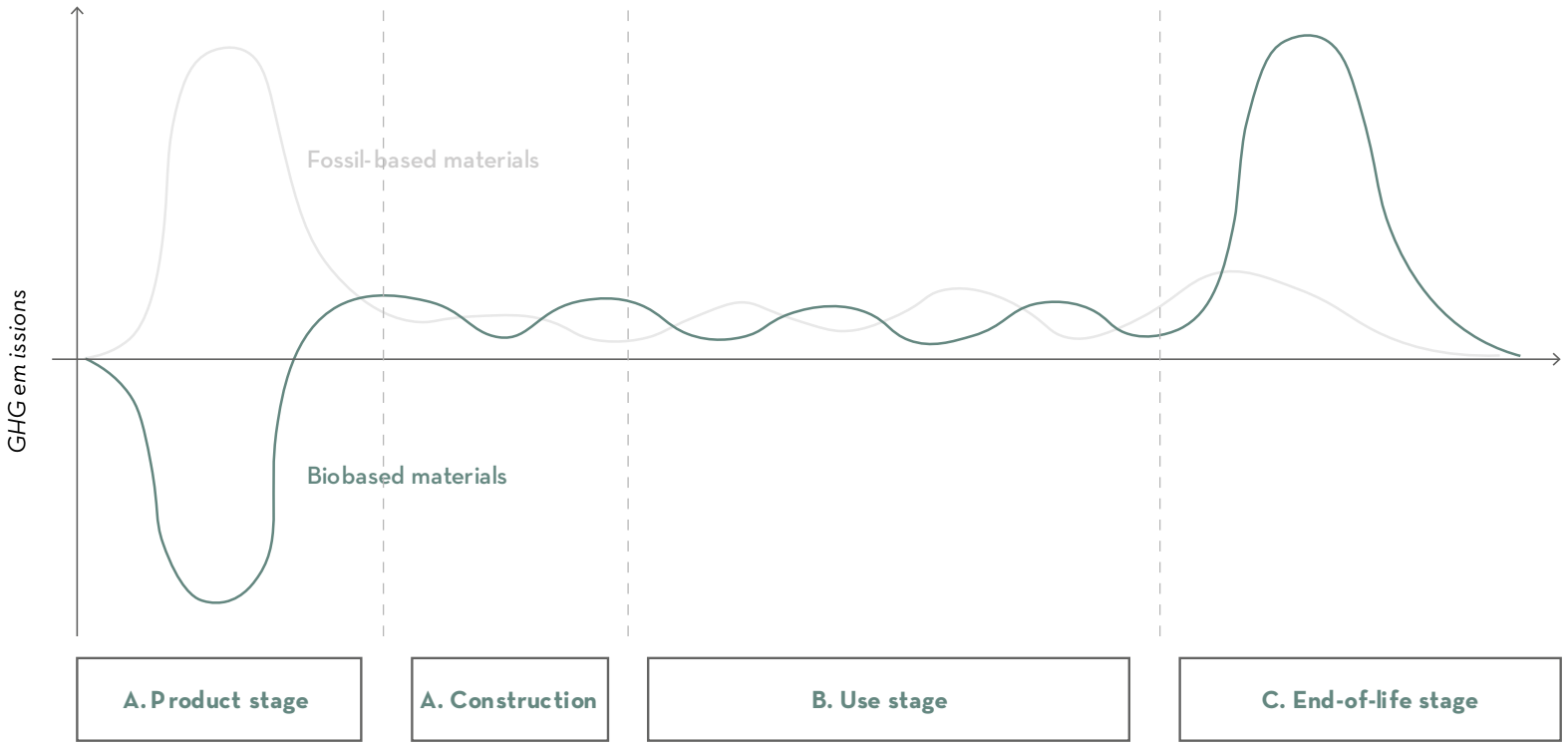


Fig. 6: GHG emissions in a life cycle (Gobbo et al., 2021)

THE BENEFIT

GLOBAL WARMING POTENTIAL

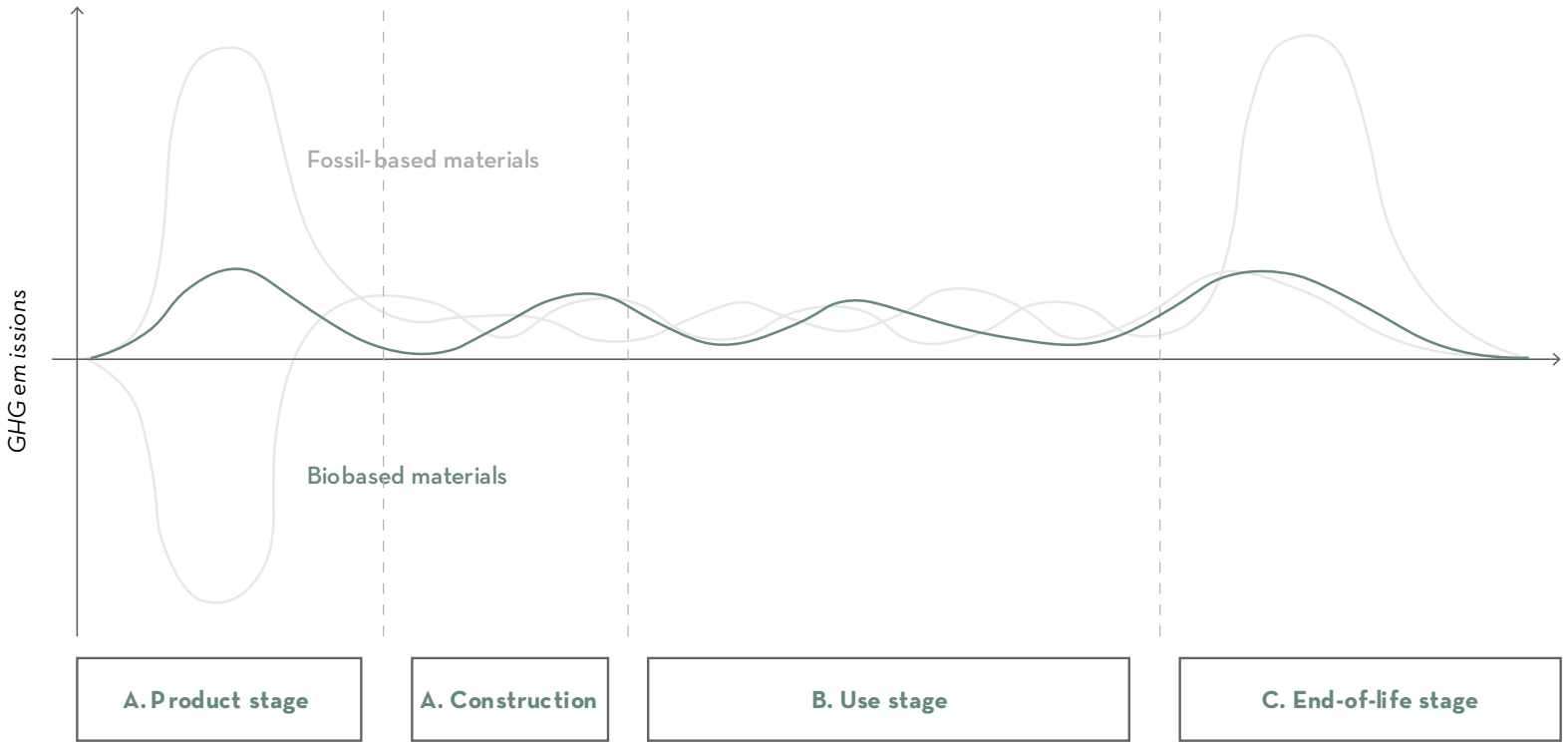


Fig. 6: GHG emissions in a life cycle (Gobbo et al., 2021)

THE BENEFIT

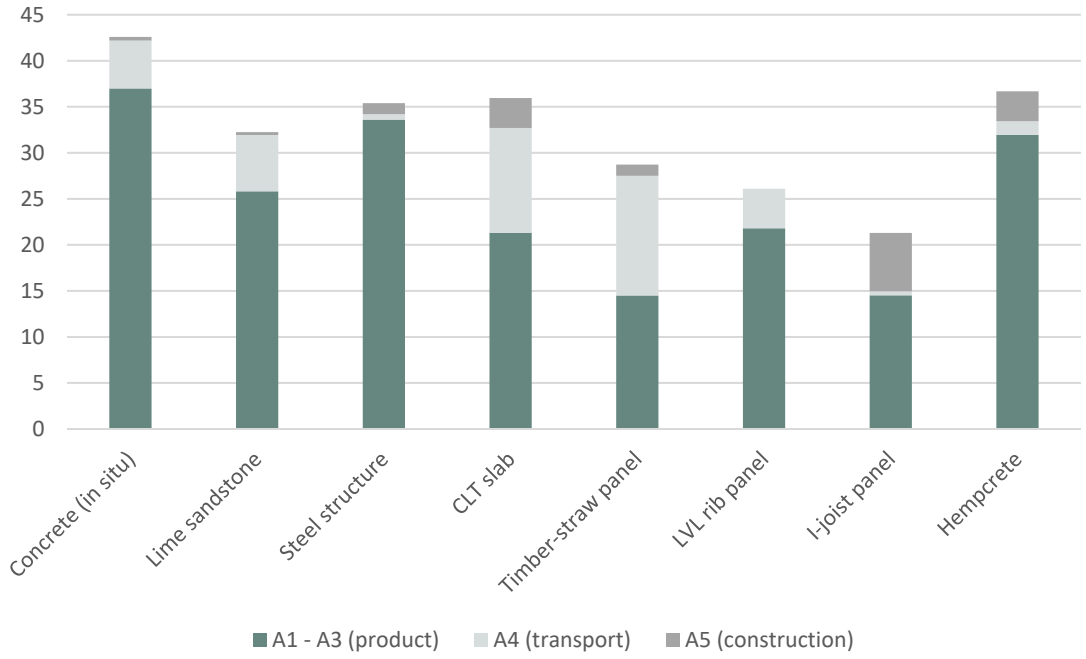
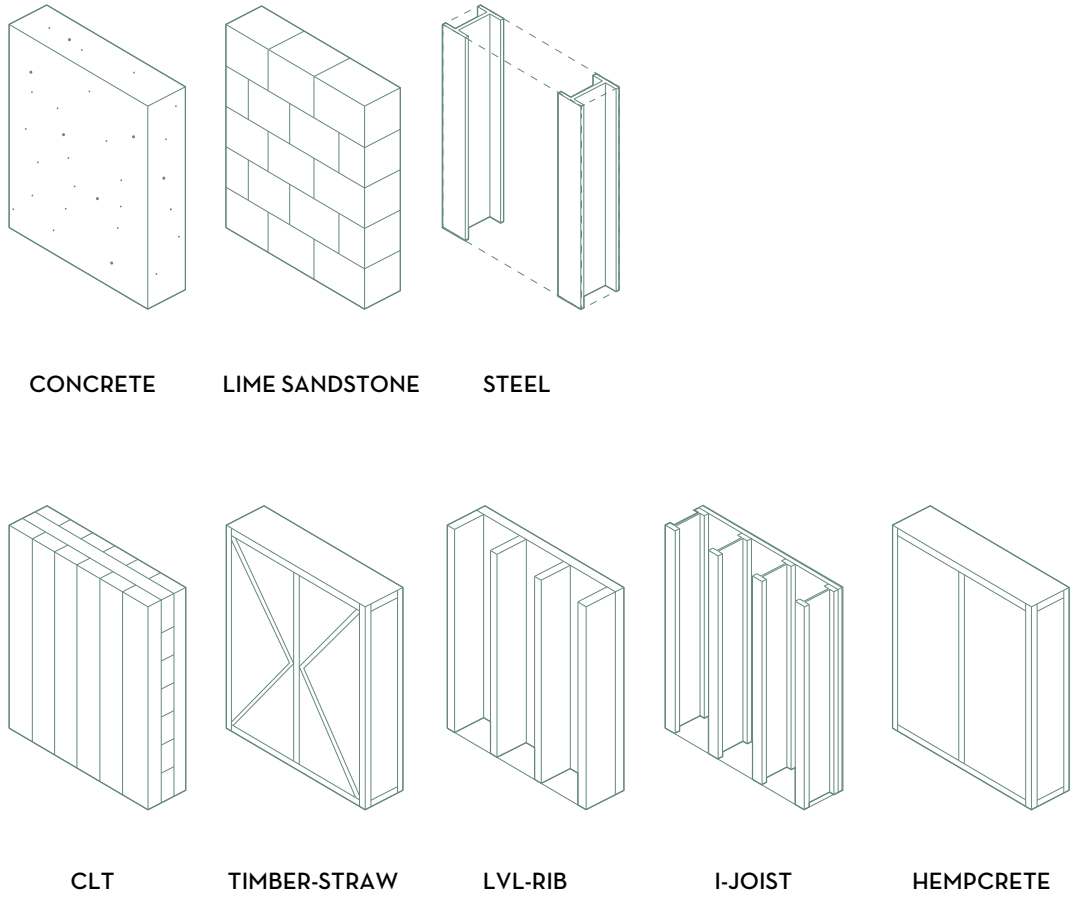


Fig. 7: GWP for 8 load-bearing structures

COMPARISON OF GWP



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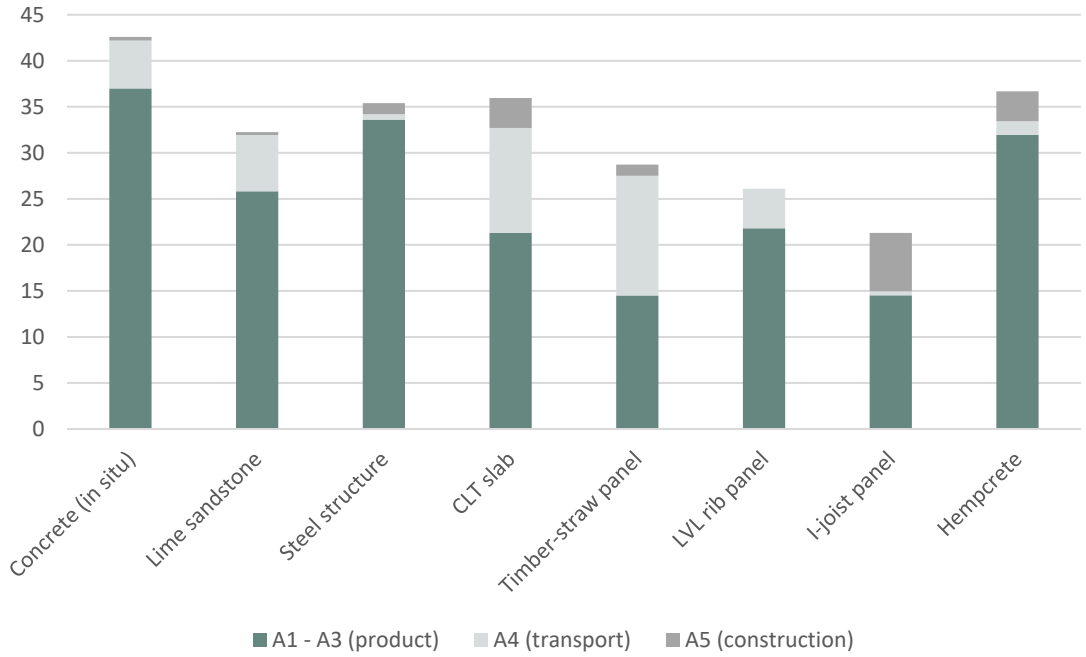


Fig. 9: GWP for 8 load-bearing structures

Image 20 Timber-straw panel (Ecococon, n.d.) from: https://www.biobasedbouwen.nl/producten/ecococon-prefab-stropanelen/

THE BENEFIT

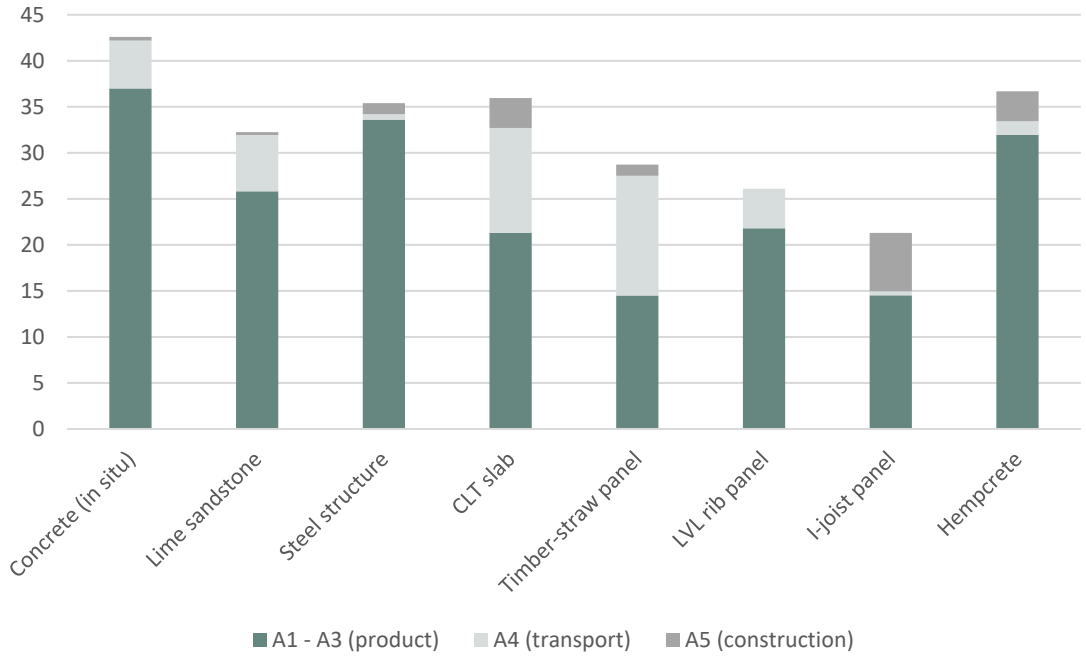


Fig. 9: GWP for 8 load-bearing structures

Image 21 Scandinavian forestry from: globalwoodmarketsinfo.com/norway-boosts-softwood-log-exports-eu-countries-filling-russian-supply-gap/

THE DESIGN

DESIGN CURRENT DESIGN

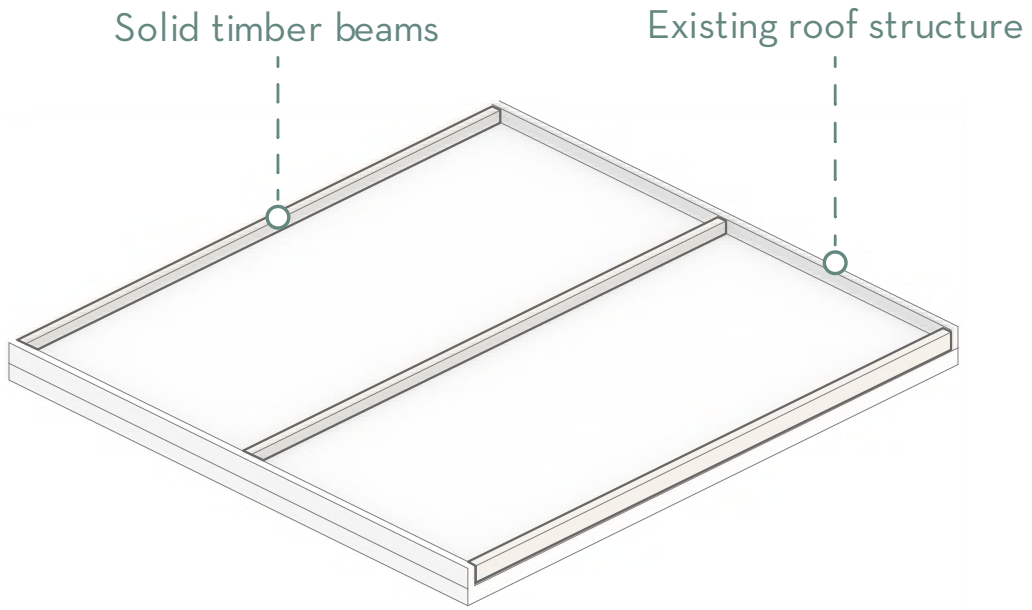


Fig. 10: Structure of the top-up

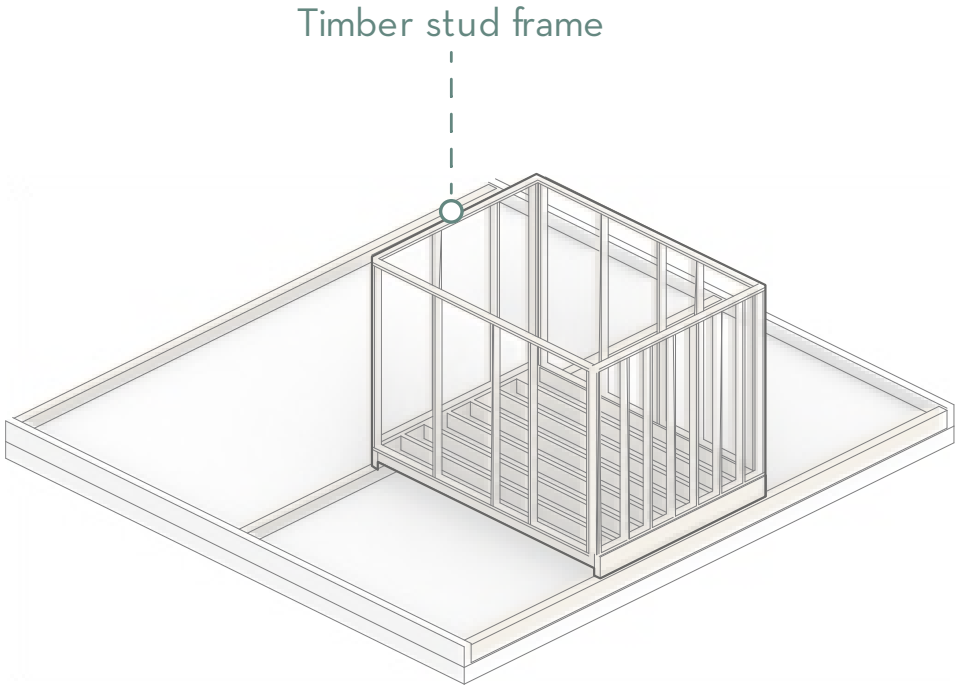
DESIGN TEAM

nieuwe architecten

smits vastgoedzorg

bob

DESIGN CURRENT DESIGN



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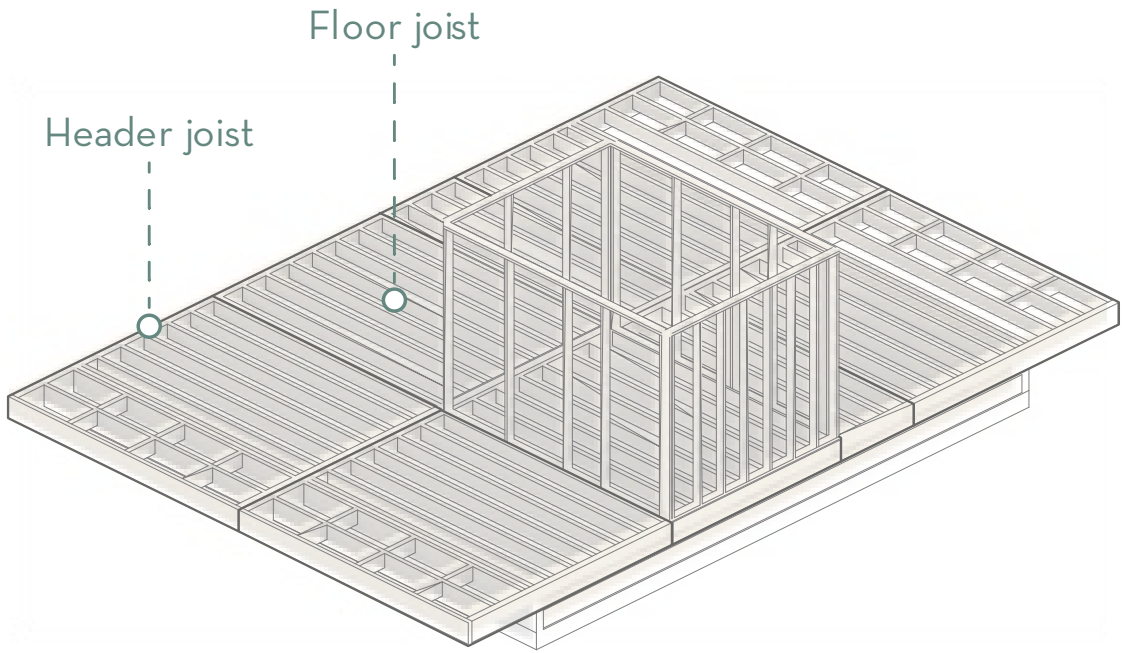

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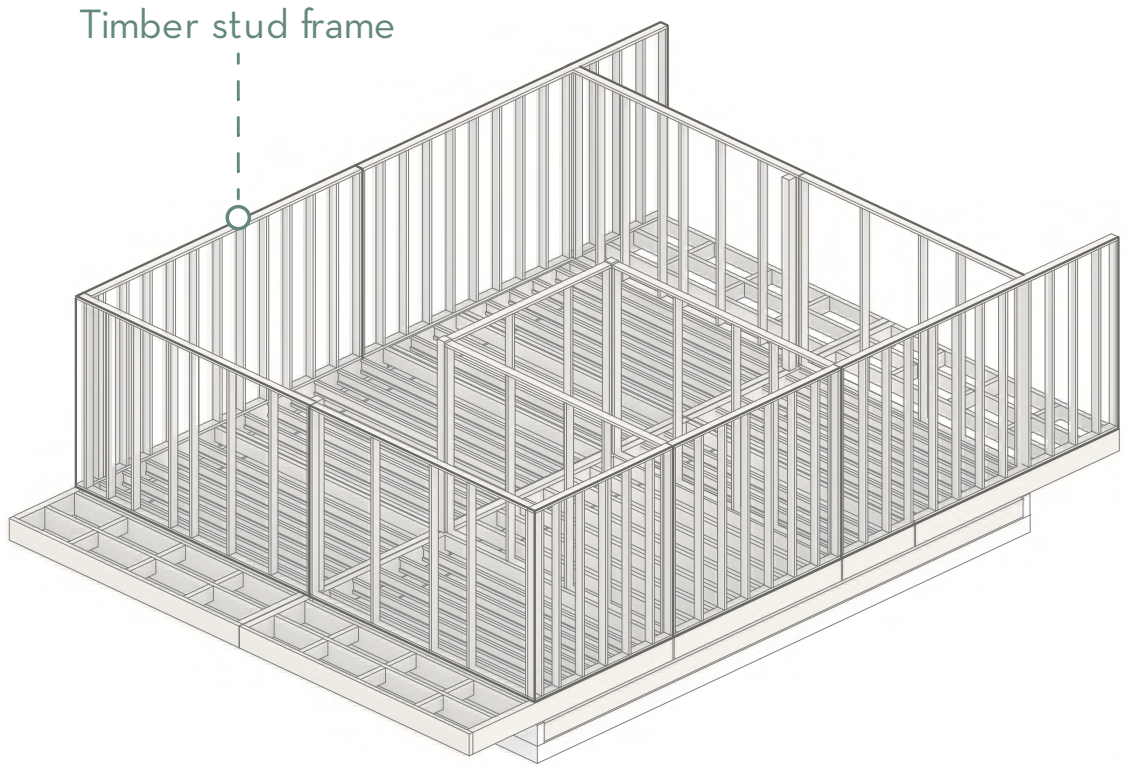

Fig. 10: Structure of the top-up

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smits vastgoedzorg

DESIGN CURRENT DESIGN

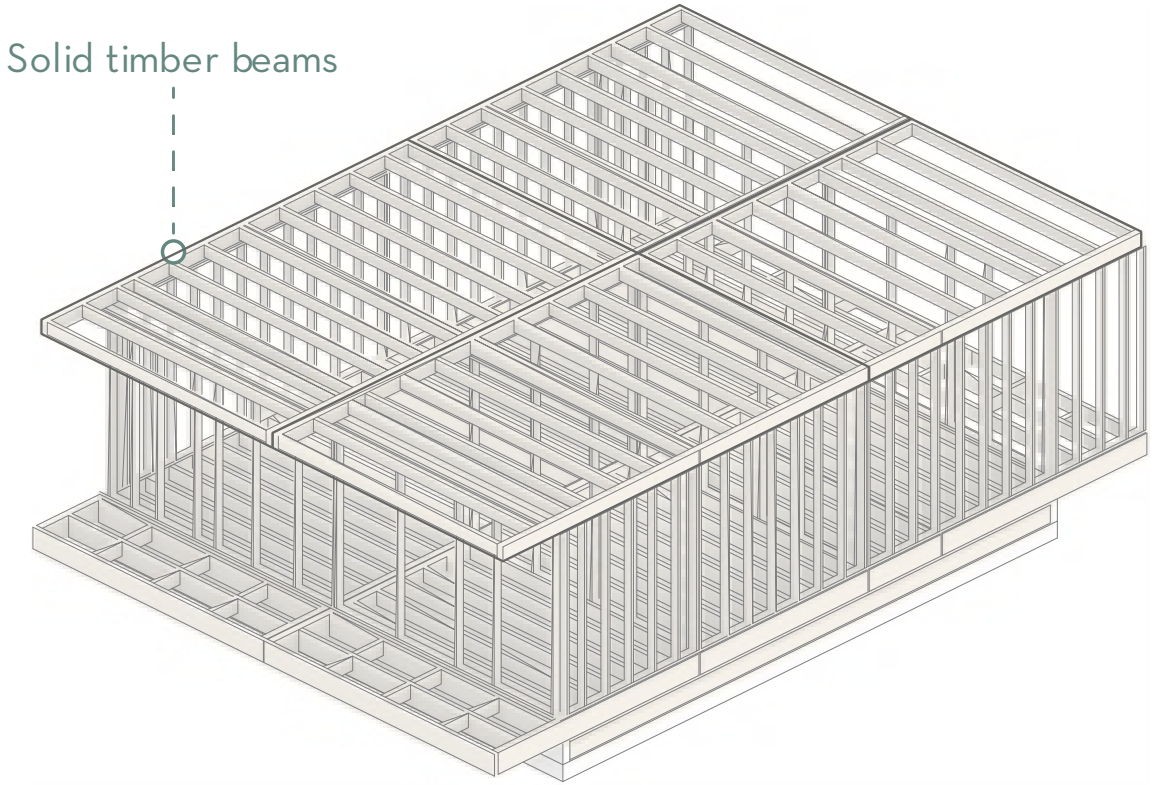


Fig. 10: Structure of the top-up

DESIGN TEAM

nieuwe architecten

smits vastgoedzorg

DESIGN SCENARIO 2023

+ Maximize the amount of biobased materials

– Limit the amount of scarce biobased materials

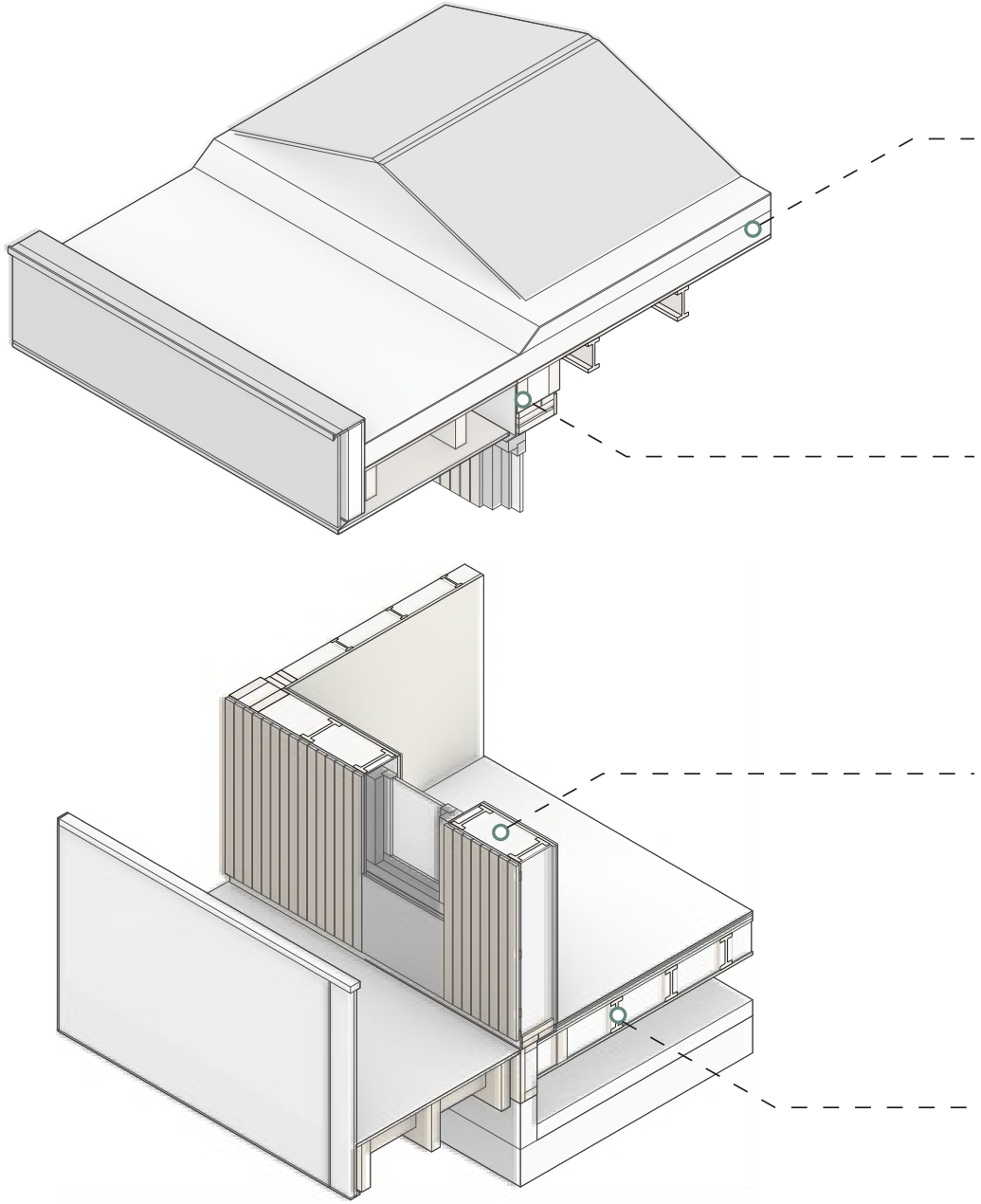


Fig. 11: Materialisation of the top-up

WOOD FIBRE

LAMINATED VENEER LUMBER

FLAX WOOL

I-BEAMS

DESIGN SCENARIO 2023

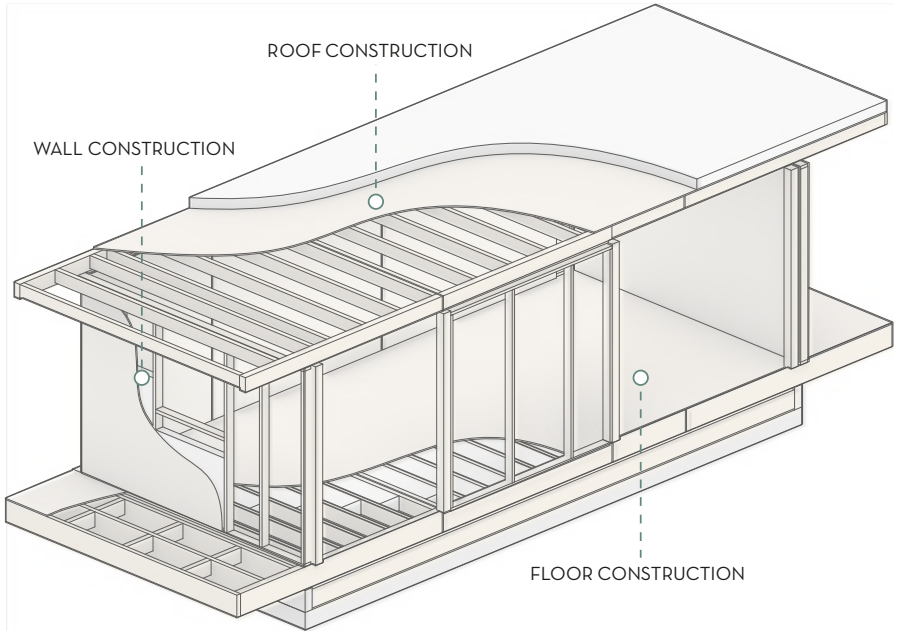


Fig. 12: The top-up decomposed

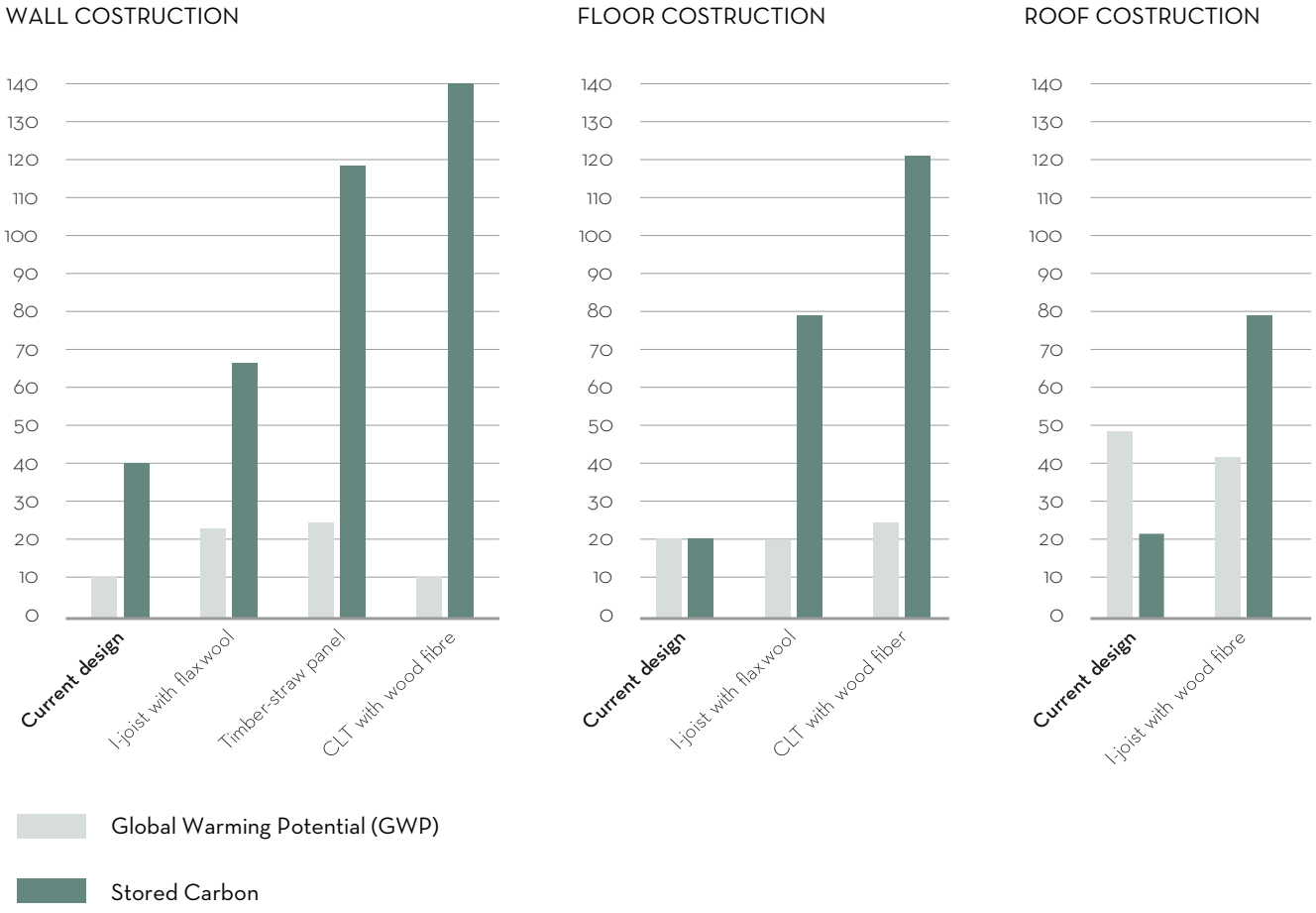
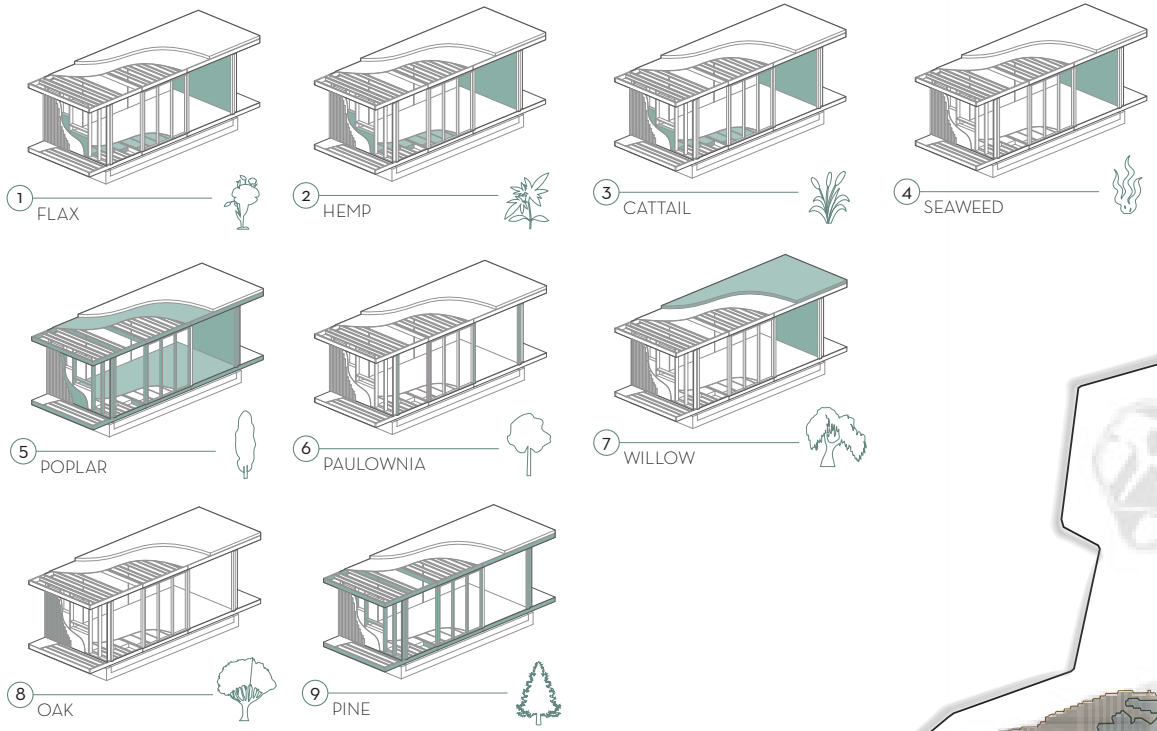


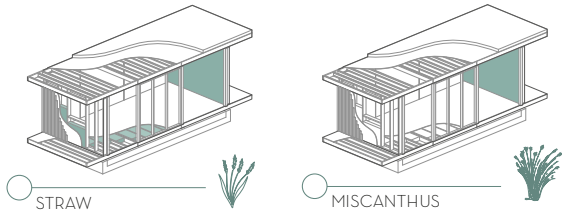
Fig. 13: GWP and stored carbon of design alternatives

DESIGN SCENARIO 2030

ALLOCATED RESOURCES



UN-ALLOCATED RESOURCES



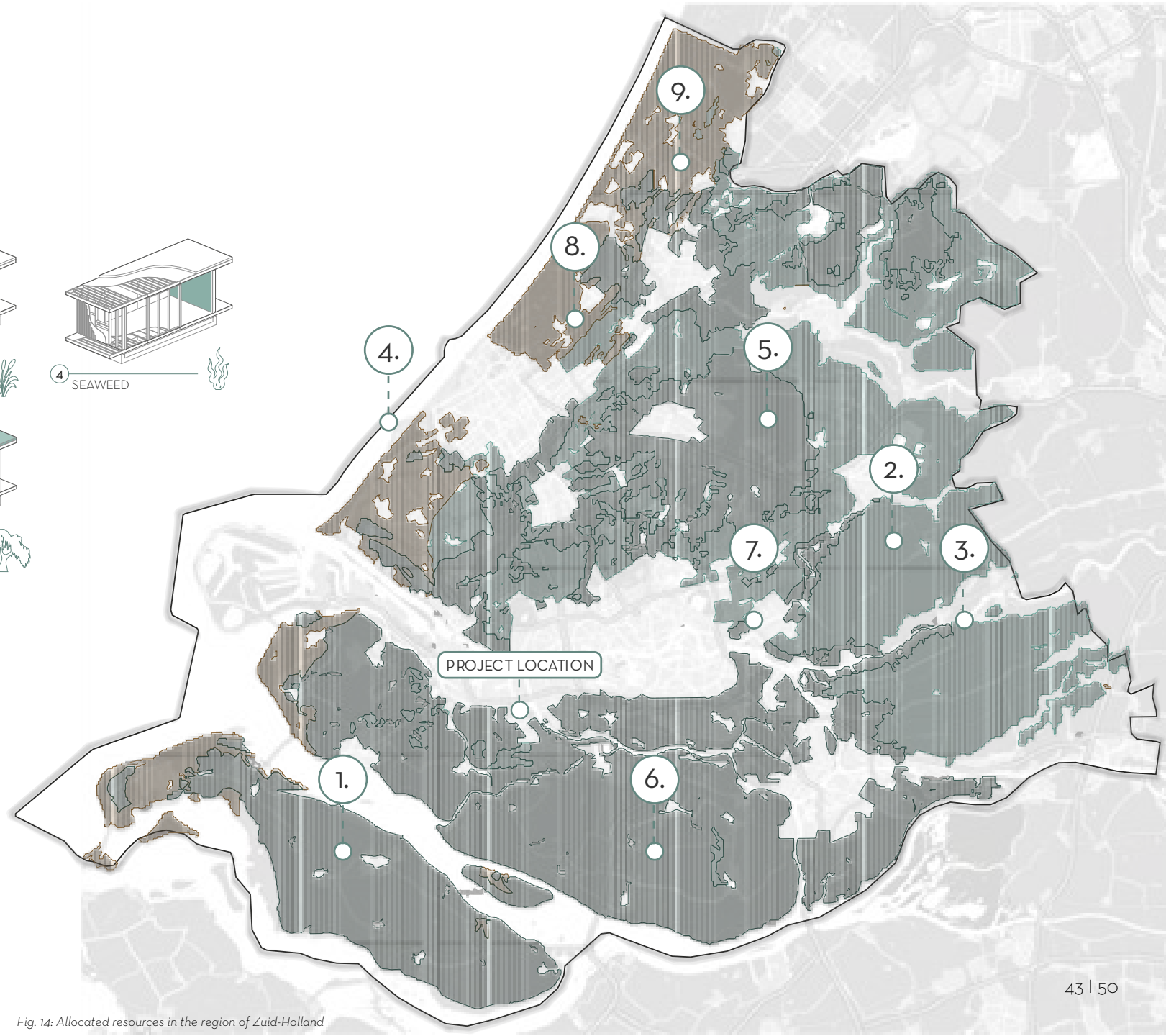


Fig. 14: Allocated resources in the region of Zuid-Holland

DESIGN
SCENARIO 2030

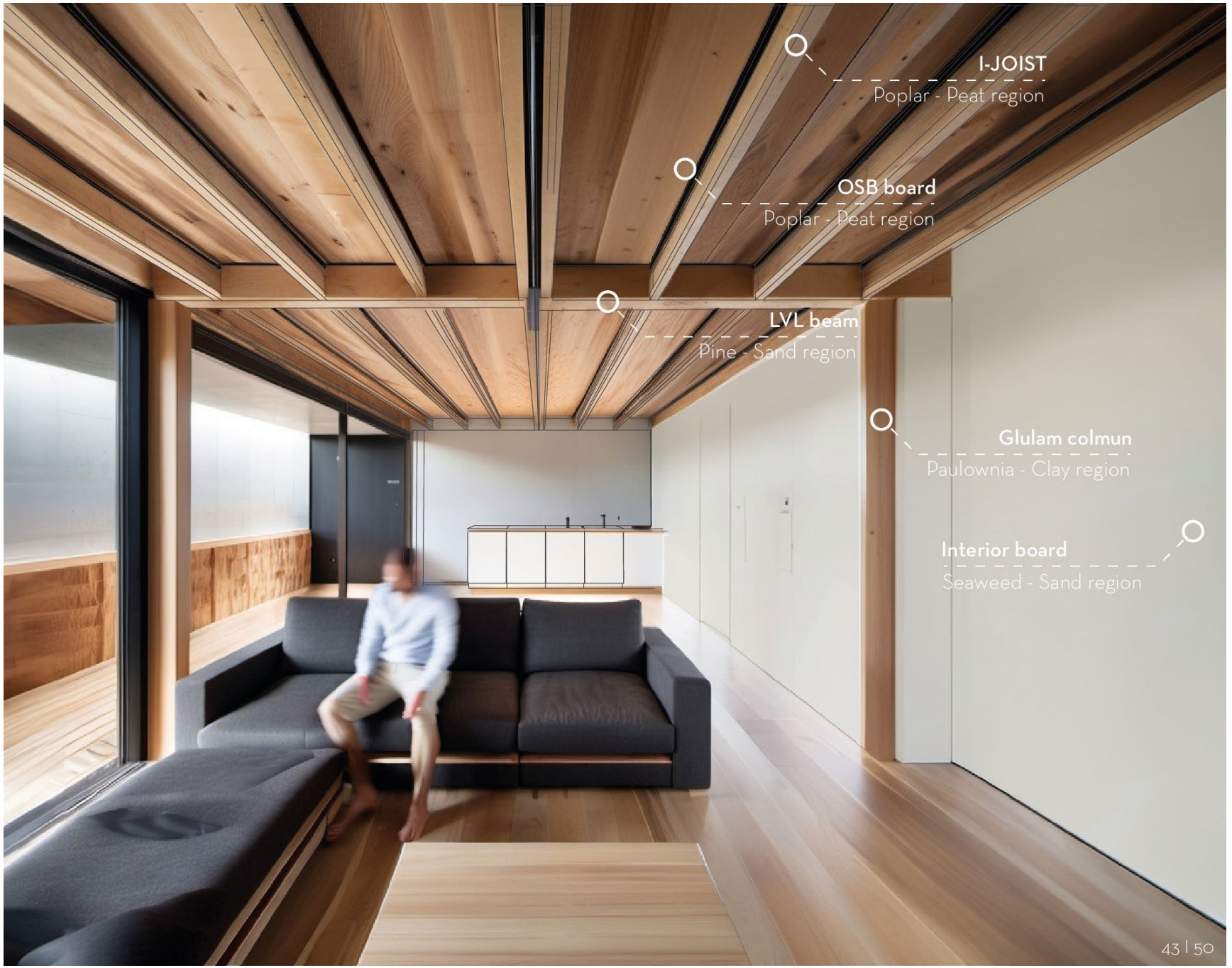


Image 22: Visualization of the interior

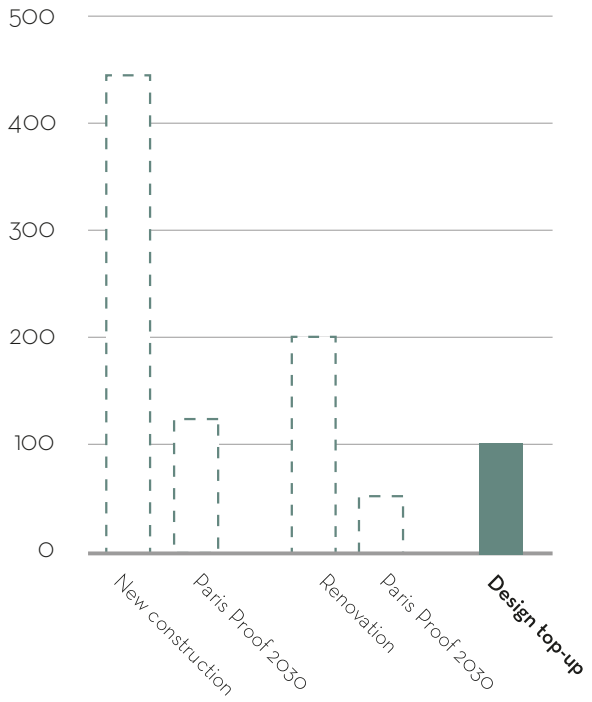
DESIGN
SCENARIO 2030

Image 23: Visualization of a section

DESIGN
SCENARIO 2030

Image 24: Visualization of a section

DESIGN
SCENARIO 2030



Embodied emission (Kg CO_2/m^2)

Fig. 2: Paris Proof housing, adapted from: Dutch Green Building Council. (2020).

Image 24: Visualization of a section

THE CONCLUSION

CONCLUSION

MAIN RESEARCH QUESTION

- How can locally sourced biobased building materials be used in constructing top-ups in The Netherlands?

HYPOTHESIS

- The 100 000 required top-ups could be constructed with locally sourced biobased materials.
- By doing so the embodied emissions will be reduced.

CONCLUSION

- It is currently not possible to construct the 100 000 required top-ups with biobased materials
- The strong believe is that by 2030 the production and cultivation of biobased materials could significantly be increased without competing with food production or biodiversity.
- By constructing these top-ups with biobased materials the embodied emissions will reduce
- It is very complex to prove whether sourcing these materials locally has a positive impact on the GWP, since trade-offs could take place

QUESTIONS?