

A photograph of a modern building complex at dusk, reflected in water. The building has a prominent glass facade and is illuminated from within. A glass bridge connects different parts of the complex. The sky is a deep blue, and the water reflects the lights from the building and the sky.

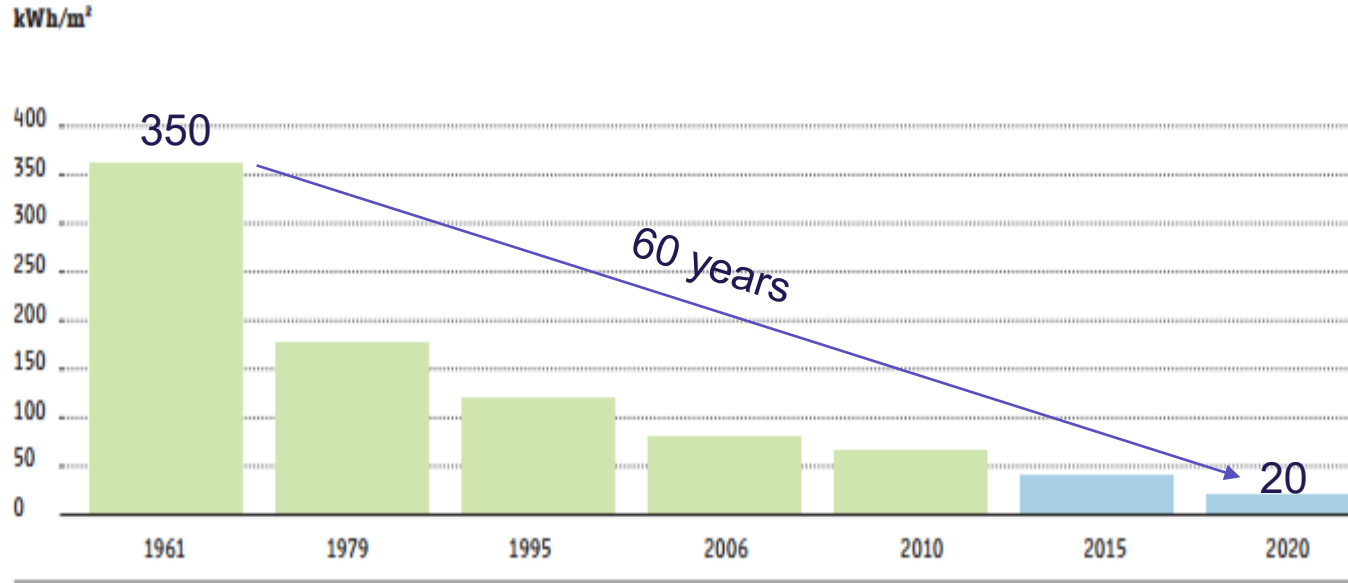
WHERE SHOULD WE FOCUS TO ACHIEVE LOW CARBON FUTURE IN THE CONSTRUCTION SECTOR?

HARPA BIRGISDOTTIR



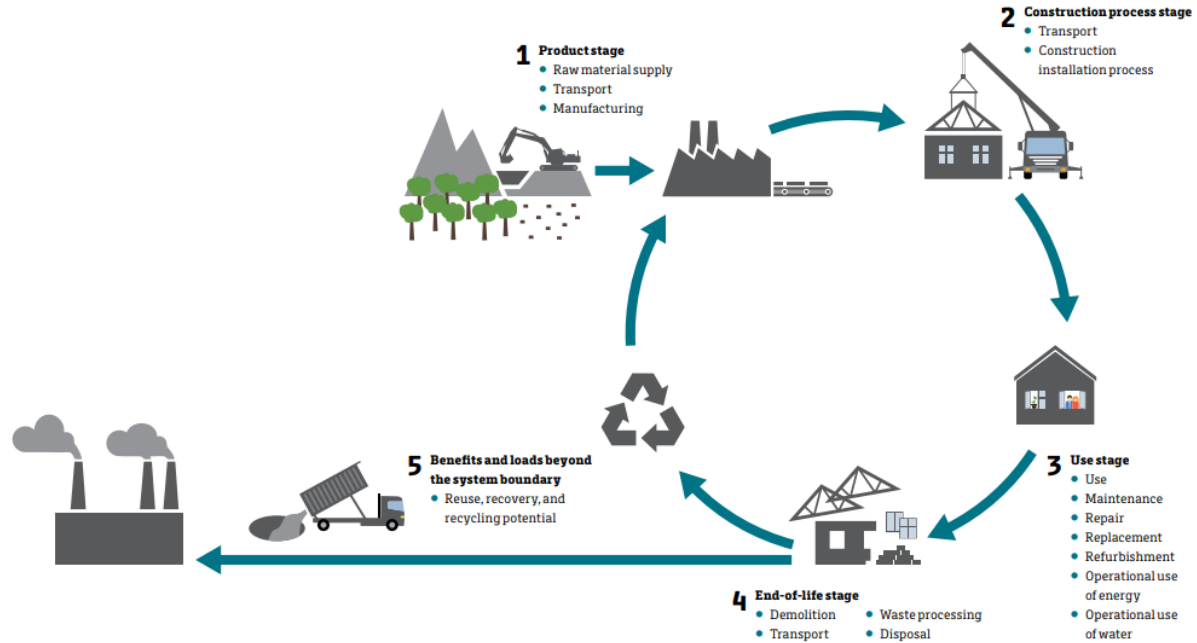
DANISH BUILDING RESEARCH INSTITUTE
AALBORG UNIVERSITY COPENHAGEN

Development of the operational energy requirements



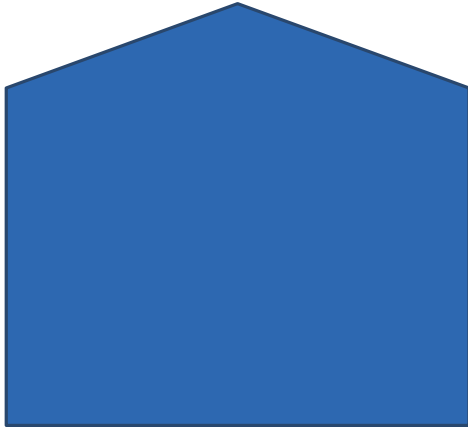
Kilde Energistyrelsen

Focus on building life cycle

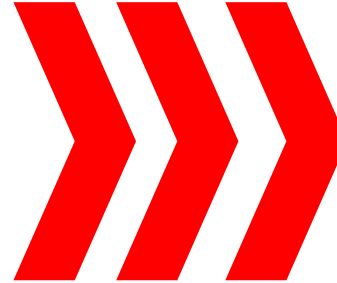


Whole life carbon assessment for buildings

Emissions related to
Building materials
(Embodied)

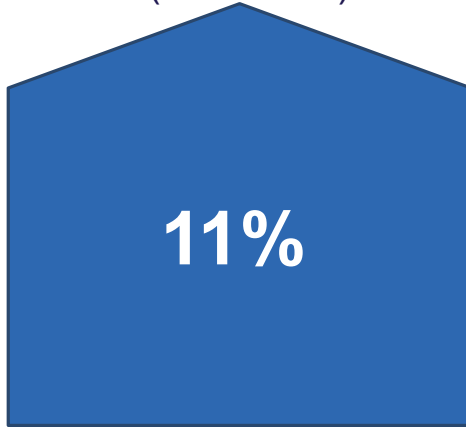


Emissions related to
Operational energy
consumption

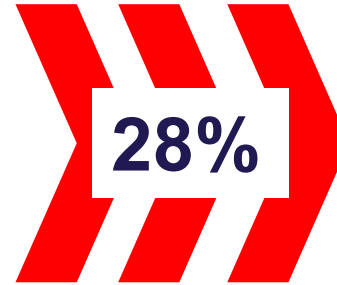


Greenhouse gas emissions related to built environment on global scale

Emissions related to
materials for buildings
and infrastructure
(Embodied)



Emissions related to
Operational energy
consumption



Bringing embodied carbon upfront, WGBC 2019

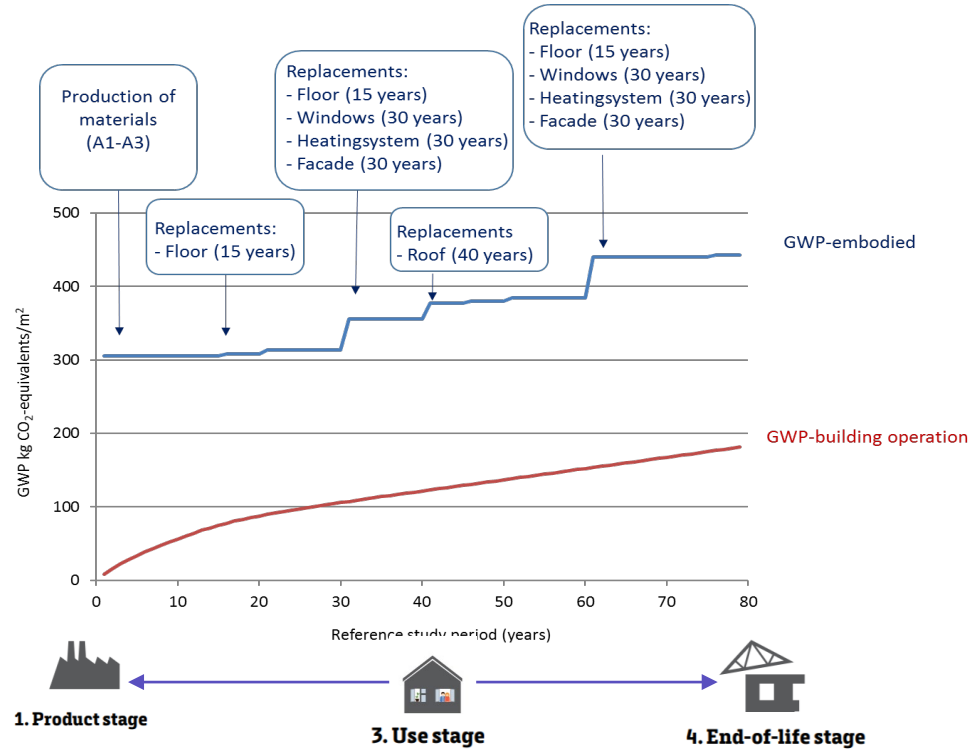
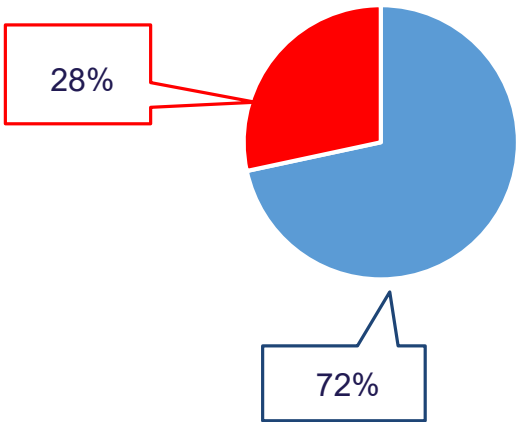




How does it look like for the buildings we are building today?



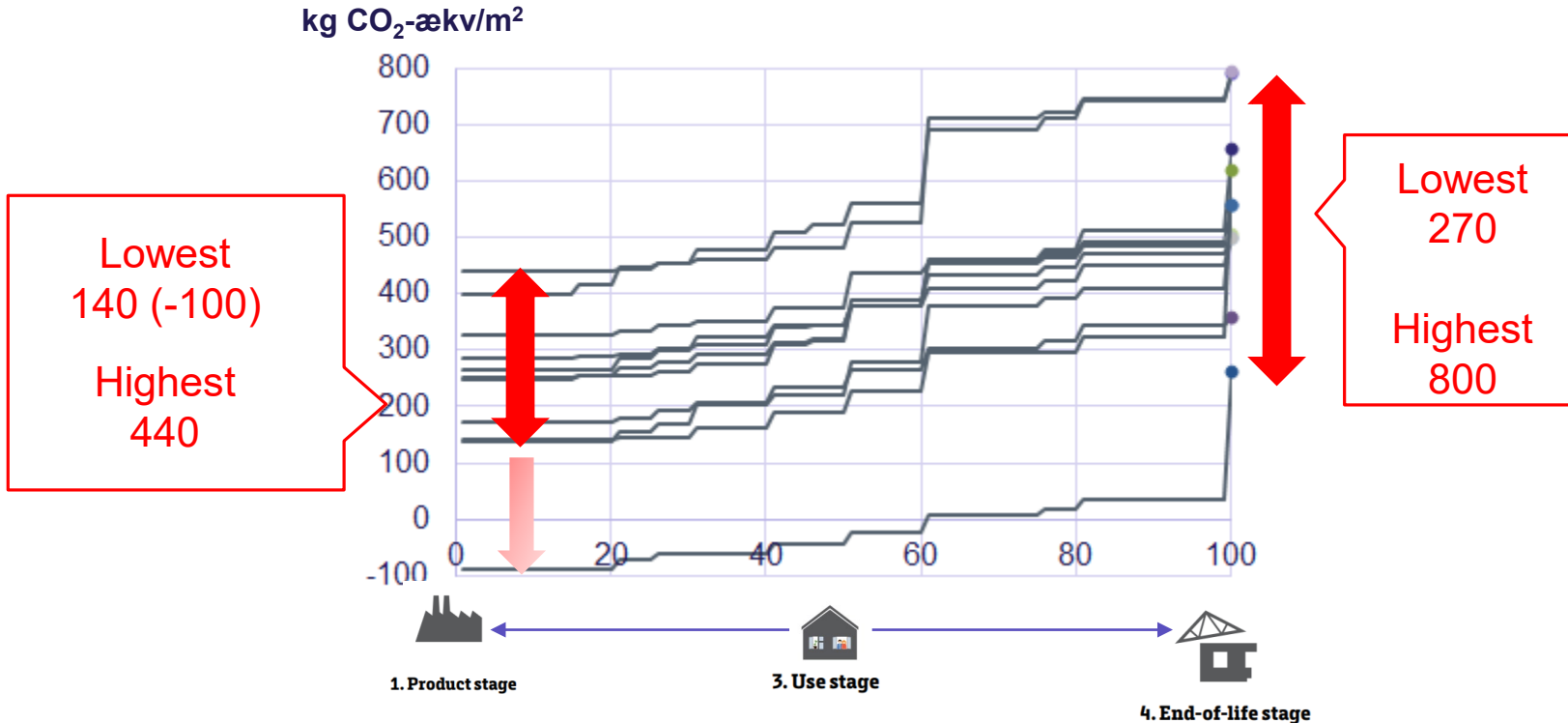
Whole life carbon assessment for an office building – an example



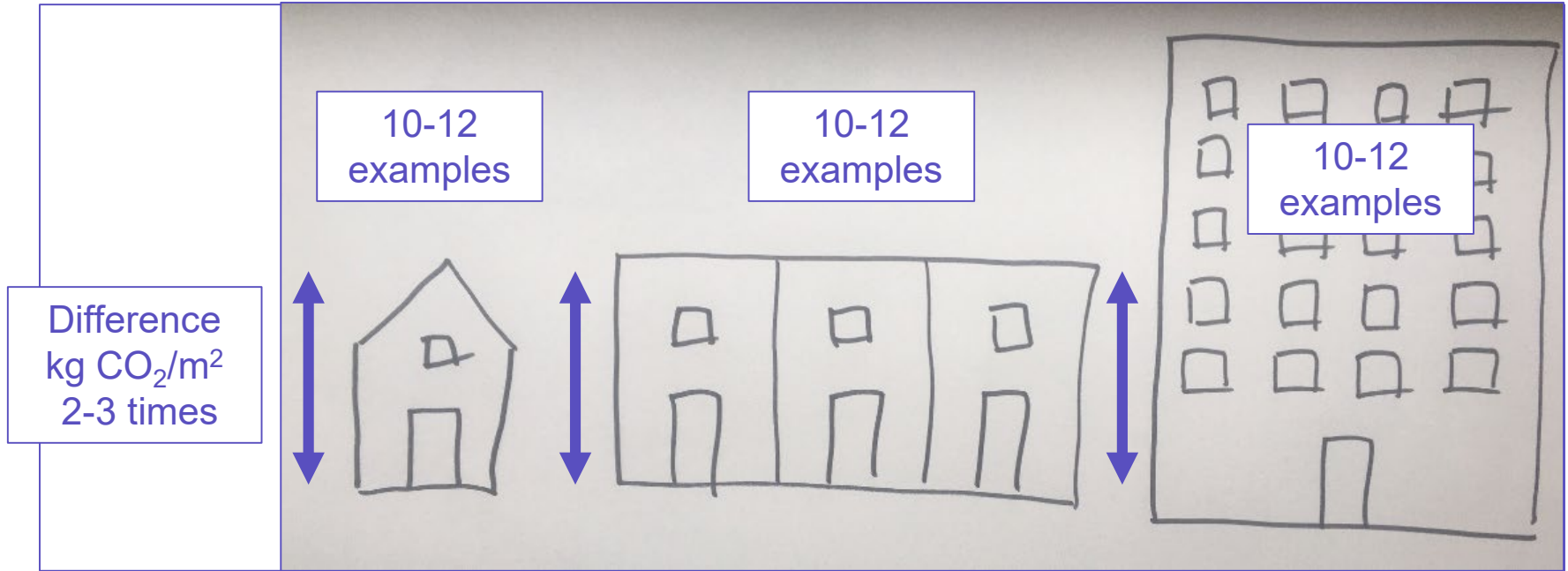
Not regulated

Regulated

There is a large potential to reduce the embodied impacts

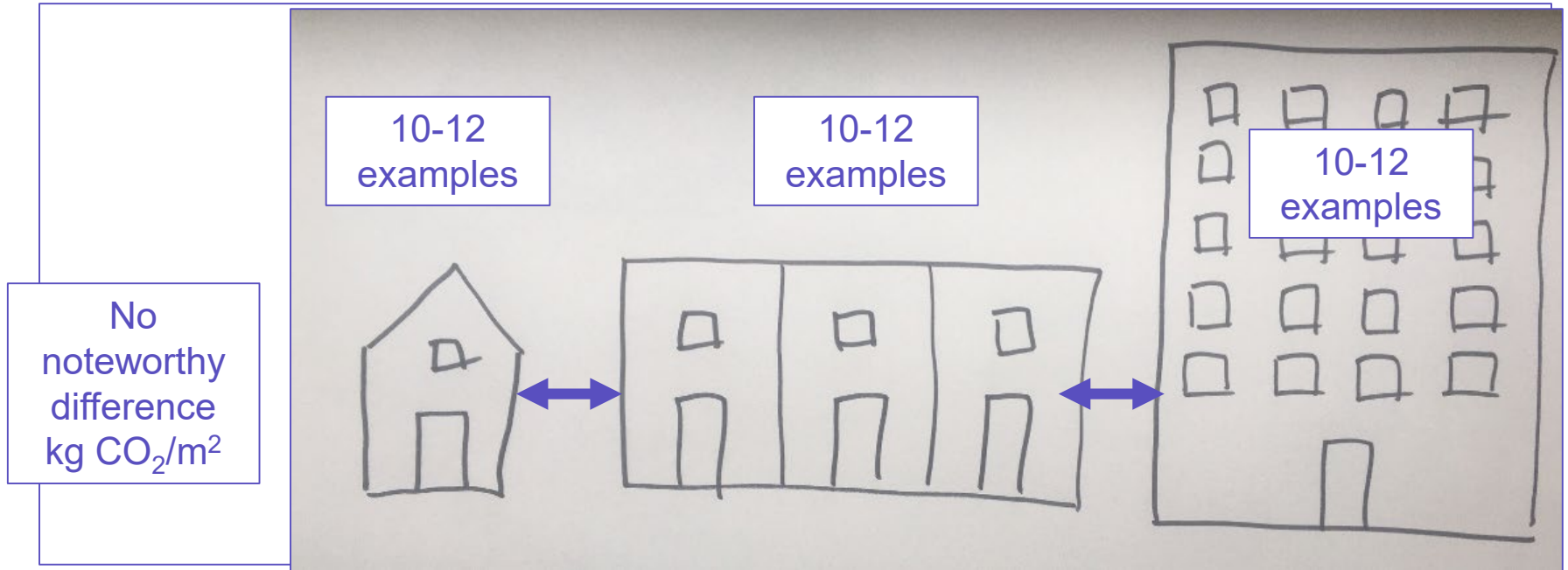


Differences in the carbon footprint of residential buildings

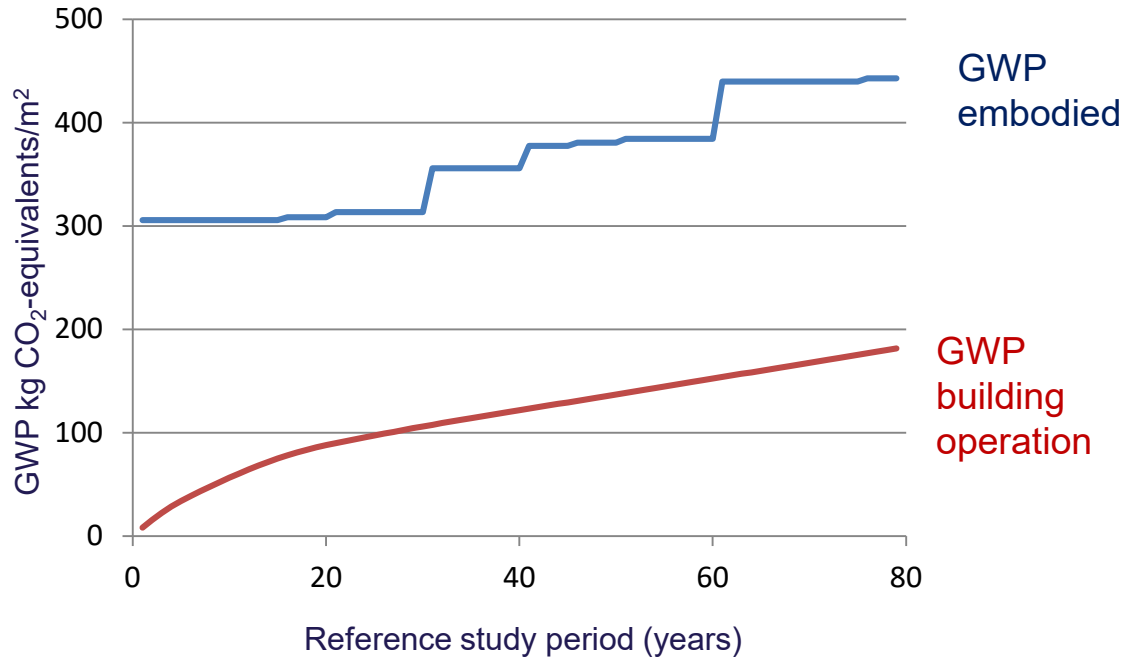


Analysis of 60 building cases (about 35 residential)
Report available in few months

Difference between the different form for living



How can we reduce the embodied carbon of buildings?



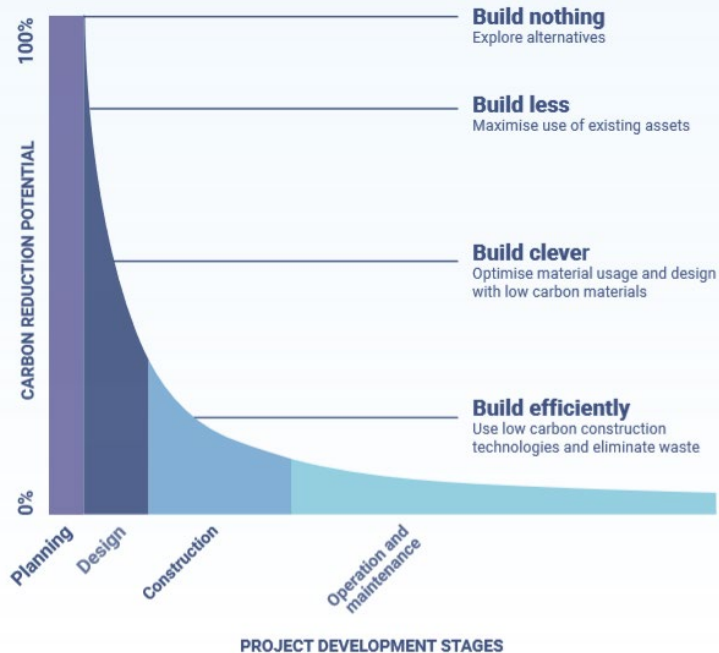


70% reduction in 2030 according to Danish political goals

'net zero' in 2050 in order to stay below 1.5°C (IPCC)

Decarbonized buildings in 2050 (EU through EPBD)

Carbon reduction potential



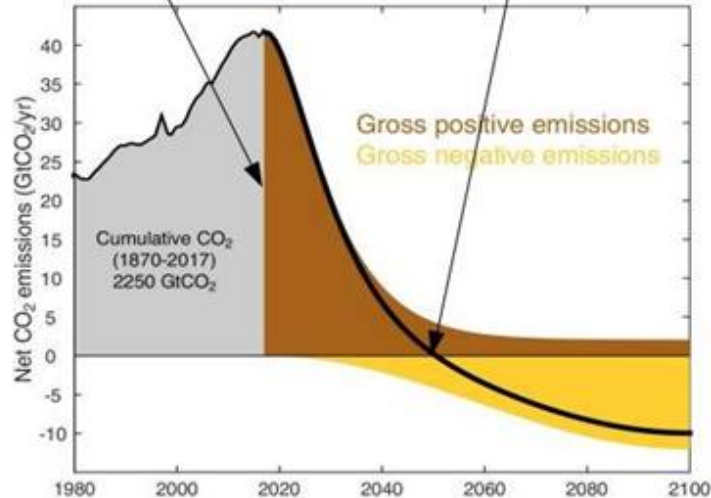
- The potential within the **existing buildings**: Renovation of existing buildings
- The potential to reduce impacts of **new buildings**
 - Design strategies
 - Choice of materials
 - Circular economy strategies
 -
 - Size

HM Treasury: Infrastructure Carbon Review, 2013 i World GBC: Bringing embodied carbon upfront, 2019

Limited carbon budget left in order to stay below 1.5°C

This budget left, is needed to invest in reducing existing (buildings) emissions!

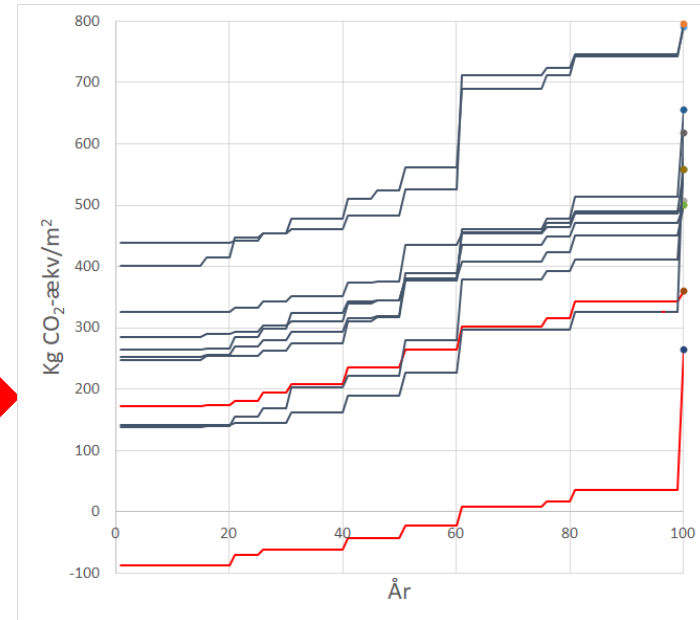
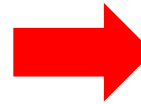
Therefore: New buildings should already comply with building regulations of 2050 !



Ronald Rovers, www.ronaldrovers.com

How can we reduce the embodied carbon of buildings?

- It is time to take some steps in the right direction
- Some big steps
- Identify the **drivers** and **solutions** that are necessary
 - to start building only these buildings from now on
 - to reach net zero emission buildings in 2050



International Energy Agency

Strategies for Reducing Embodied Energy and Embodied GHG Emissions

Guideline for Designers and Consultants – Part 2

IEA EBC Annex 57

September 2016

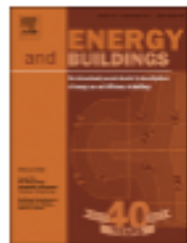




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Design and construction strategies for reducing embodied impacts from buildings – Case study analysis

Tove Malmqvist^{a,*}, Marie Nehasilova^b, Alice Moncaster^c, Harpa Birgisdottir^d, Freja Nygaard Rasmussen^d, Aoife Houlihan Wiberg^e, José Potting^a



Design strategies for reducing embodied emissions

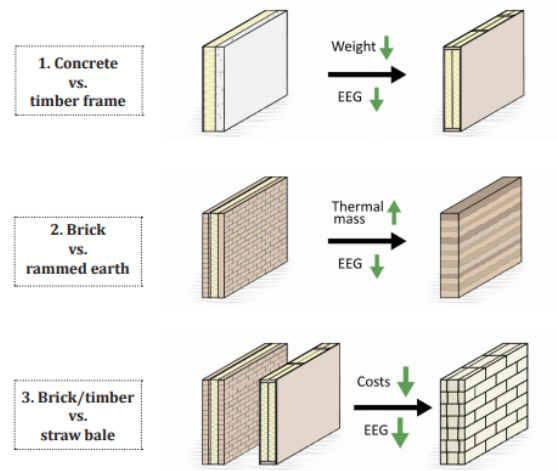
- **Substitution of materials**
 - Natural Materials for load bearing structures
 - Natural materials
 - Recycled & reused materials and components
 - Innovative materials
- **Reduction of resource use**
 - Light-weight constructions
 - Building form and design of layout plan
 - Design for flexibility and adaptability
 - Low maintenance and service life extension
 - Reuse of building structures
- **Reduction of construction stage impacts**
- **Design for low end of life impacts**
 - Design for low impact of end-of-life stage

A close-up photograph of a light-colored wooden surface, possibly a table or floor, showing a prominent grain pattern and several dark, diagonal cracks. A white rectangular box is centered horizontally across the middle of the image, containing the text "Use of Wood?".

Use of Wood?

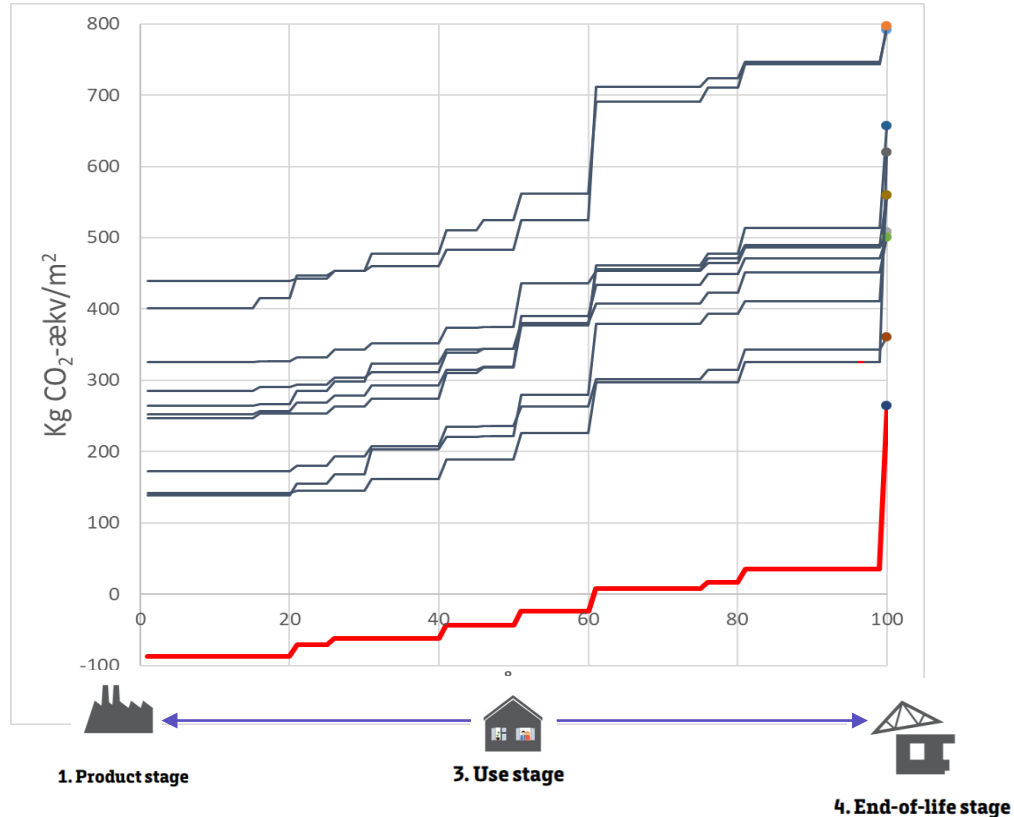
Design strategies for reducing embodied emissions

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27-77% reduction compared to concrete, masonry and steel

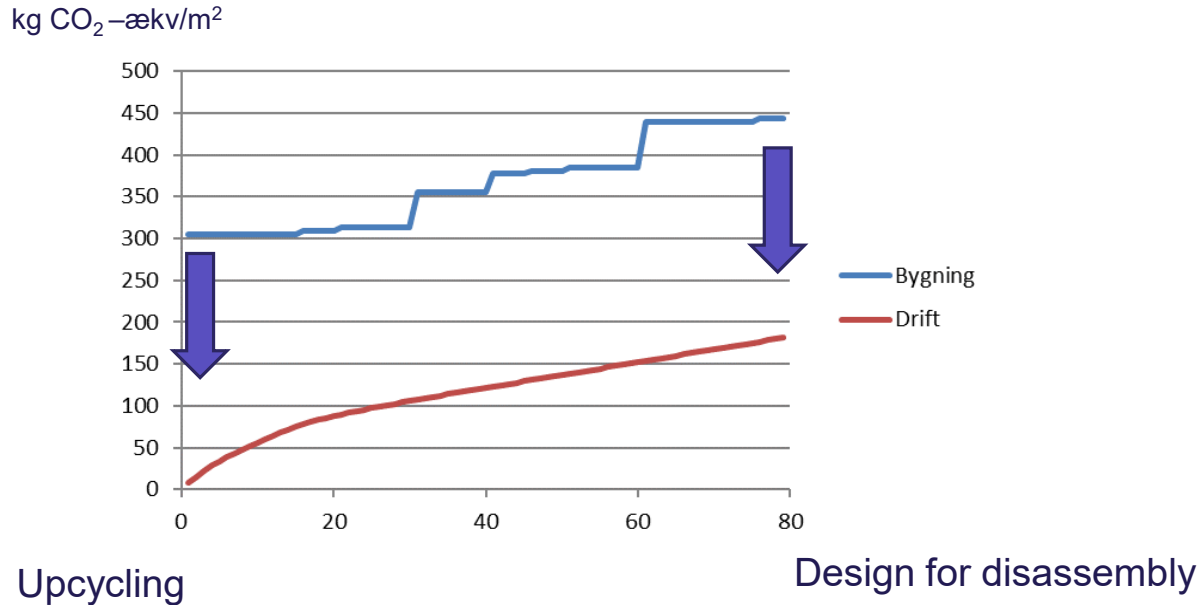
Supported by recent Danish cases (SBI 08:2017)



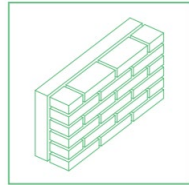
A large pile of red bricks and rubble is the central focus of the image. In the background, a tracked excavator is visible, partially obscured by the debris. The scene appears to be a demolition or construction site. The text is overlaid on a white rectangular background in the center of the image.

**Reuse/Recycling
Circular Economy?**

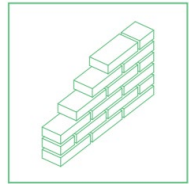
Many circular strategies targeting different solutions and timescales



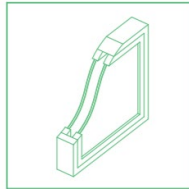
Data needed for all solutions – example:



- Upcycling reused bricks as facade elements
- **61%** CO₂ reduction compared to new bricks



- Reuse old bricks
- **78%** CO₂ reduction compared to new bricks



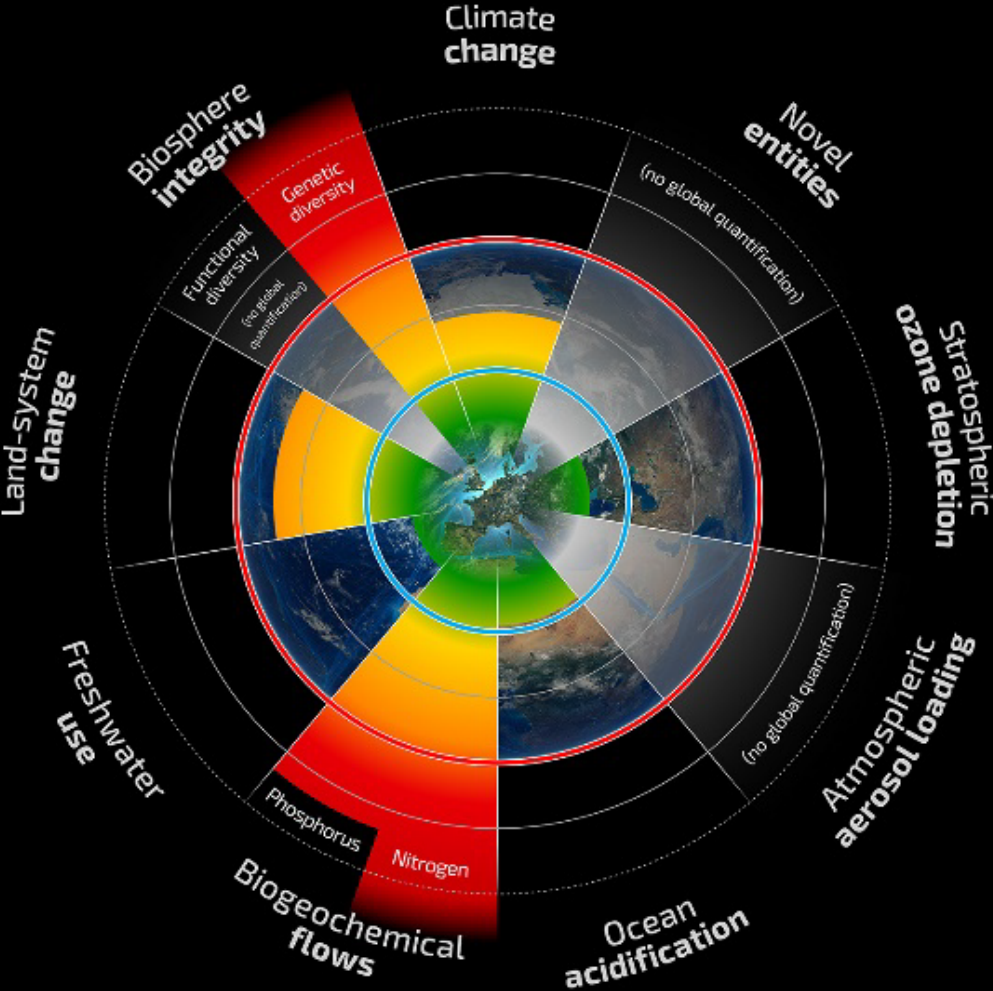
- Reuse glass from windows in new windows
- **97%** CO₂ reduction compared to new glass in windows

Design strategies for reducing embodied emissions

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Planetary Boundaries

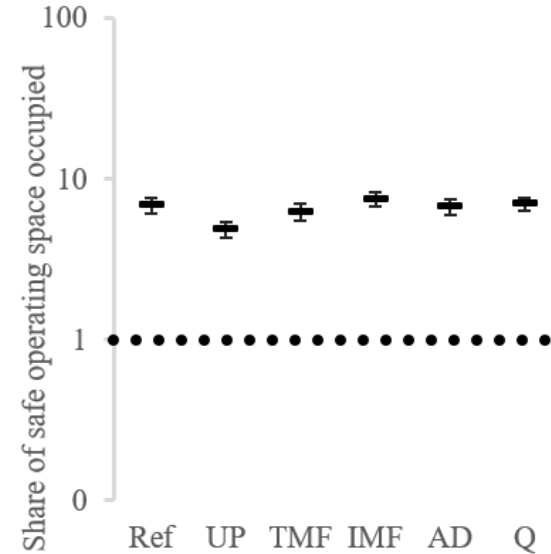
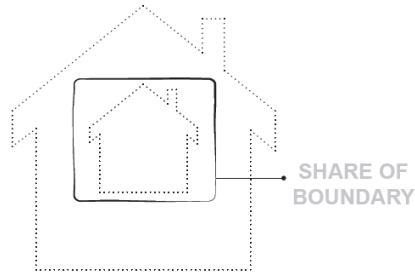
A safe operating space for humanity



- Beyond zone of uncertainty (high risk)
- In zone of uncertainty (increasing risk)
- Below boundary (safe)
- Boundary not yet quantified

Steffen et al. (2015). Planetary boundaries: Guiding human development on a changing planet. *Science*
Grafik: Globaia

Absolute environmental sustainability – climate change



Assessing building's absolute environmental sustainability performance using LCA
Pernille Ohms^a, Camilla Andersen^a, Freja Nygaard Rasmussen^b, Morten Rydberg^c, Michael Hauschild^c, Morten Birkved^d, Harpa Birgisdottir^b



We also need to
think about the size



We all need to work together on this task

Fridays for Future, Ljubljana September 27th 2019