Best practices in reducing embodied emissions

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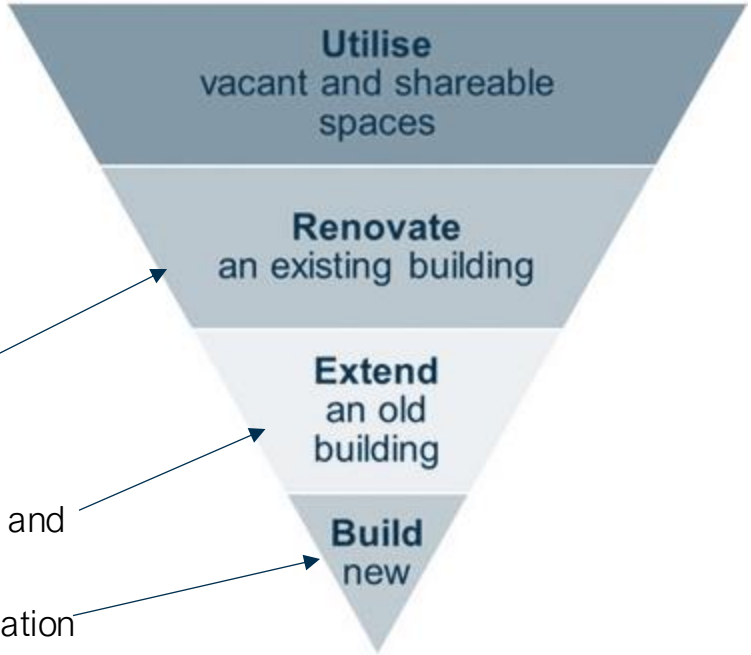
Stretching the limits on embodied carbon – with a view towards the sufficiency pyramid

Best practice cases:

- Combining levers and measures along the value chain
- Reducing embodied carbon
- At least maintaining (if not improving operational carbon)
- Cost neutral via resource efficiency

Cases:

- Renovation - Änggården - Low-carbon renovation
- Extension/reconstruction - Lumi - Build on top to reduce land and carbon footprint
- New buildings – Hestur and Kungsörnen - Cost-efficient mitigation via resource efficiency



Source: Kuittinen (2023): Building within planetary boundaries: moving construction to stewardship

Änggården – Reducing operational and embodied carbon in renovation

Large scale renovation (poor condition):

- New windows, facades, roofs
- Additional insulation and new ventilation system
- Changed water and sewage mains
- Bathroom renovation and other maintenance
- Balconies added

Measures taken:

- Reuse – Radiators, toilets, window sills, doors
- Reused paving stone
- Reduced amounts of concrete and steel
- Best product choice for insulation and façade system
- Waste minimization
- Transports with biodiesel + electrified

Änggården – Reducing operational and embodied carbon in renovation

Results:

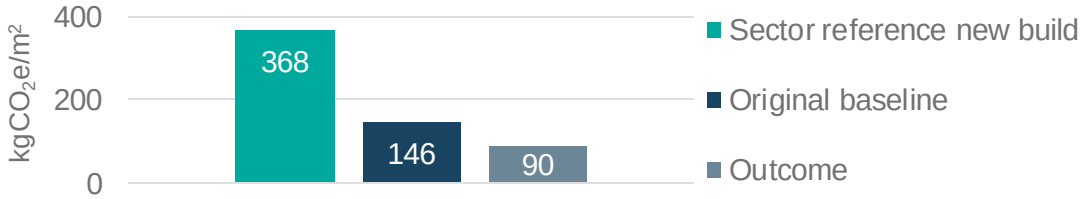
- 90 kg CO_2e/m^2 gross floor area
- 38% reduction in embodied carbon from project baseline
- Reduced energy consumption

Goal conflict:

- Windows – Circularity, cost, quality and CO_2

Success factors:

- Contract requirements
- Climate coordinator and calculations
- Close cooperation



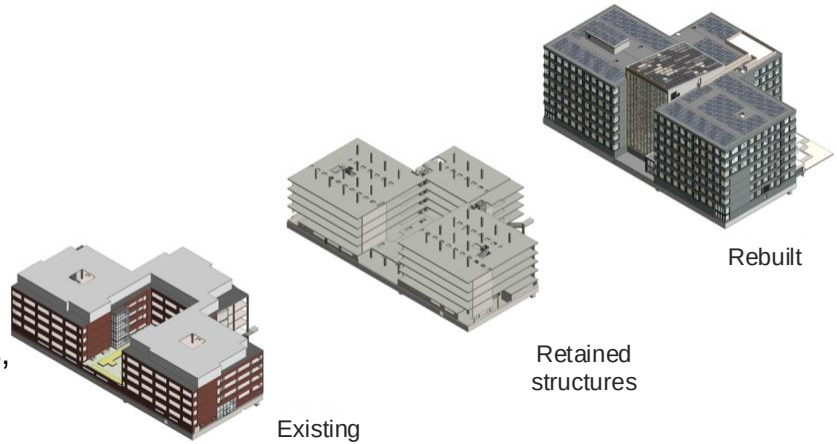
Lumi – Rebuild and build on top instead of demolition

Demolition turned extension:

- Office building from the 1970s
- Client and architect pushed for a rebuild
- Taking circularity to next level
- Systematic and advanced design and digitisation process

Measures taken:

- Retained 80% of foundation and structure
- Extending with 3 floors in wood
- Replaced façade
- Brought together separate buildings with joint entry
- Reused light concrete flooring, ceilings, gypsum boards, steel joists, carpets, radiators, electrical boxes etc. etc.



Lumi – Rebuild and build on top instead of demolition

Results:

- 190 $kgCO_2e/m^2$ gross floor area
- 50% reduction compared to new build
- 20 months – less than half of demolish-new build

Goal conflicts:

- Difficult with reuse based on planning and building regulations
- Shifts in costs: + Design and deconstruct – Material & transport

Success factors:

- Interested and solution-oriented project partners
- Calculations, patience, cooperation, design details

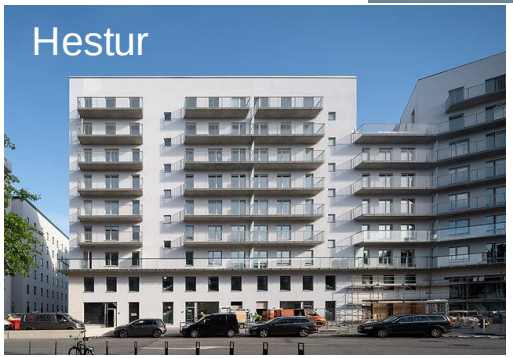
Hestur and Kungsörnen - Cost-efficient mitigation via resource efficiency

Two multi-family rental buildings:

- Prefabricated concrete (Hestur) and in-situ cast concrete frame (Kungsörnen)
- Focus on affordable housing – functionality and energy use
- Cooperative agreement in Hestur
- Tendering based on 80% price, 20% CO_2 in Kungsörnen

Measures taken:

- Resource efficient design – form factors, layout etc.
- Construction optimisation – Slimmed structural elements
- Right quality and exposure class – Reduces cement content
- Optimised concrete recipes – Slag replaces cement
- Conscious product choices – e.g. Recycled reinforcement
- Reduced reinforcement and minimised waste



MISTRA CARBON EXIT

Hestur and Kungsörnen - Cost-efficient mitigation via resource efficiency

Results:

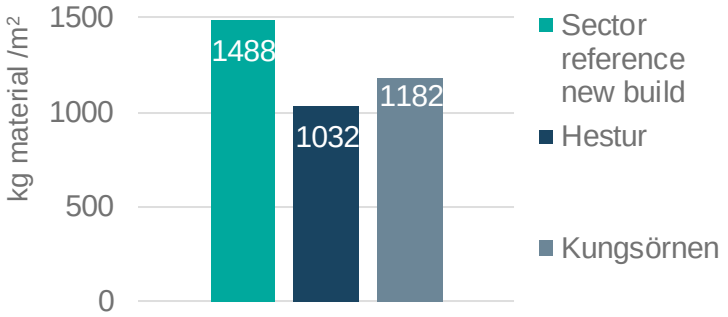
- 207 $kgCO_2e/m^2$ in Hestur and 168 $kgCO_2e/m^2$ in Kungsörnen
- 36% / 50% CO_2 reduction compared to sector reference
- 50% / 70% CO_2 reduction in structural frame
- 33% / 20% reduction in material consumption
- Both project cost neutral – Reduced material costs

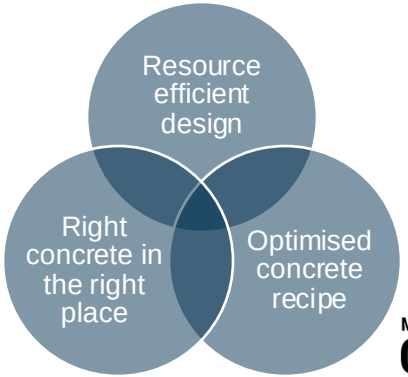
Challenges:

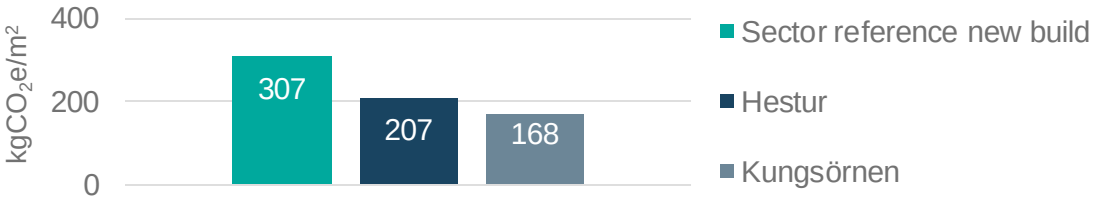
- Competence and material development during ongoing project

Success factors:

- Close cooperation and focus on resource efficiency at every stage
- Daring to question old norms

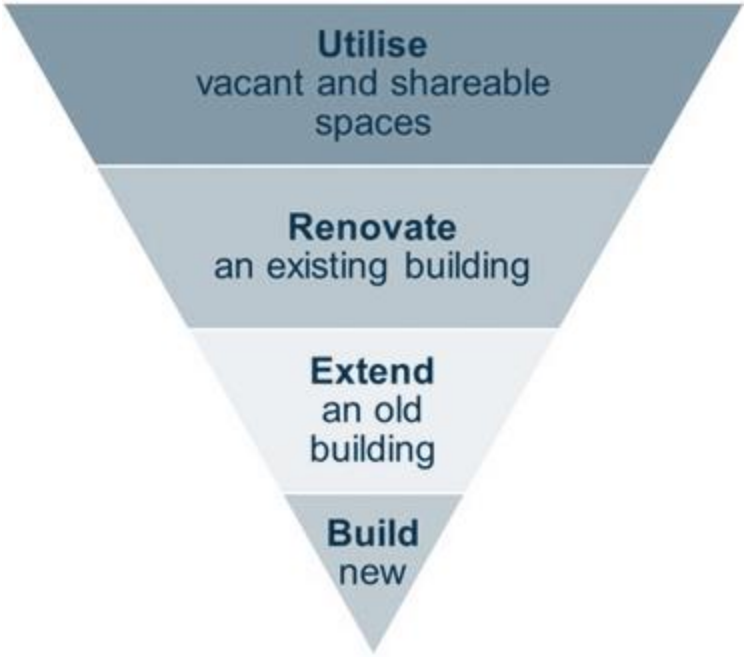






Success factors to bring forward

- Focus on the “resource hierarchy”
- Creating conditions for close collaborations
- Procurement and contractual forms
- Build engagement throughout project team
- Dare to question old norms
- Resource efficiency and circularity at every stage
- Remember the life cycle
- Systematic processes and digitisation
- Expect cost shifts – with cost neutrality as a goal



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