LIVING PLACES SCALABILITY

Typology and impact study

Mission and main objective

Main objectives:
Development project

Is to reduce m2 price, Continuing to ensure a low LCA and to keep the healthy building principles. Target price is yet to be defined but initial price given from E+P should be lowered between 10-20% to ensure scalability.

01 **REDUCE PRICE**
Target price:
11.300 DKK ex. VAT / 14.500 DKK incl. VAT

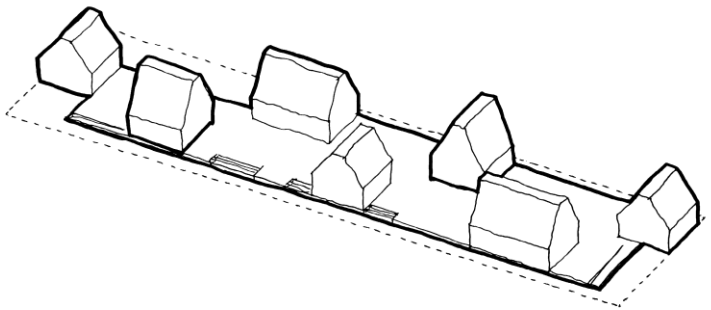
02 **KEEP OR REDUCE LCA**
Keep the LCA as low as possible.
minimum <6kg CO2/ m2/year

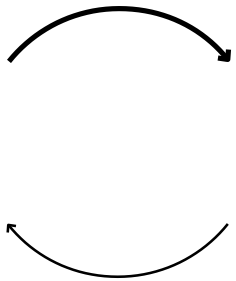
03 **KEEP OR INCREASE HEALTH**
Maintain a healthy indoor climate
minimum Indoor climate classe 1 or 2

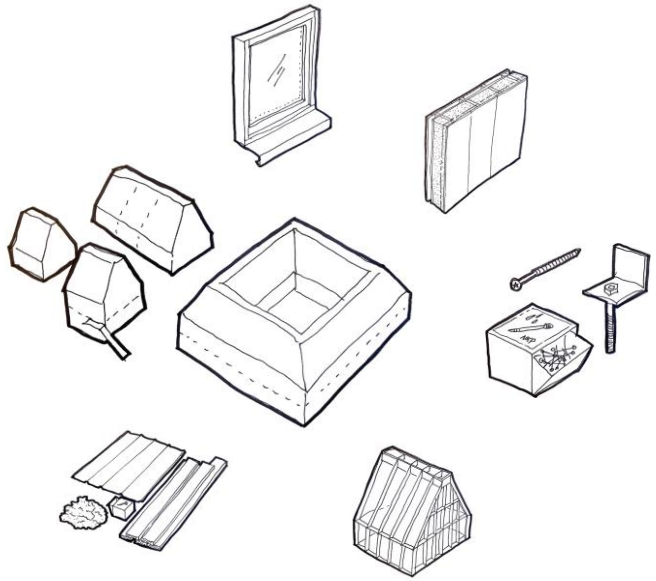
Process and timeline

Knowledge sharing: concurrently processes

To ensure that the process becomes as productive as possible, the development project should inform the Living Places Copenhagen about key findings and vice versa.





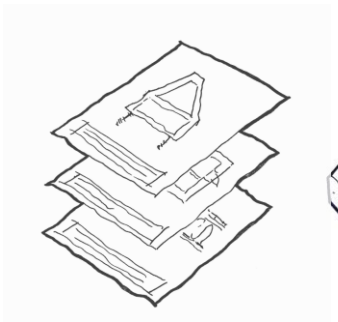


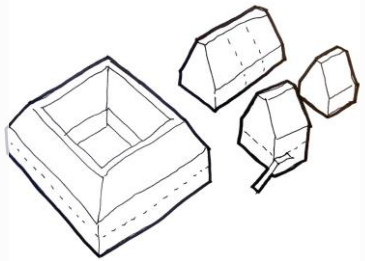
Living places Copenhagen

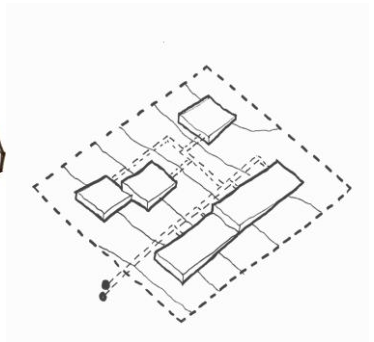
Development project

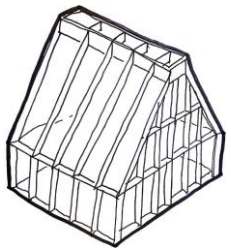
Optimization process
Subjects

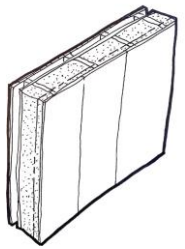
We have proposed various subjects to look into, in order to guide the process.

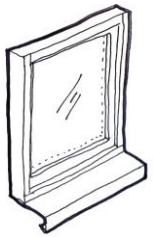


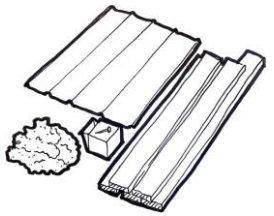


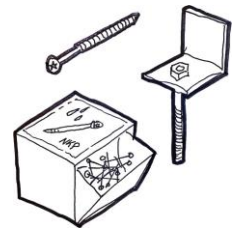












Planning

Rådgiver
Entrep
renør
bygher
re
komm
une

Typology /scale

detached house
two-family house
row-house
dense low rise
low rise linear
block
low city block

Site prepreation (foundation)

kloakering
vand
strøm
fundameneter
tilslutning
afsætning
- - -

Construction system

Wood cassette
CLT
LVL rammer
I-profile wood
Eco-cocoon
ACC blocks
- - -

Build up

Three layer wall build up
Two layer wall build up
One layer wall build up
Hempcrete

Component

3 layer windows
2 layer windows
kitchens
stairs
ventilation-system
heating system
Electrical system

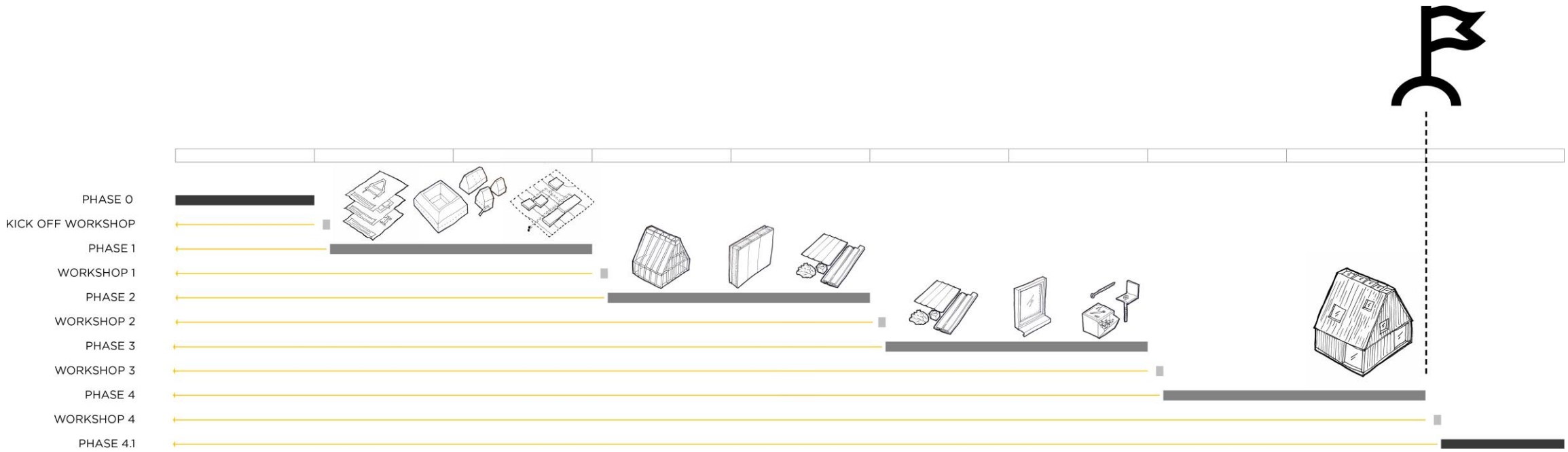
Materials

Outer wall surface
Inner wall surface
Roof plates
Insulation
floors
Wet surface
cielings

Assembly

nails
screws
bracets
locking groove
montana
suspension
- - -

Process plan
Development project

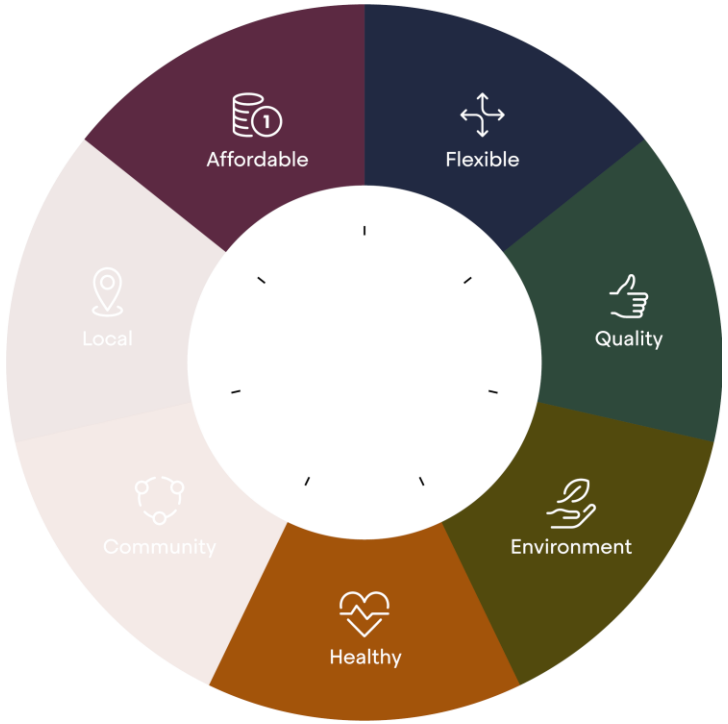


How we benchmark and select

Optimization process Relevant subjects

Based on the compass model we have to ensure benchmarking on multiple subjects to ensure that the project does not compromise its holistic approach.

Compass Model



Compass Model

Affordable

Material cost
Labor cost
Operation cost
etc.

Flexible

Process
Buildability
Reconfigurations
etc.

Quality

Durability
Ease of use
etc.

Environment

Embodied CO2
Operational CO2
etc.

Health

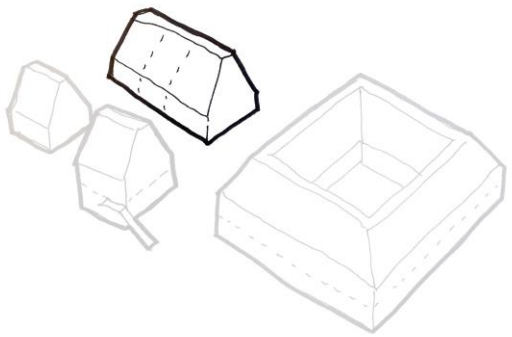
Daylight
IAQ
Thermal environment
Noise
etc.

Process for optimization: example

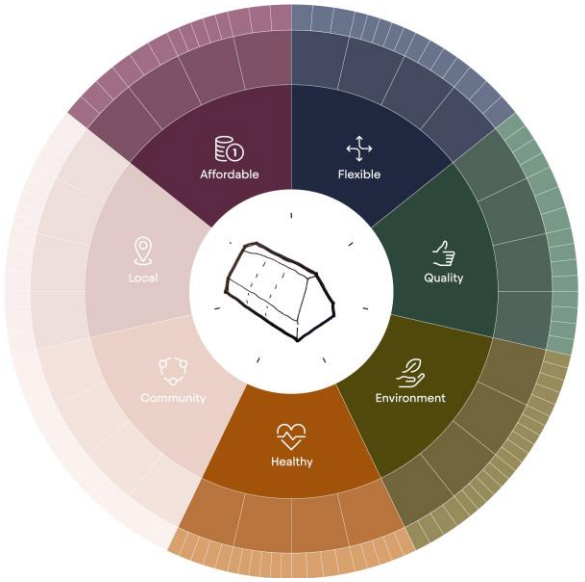
To ensure we effectively bring everyone’s knowledge to the table we propose a methodology that enables us to screen these subjects fast and efficiently. This will give us a quick overview on what directions we should pursue in depth to enable a price reduction without compromising on Environmental impact, and indoor environment.

Subject

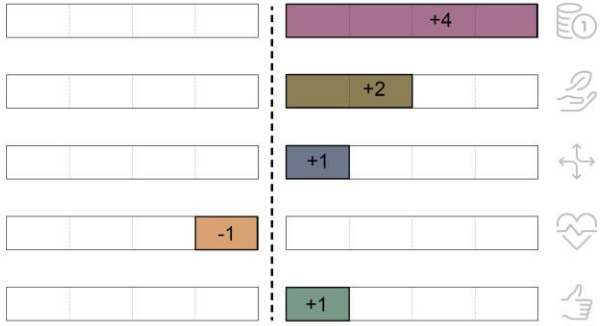
Rowhouse



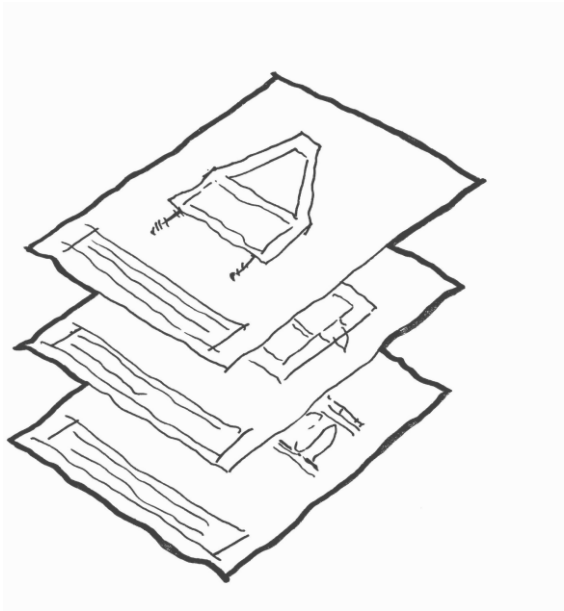
Compass Model



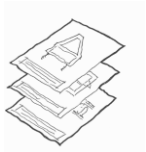
Technical Estimations



Optimization
Advise and findings

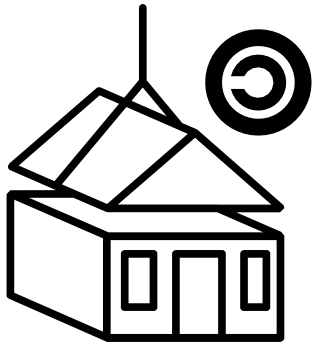


PLANNING



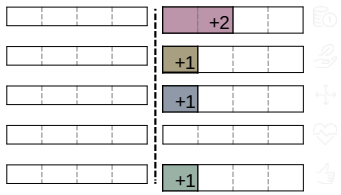
Planning

Having used the process described above, we have come up with some advice for how we can bring down price and LCA whilst keeping, or increasing the healthy indoor environment. These are the sections of the best examples we have chosen and where we can influence the most.



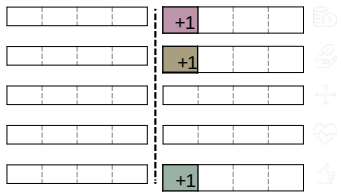
Copyleft concept

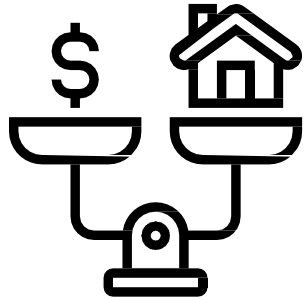
is based on a similar approach to enable rapid scalability as the typehouse companies, we can lower prices from architects, engineers and entrepreneurs significantly, by having developed typologies that can scale to multiple locations, all based on the same KPI´s and building systems. We estimate that we can reduce price pr. m2 from architect and engineers with up to 5-25% depending on the projects location and if its can be based in prexcisting work.



Fire engineer (for typologies)

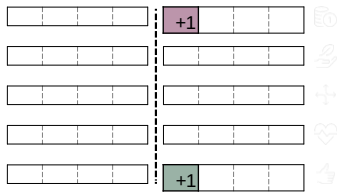
To enable lower price and lower LCA typologies money should be spent up front to have a fire engineer okay the non pre-accepted solution, this will enable a lower LCA and price. Simultaneously it enables us to scale these solutions, without a minimal risk.

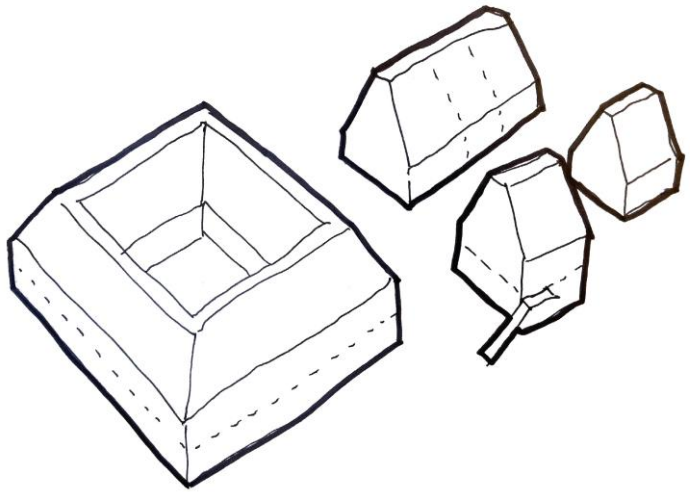




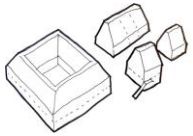
Avoid functioning tendering (funktions udbud)

With the high ambitions to reduce the environmental impact of Living Places, it is important to maintain control over which materials and products are used in construction. Products with the same technical quality can have very different environmental impacts depending on the production method and location, which is why the final CO2 performance of the construction is strongly dependent on product choice. In the case of function tenders, it is difficult to set requirements for the use of specific products, as only the function is required, and not the environmental profile, and it is therefore necessary to avoid this type of tender.





Typology / scale



Typology scale

Scaling both up and down in relation to the original typology, we have investigated a range of building heights from 2-5 floors. Looking at LCA and price, together with fire regulations and other relevant subjects. The limit of 5 floors is kept to maintain the fireregulations low - thus making it possible to keep a low LCA in combination with a low price.

2 floor
1 home

3 floor
1 home

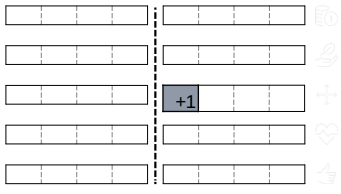
(Original)

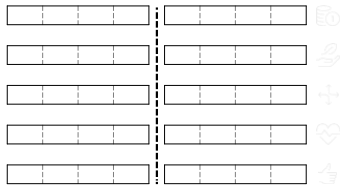
3 floor
2 homes

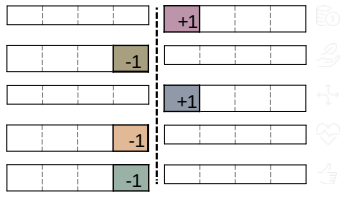
4 floor
2 homes

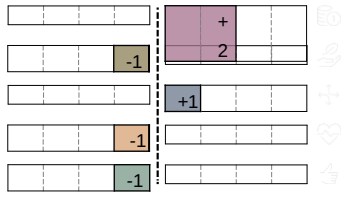
4 floor
3 homes

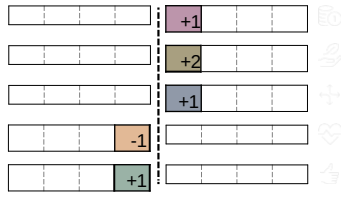
5 floor
3 homes

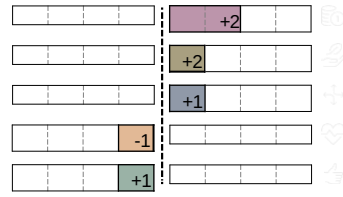


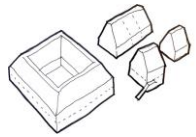






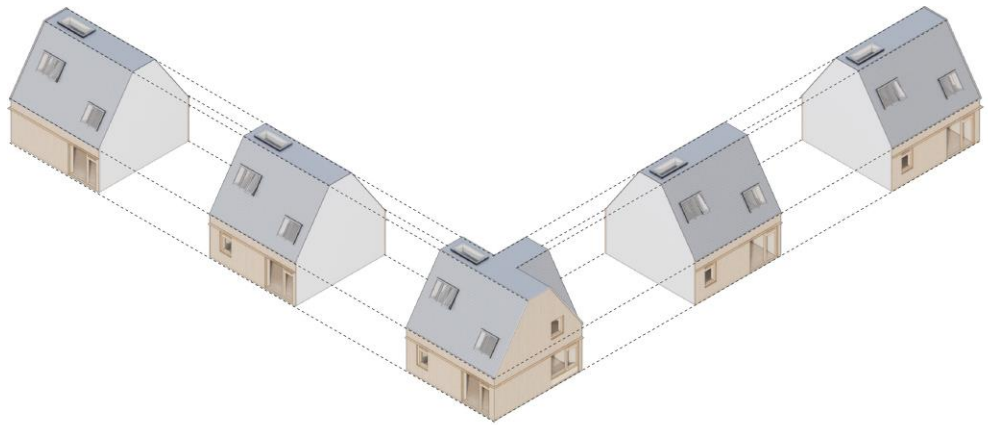


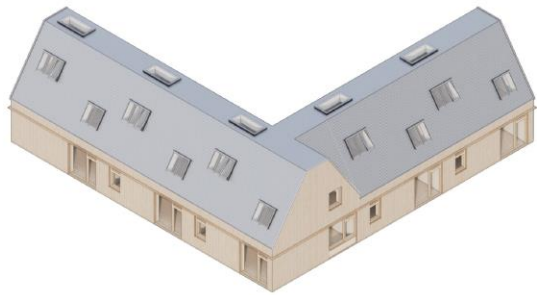


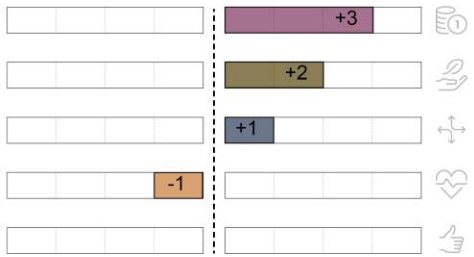


How we divided the building

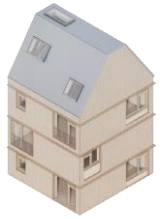
Together with the scale in height, we developed a modular thought for adding buildings in rows or courtyards, while still keeping track of LCA and price and making an optimized building system without one-off solutions.

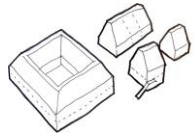






Typologies

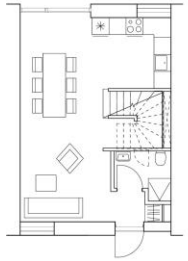
	2 levels	3 levels	3 levels (2 units)	4 levels (2 units)	4 levels (3 units)	5 levels (3 units)
Middle-house						
Gable-house						
Corner-house						

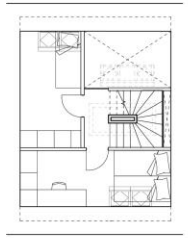


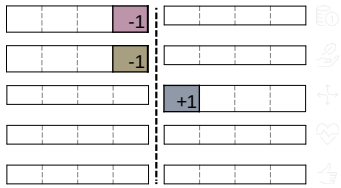
Typology scale

To further broaden the scalability of the system, we ensured that the building system could be scaled into various sizes.

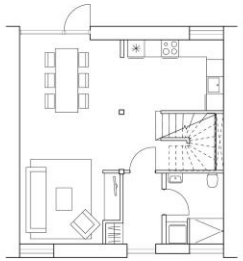
2 levels
80 m2

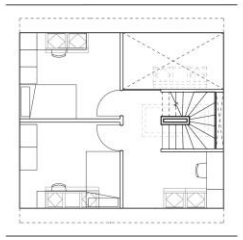


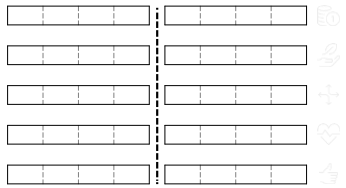




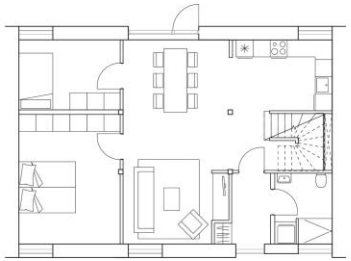
2 levels
105m2

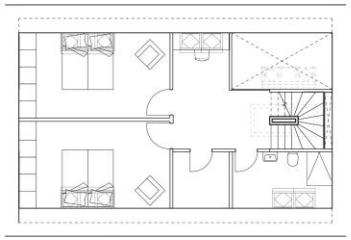


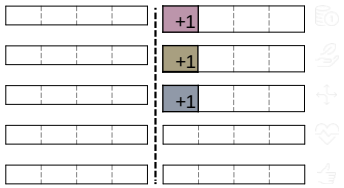


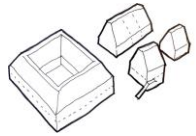


2 levels
150 m2





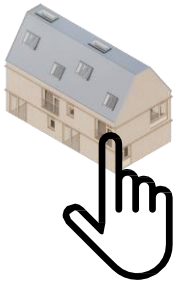




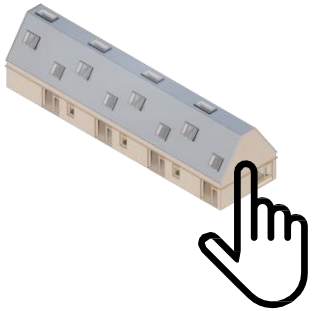
Selected typologies to investigate

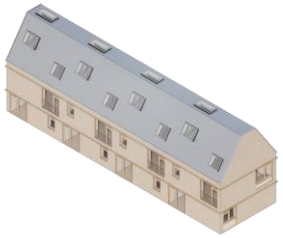
Having used the process described above, we have developed new typologies that enable us to bring down price and LCA whilst keeping, or increasing the healthy indoor environment.
These typologies are investigating which ones would be the best suited for further development.

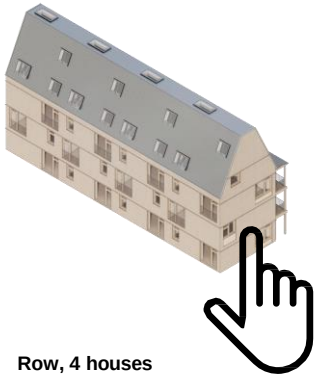
Single detached



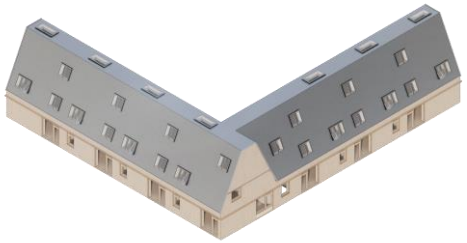
Double

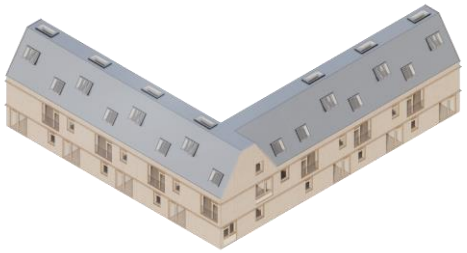


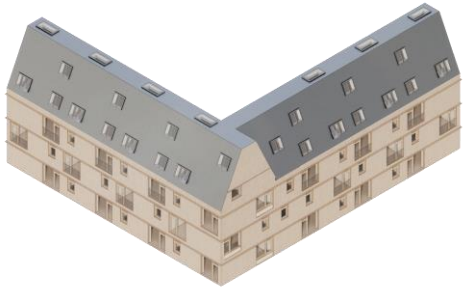




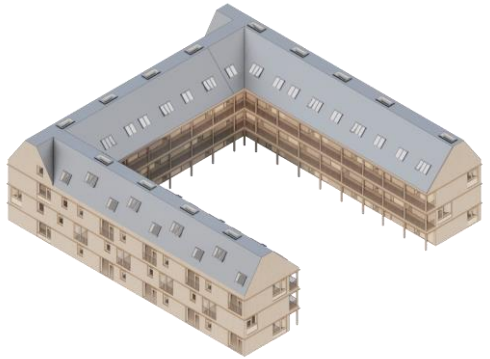
Row, 4 houses

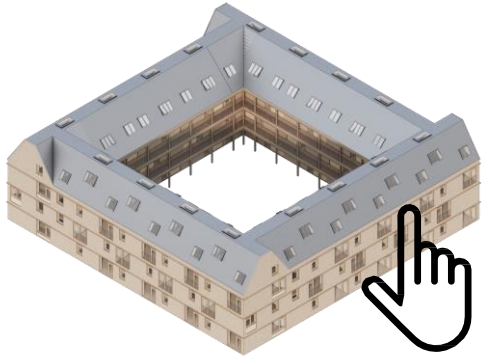




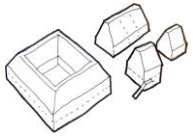


L-block





Courtyard



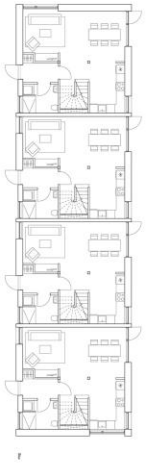
Plans & revisions

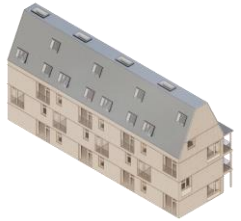
To ensure we could use this method we also created plans, this served both as a way to ensure we could create plans that were good in all scales and that we could create plans that could expand and increase.

2 floor Detached house

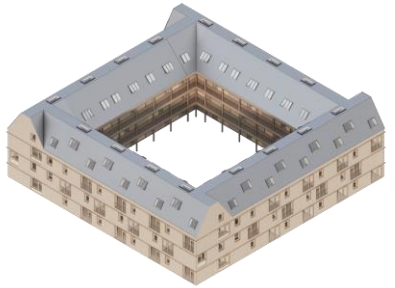
3 floor Row house

2 floor Row house

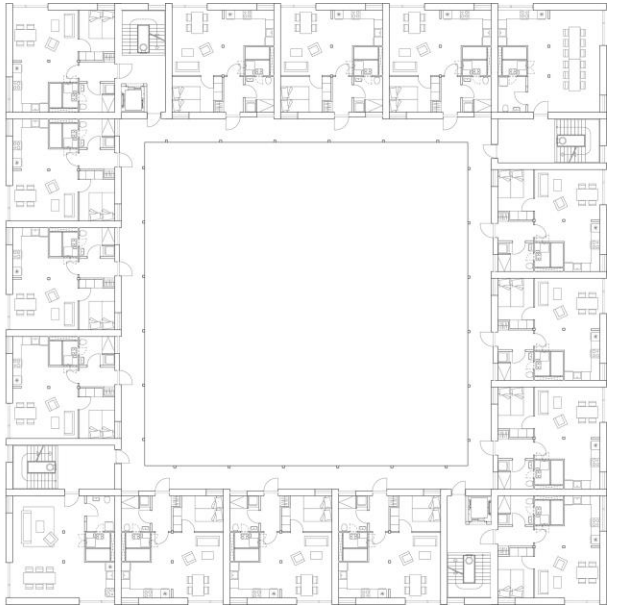


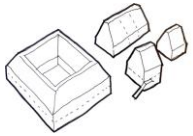


5 floor Linear housing



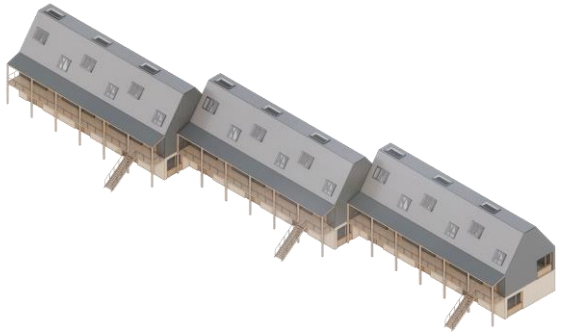
4 floor courtyard housing



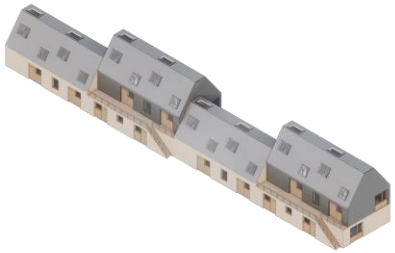


Scale breakdowns and diveristy studies

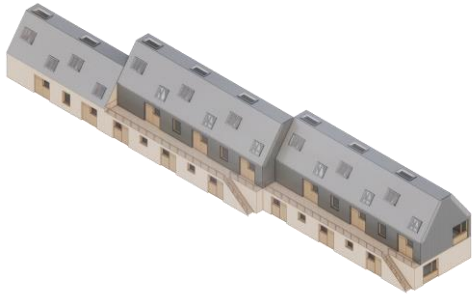
Investigation into how we can combine the various modules and how it affects the esthetics, price and LCA.



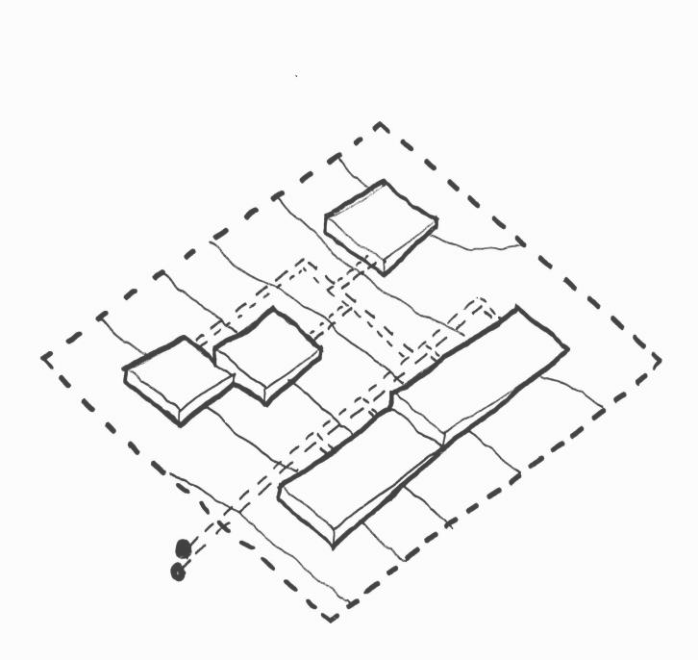
Invesigation into how typologies can be shifted to breakdown the scale



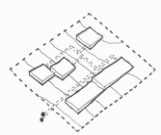
Invesigation into how we can mix heights and accessability, to breakdown scale and inhance density



Investigation into how we can breakdown scale by shifting typolgies while mixing typology heights

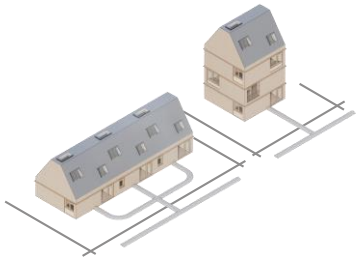


Site / preparation



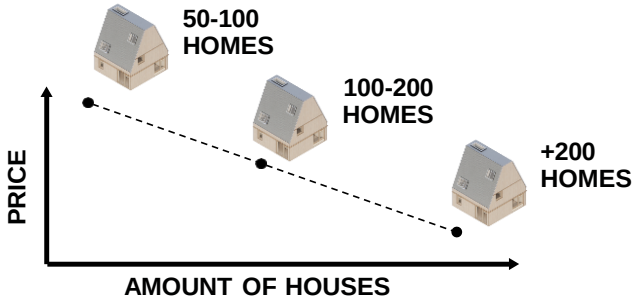
Site preparation

Having used the process described above, we have developed some principles and investigation possibilities for how we can reduce price and LCA and increase healthy building principles.



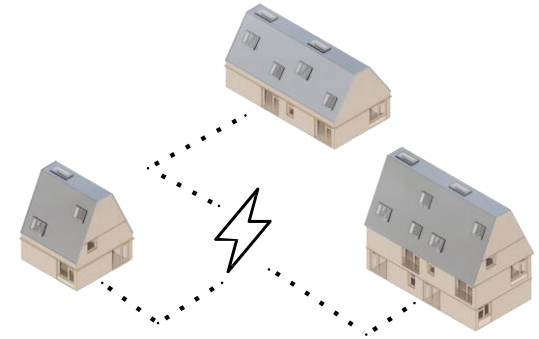
Shared sites boundary (fælles matrikel)

By creating a shared boundary we only have to pay for one connection to the electricity grid, water grid, sewage etc. This reduces price and makes it more flexible and easy to construct.



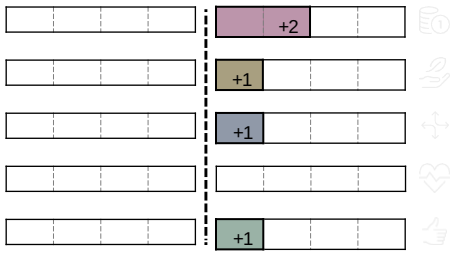
Sytems design = scalability & lowered cost

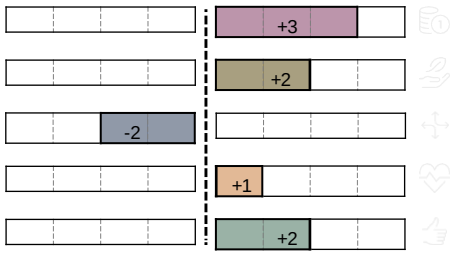
In order to ensure we deliver on the vision and mission, we have to create a system and thereby we are able to create scalability since, we can repeat and buy materials in bulk and set up partnerships. Depending on which scenarios we choose the price fluctuate.
Scenario 1: 50-100 homes: There are most business plots in the market - where a setup to this extent can be realized. Scenario 2: 100-200 homes: The repetition effect is large, which is why this setup is considered potentially cheaper than the realization of scenario 1. Scenario 3: +200 homes: The repetition effect is large, which is why this setup is considered potentially cheaper than the realization of scenario 1.

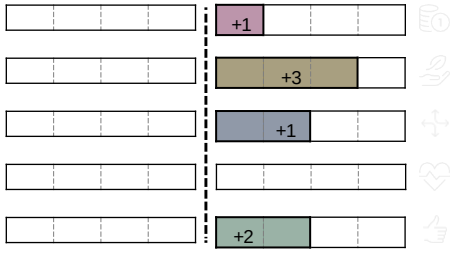


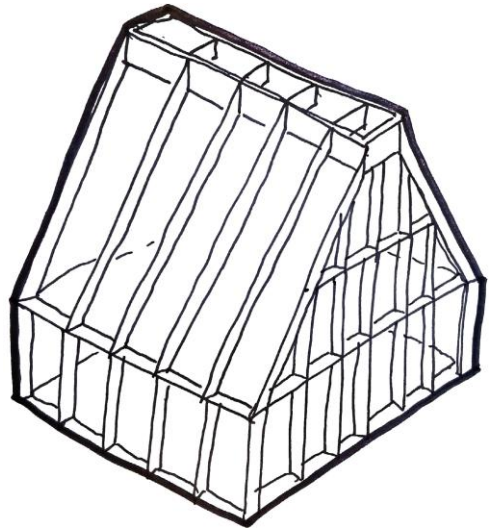
Energy communities

By planning for an energy community, we can reduce both emission and price compared to using individual heat pumps or district heating.







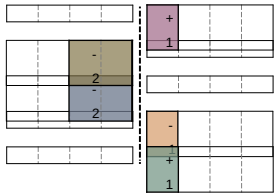


Construction system

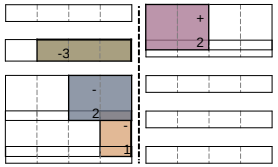
Construction system

To ensure we effectively bring everyone’s knowledge to the table we propose a methodology that enables us to screen these subjects fast and efficiently. This will give us a quick overview on what directions we should pursue in depth to enable a price reduction without compromising on Environmental impact, and indoor environment.

Block System

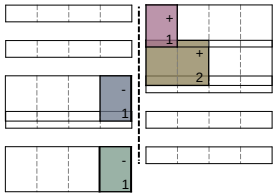


Brick system

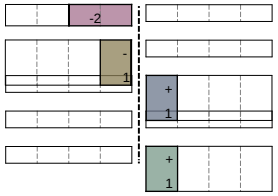


Concrete block

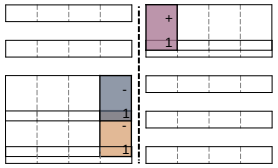
Wood Construction System



I-beams wood cassette

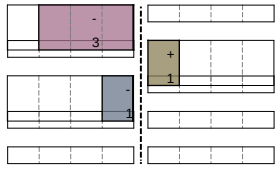


CLT

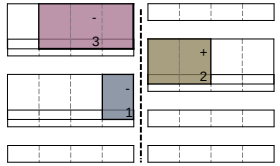


LVL-system

Composite System



Straw (ecococoon)

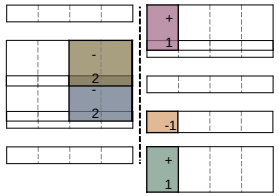


Hempcrete

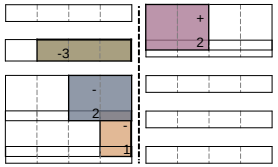
Construction system

To ensure we effectively bring everyone’s knowledge to the table we propose a methodology that enables us to screen these subjects fast and efficiently. This will give us a quick overview on what directions we should pursue in depth to enable a price reduction without compromising on Environmental impact, and indoor environment.

Block System

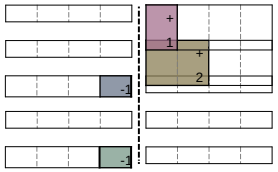


Brick system

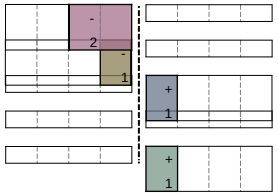


Concrete block

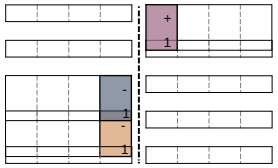
Wood Construction System



I-beams wood cassette

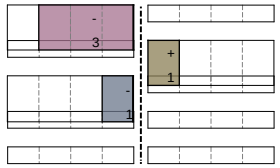


CLT

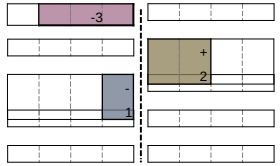


LVL-system

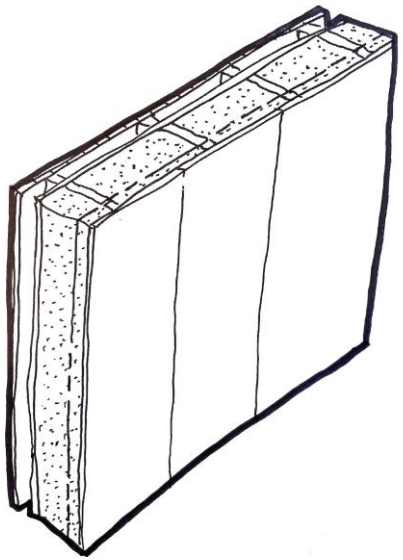
Composite System



Straw (ecococoon)



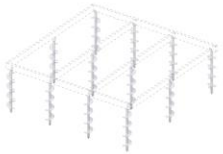
Hempcrete



Build-up

Build-up

By using the process, we have investigated various build ups. We have developed LCA, prices and detailed drawing for numerous versions. This catalog can be expanded and serves as a knowledge bank for the team.



01

Fundation

Deck
Pillars
Etc

02

Terrain deck

Structure
Insulation
Flooring

03

Outerwalls

Strucutre
Insulation
Facade

04

Floor build-up

Structure
Insulation
Flooring

05

Inner walls

Structure
Insulation
Finishes

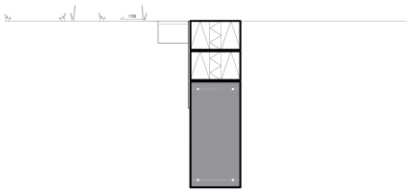
06

Roof build-up

Structure
Insulation
Finishes

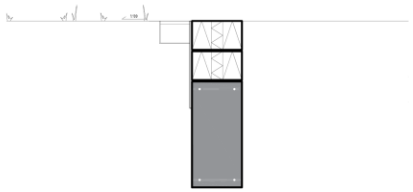
Bui
Foundation

Traditional foundation
Leca and concrete



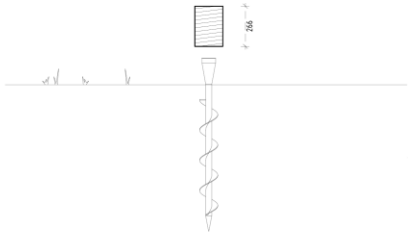
450 x 600 mm concrete C15 incl. reinforcement (Celsa Steel)
2 pcs. Lecaterm blocks
10 mm plaster

Traditional foundation
Future cement



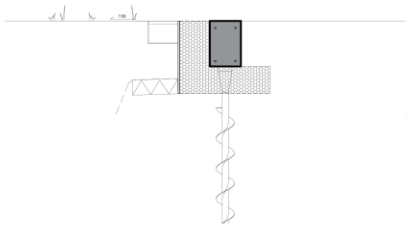
450 x 600 mm concrete C15 with FutureCem incl. reinforcement (Celsa Steel)
2 pcs. Lecaterm blocks
10 mm plaster

Elevated screw pile foundation



Krinner screw foundations in steel, 36 kg / pc.
Incl. glulam strap: 2 pcs. 266x185 and 2 pcs 200x185 mm

L-element



L-element from Sundolit
Concrete filling C15 with FutureCem
Screws for holding, 36 kg / pc

Build-up
Foundation

Traditional foundation Leca and concrete

LCA: 20
Price [excl. DB]: 20.985 DKK

450 x 600 mm concrete C15 incl. reinforcement (Celsa Steel)
2 pcs. Lecaterm blocks
10 mm plaster

Traditional foundation Future cement

LCA: 18
Price [excl. DB]: 22.906 DKK

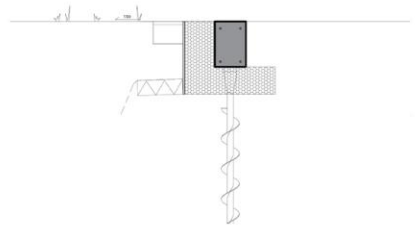
450 x 600 mm concrete C15 with FutureCem incl. reinforcement (Celsa Steel)
2 pcs. Lecaterm blocks
10 mm plaster

Elevated screw pile foundation

LCA: 20
Price [excl. DB]: 39.140 DKK

Krinner screw foundations in steel, 36 kg / pc.
Incl. glulam strap: 2 pcs. 266x185 and 2 pcs 200x185 mm

L-element



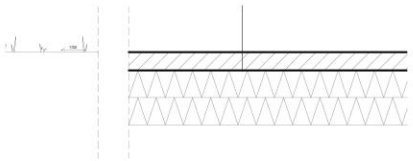
LCA: 16
Price [excl. DB]: 22.595 DKK

L-element from Sundolit
Concrete filling C15 with FutureCem
Screws for holding, 36 kg / pc

Values: 3 floors - 1 unit - Middle element

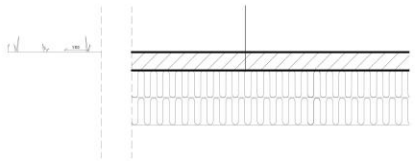
Bui
Terrain deck

Concrete deck on polystyrene



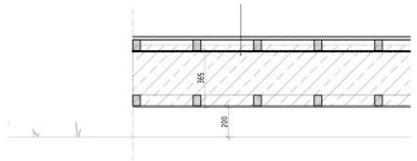
120 mm concrete slab layer C15 with FutureCem incl. reinforcement (Celsa Steel)
360 mm polystyrene S80, kl. 38
50 mm screed in sand / sand pad

Concrete deck on Rockwool terrain bats



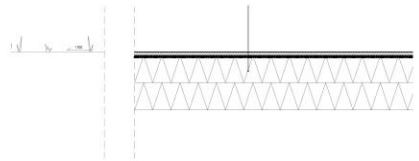
120 mm concrete slab layer C15 with FutureCem incl. reinforcement (Celsa Steel)
360 mm Rockwool Terrain Batts, at 38
50 mm screed in sand / sand pad

Raised light deck paper insulation



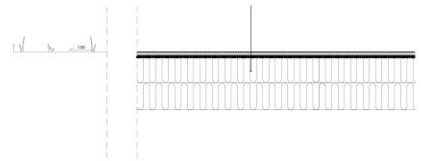
22 mm chipboard, waterproof (Kronospan)
45x70 mm batten C18 - c / c 400 mm
70 mm Paper wool granules, at 37, fire class B-s2, d0
0,2 mm vapor barrier / vapor brake
45x295 Construction wood, c / c 600 mm
295 mm Paper wool granules, kl. 37, fire class B-s2, d0
8 mm hard wind barrier at 1 Windstopper Extreme

Light deck on polystyrene

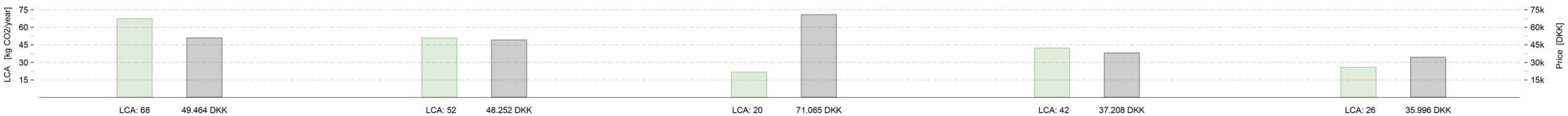


22 mm chipboard, waterproof (Kronospan)
0,2 mm vapor barrier / vapor brake
360 mm polystyrene S80, at 38
50 mm screed in sand / sand pad

Light deck on Rockwool terrain bats



22 mm chipboard, waterproof (Kronospan)
0,2 mm vapor barrier / vapor brake
360 mm Rockwool Terrain Batts
50 mm screed in sand / sand pad



Build-up
Terrain deck

Concrete deck on polystyrene

LCA Price [excl. DB]

120 mm concrete slab layer C15 with FutureCem incl. reinforcement (Celsa Steel)
360 mm polystyrene S80, kl. 38
50 mm screed in sand / sand pad

Concrete deck on Rockwool terrain bats

120 mm concrete slab layer C15 with FutureCem incl. reinforcement (Celsa Steel)
360 mm Rockwool Terrain Batts, at 38
50 mm screed in sand / sand pad

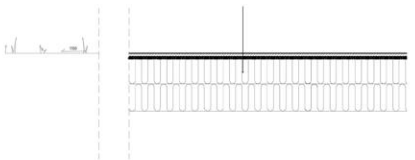
Raised light deck paper insulation

22 mm chipboard, waterproof (Kronospan)
45x70 mm batten C18 - c / c 400 mm
70 mm Paper wool granules, at 37, fire class B-s2, d0
0,2 mm vapor barrier / vapor brake
45x295 Construction wood, c / c 600 mm
295 mm Paper wool granules, kl. 37, fire class B-s2, d0
8 mm hard wind barrier at 1 Windstopper Extreme

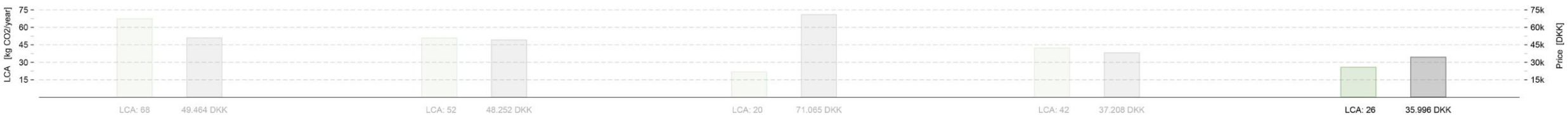
Light deck on polystyrene

22 mm chipboard, waterproof (Kronospan)
0,2 mm vapor barrier / vapor brake
360 mm polystyrene S80, at 38
50 mm screed in sand / sand pad

Light deck on Rockwool terrain bats



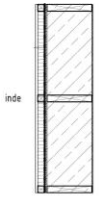
22 mm chipboard, waterproof (Kronospan)
0,2 mm vapor barrier / vapor brake
360 mm Rockwool Terrain Batts
50 mm screed in sand / sand pad



Values: 3 floors - 1 unit - Middle element

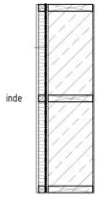
Bui
Exterior wall

Timber frame structure with glass wool



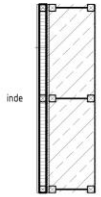
8 mm Windstopper Extreme (Cembritt)
45x295 mm studs, K18 c / c 600 mm
295 mm glass wool, at 34 - bats (Isover)
18mm OSB board
45x70 mm studs c / c 450 mm
45 mm glass wool at 34 (Isover)
15 mm fiberglass

Timber frame structure with paper wool insulation



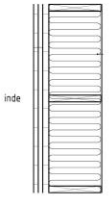
8 mm Windpanel Premium (diffusion open)
45x295 mm studs, K18 c / c 600 mm
295 mm paper wool insulation, at 37 - Granulate fire class B-s2, d0 (IsoCell)
18mm OSB plate G3
45x70 mm studs c / c 450 mm
45 mm wood fiber bats, at 38 fire class B-s2, d0 (Woodfiber)
15 mm fiber gypsum board cladding with tongue / groove
joint

Timber frame structure I-beam with wood fiber insulation



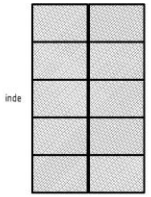
8 mm Windpanel Premium (diffusion open)
300 mm I-beams c / c 600 mm (Masonite Beams)
300 mm wood fiber insulation, at 38 - Granules (Hunton)
18mm OSB plate G3
45x70 mm studs c / c 450 mm
45 mm wood fiber insulation, at 38 (Hunton)
15 mm fiber gypsum board cladding with tongue / groove joint

CLT with paper wool insulation

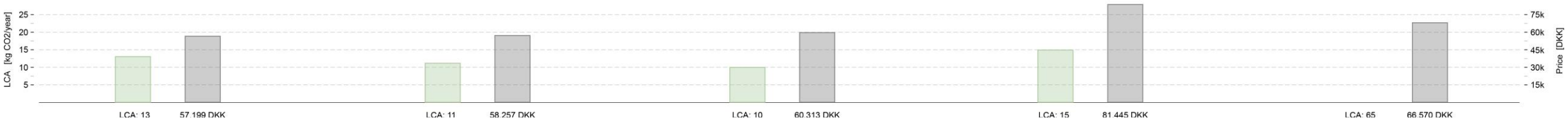


8 mm Windstopper Extreme (Cembritt)
45x345 mm I-beams c / c 600 mm
345 mm insulation, paper wool, at 37 -granules
100 mm CLT (Södra)

Cell block brick



2 x 365 mm insulated cell blocks (Thermoplan)



Build-up
Exterior wall

Timber frame structure with glass wool

LCA

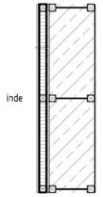
Price [excl. DB]

8 mm Windstopper Extreme (Cembritt)
45x295 mm studs, K18 c / c 600 mm
295 mm glass wool, at 34 - bats (Isover)
18mm OSB board
45x70 mm studs c / c 450 mm
45 mm glass wool at 34 (Isover)
15 mm fiberglass

Timber frame structure with paper wool insulation

8 mm Windpanel Premium (diffusion open)
45x295 mm studs, K18 c / c 600 mm
295 mm paper wool insulation, at 37 - Granulate fire class B-s2, d0 (IsoCell)
18mm OSB plate G3
45x70 mm studs c / c 450 mm
45 mm wood fiber bats, at 38 fire class B-s2, d0 (Woodfiber)
15 mm fiber gypsum board cladding with tongue / groove joint

Timber frame structure I-beam with wood fiber insulation



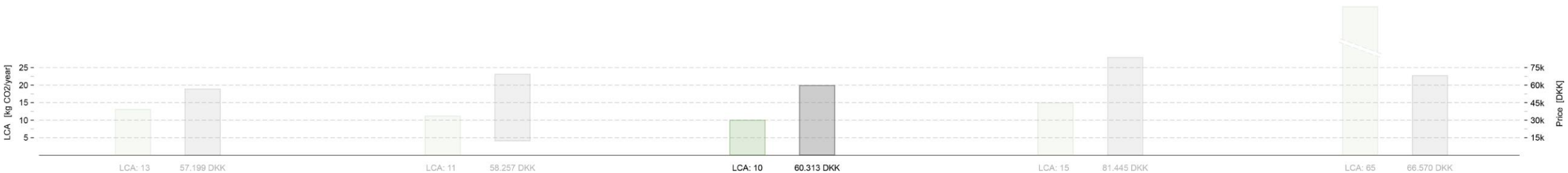
8 mm Windpanel Premium (diffusion open)
300 mm I-beams c / c 600 mm (Masonite Beams)
300 mm wood fiber insulation, at 38 - Granules (Hunton)
18mm OSB plate G3
45x70 mm studs c / c 450 mm
45 mm wood fiber insulation, at 38 (Hunton)
15 mm fiber gypsum board cladding with tongue / groove joint

CLT with paper wool insulation

8 mm Windstopper Extreme (Cembritt)
45x345 mm I-beams c / c 600 mm
345 mm insulation, paper wool, at 37 -granules
100 mm CLT (Södra)

Cell block brick

2 x 365 mm insulated cell blocks (Thermoplan)



Values: 3 floors - 1 unit - Middle element

Bui
-up
Over
view

Foundation

Traditional foundation
Leca and concrete

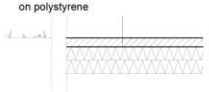
Traditional foundation
Future cement

Elevated screw pile foundation

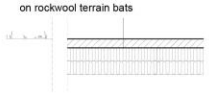
L-element

Terrain-deck

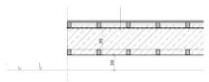
Concrete deck
on polystyrene



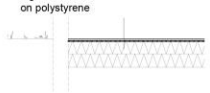
Concrete deck
on rockwool terrain bats



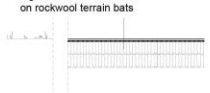
Raised light deck



Light deck
on polystyrene



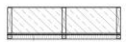
Light deck
on rockwool terrain bats



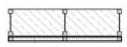
Outerwall

Timber frame structure
with glass wool

Timber frame structure
with paper insulation



Timber frame structure I-beam
with wood fiber



CLT
with paper insulation

Cell block brick

Floor build-up

Beam layer
visible massive wood

Beam layer
visible GluLam

Beam layer
covered with gipsum

CLT

Inner walls

Metal frame
with glass wool

CLT

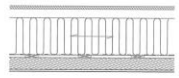
Timber frame structure
with wood fiber + 2x gipsum

Timber frame structure
with wood fiber + gipsum + OSB

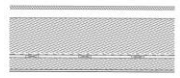
Celleblok brick

Roof build-up

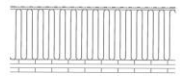
Timber frame structure
with wood fiber



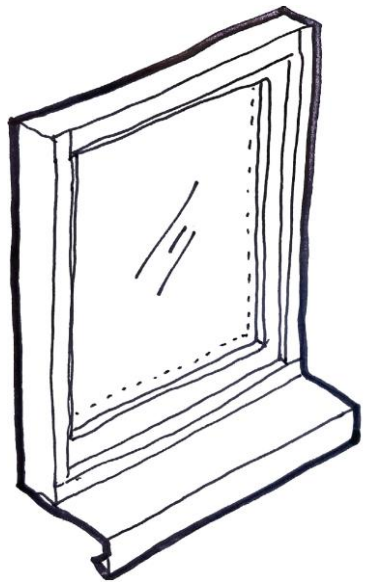
Timber frame structure
with paper insulation



CLT
with wood fiber



↓ AND MORE ↓



Components

Components
Add on - building elements

ADD ON - BUILDING COMPONENTS

In order to ensure maximum flexibility and the ability to comply with building regulations we have created a list of building components and benchmarked these against the 5 points, to ensure compliance with the overall mission for the concept.

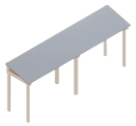
TECHNICAL COMPONENTS

In order to ensure maximum flexibility and the ability to comply with building regulations we have created a list of technical components and benchmarked these against the 5 points, to ensure compliance with the overall mission for the concept.

Components
Add on - building components

Exterior access stair

- Wood
- Steel



Roof eaves

Roof eaves - big (1,5 m)
- Steel roof
- Roofing film + photovoltaics
- Green roof

Roof eaves - small (0,5 m)

Balcony access

Column - Beam
- Wood
- Steel

Foundantions
- Concrete
- Screw foundation

Balcony access deck
- High strength concrete
- Woodconstruction (fireprotected)
- Steelconstruction (fireprotected)

Railing
- Steel
- Wood

Stairwell

Walls (firesection)
- CLT
- Concrete

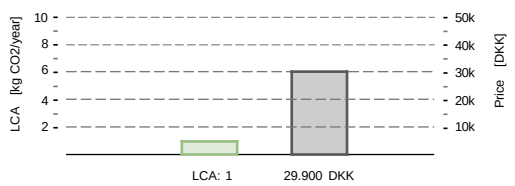
Shed / Technical room

Wood, non-insulated
Wood, insulated

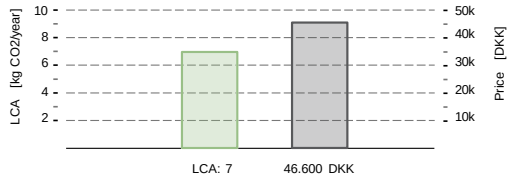
Components
Exterior access stair

Exterior access stair

Wood



Steel

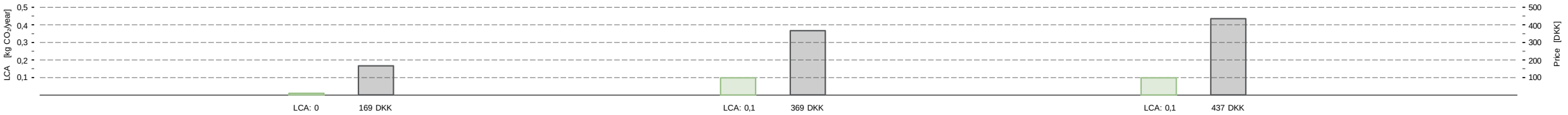


Components
Exterior access stair

Exterior access stair

Exterior access stair + balcony access + shed

Exterior access stair + balcony access + roof eaves



LCA Price [excl. DB]

LCA and price is calculated for a 3 level (165 m2) middle house, and should be added to the values of the house.

Components
Roof eaves

Roof eaves - small (0,5 m)

Roof eaves - big (1,5 m)

Balcony access

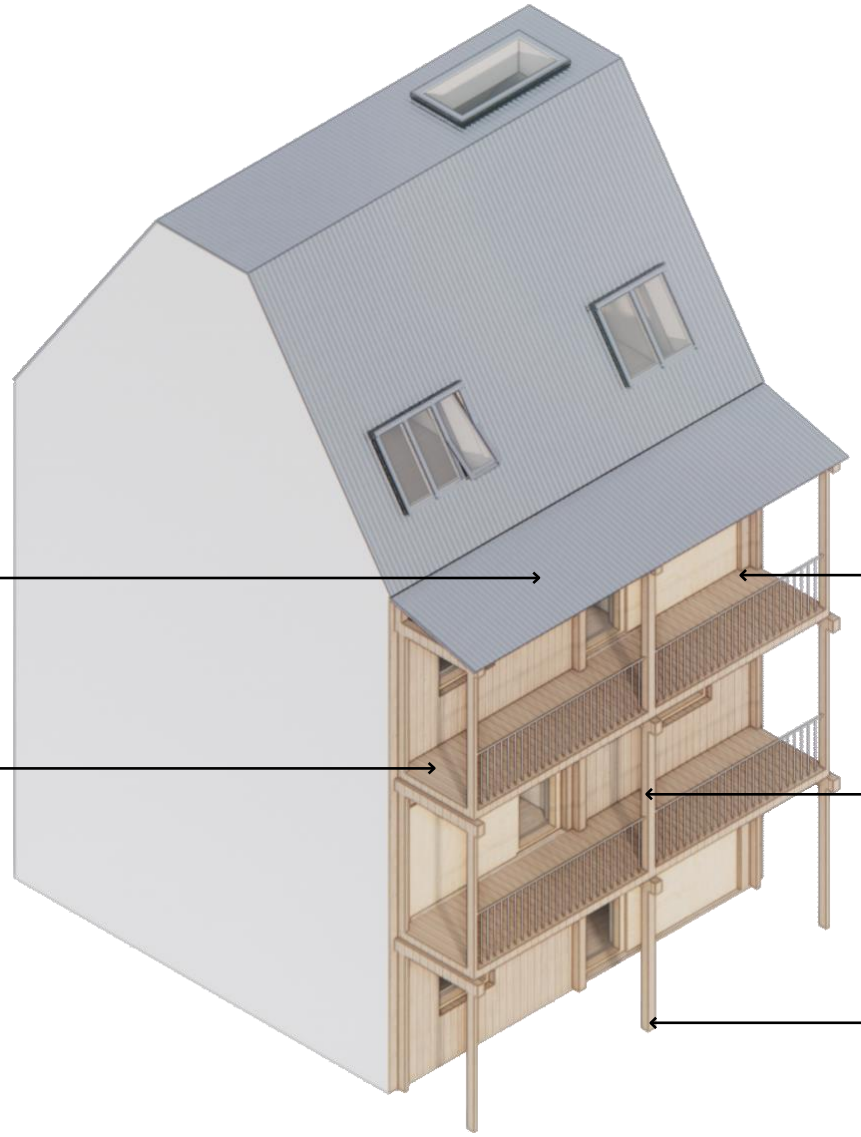
Components
Roof eaves

Roof material

Green roof

Photovoltaic

Components
Balcony access



Roof overhang 01:
- Sinus plates, steel zinc magnesium
- Spruce roof battens 38x73 pr 400mm
- Rafters, solid timber 100x200 pr 1000mm

Roof overhang 02:
- Green roof or solar panels
- Roofing paper membrane
- 25mm plywood
- 8 Mm hard wind barrier kl. 1 Cembrit extreme
- 45x125mm planks -c / c 300 mm

Balcony access deck 01, 02 & 03
See build-ups on next page

Railing 01: (steel)
- Galvanized flat steel 8x50mm frames 1950x1200
- Galvanized round steel ø 8mm per 75mm

Railing 02: (wood)
- Handrail: 100x40mm, core pine
- Posts: 100x40 pr. 975mm, core pine
- Core pine 20x50 mm pr 75mm

Column-beam system 01 - wood
- Columns: 180x180 mm GL28H
- Visible beams: 180x180 mm GL28H

Column-beam system 02 - steel
- Columns: HE120A
- Frame: UNP160

Foundation 01
- Point foundation 1x1x1 meter with steel angle for distance to ground

Foundation 02
- Screw foundation, same as for housing

Components
Balcony access

Balcony acces - steel

Foundation
- Point foundation 1x1x1 meter
- Steel angle for distance to ground

Column-beam system in steel
- Columns: HE120A
- Frame: UNP160

Balcony access deck
- 32 mm terrace boards, spruce
- 45x150 mm wood construction
- Plywood, roofing film
- UNP 80 per 0.5 m
- 2x15 mm fireboard

Railing in steel
- Galvanized flat steel 8x50mm frames 1950x1200
- Galvanized round steel ø 8mm per 75mm

Balcony acces - wood

Foundation
- Screw foundation, same as for housing

Column-beam system in wood
- Columns: 180x180 mm GL28H
- Visible beams: 180x180 mm GL28H

Balcony access deck
- 32 mm terrace boards, spruce
- 45x150 mm wood construction
- Plywood, roofing film
- 45x195 mm plywood C18 per 300 mm
- 2x15 mm fireboard

Railing in wood
- Handrail: 100x40mm, core pine
- Posts: 100x40 pr. 975mm, core pine
- Core pine 20x50 mm pr 75mm

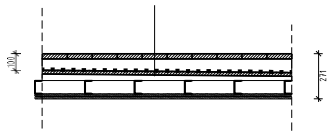
Balcony acces - high-strength concrete

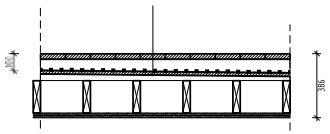
Foundation
- Screw foundation, same as for housing

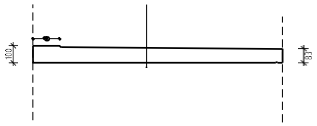
Column-beam system in wood
- Columns: 180x180 mm GL28H
- Visible beams: 180x180 mm GL28H

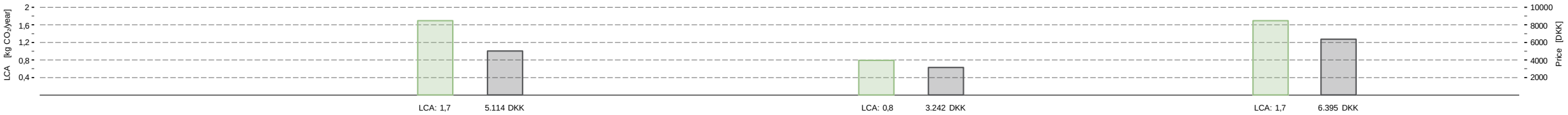
Balcony access deck
- Fiber concrete

Railing in steel
- Galvanized flat steel 8x50mm frames 1950x1200
- Galvanized round steel 8mm per 75mm







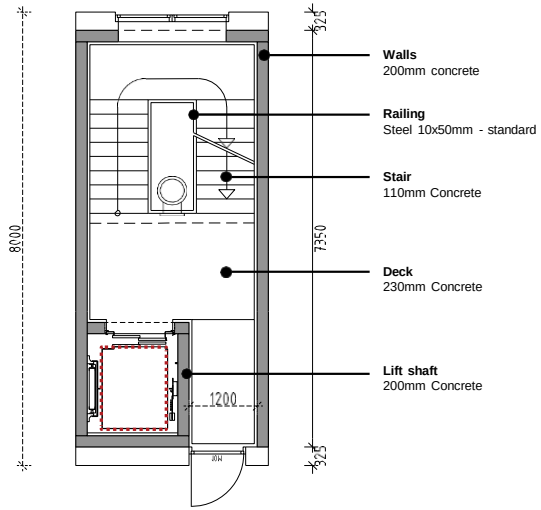


LCA Price [excl. DB]

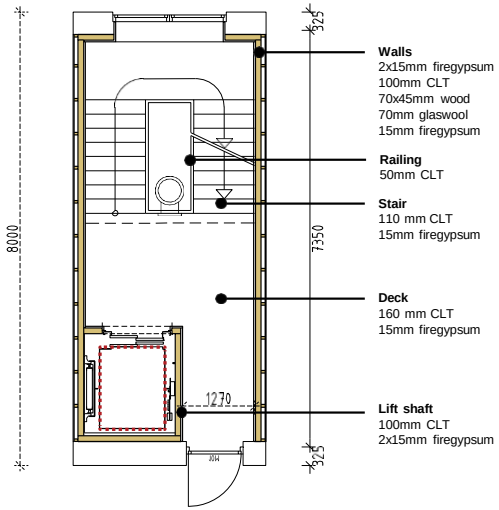
LCA and price is calculated for a 4 level balcony corridor for a middle house.

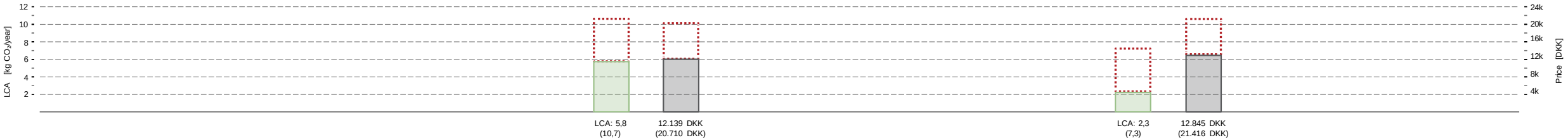
Components
Stairwell

Concrete



CLT





LCA Price [excl. DB] Incl. elecator LCA and price is calculated for a 4 level stairwell house, middle element.

Components
Add on - technical elements

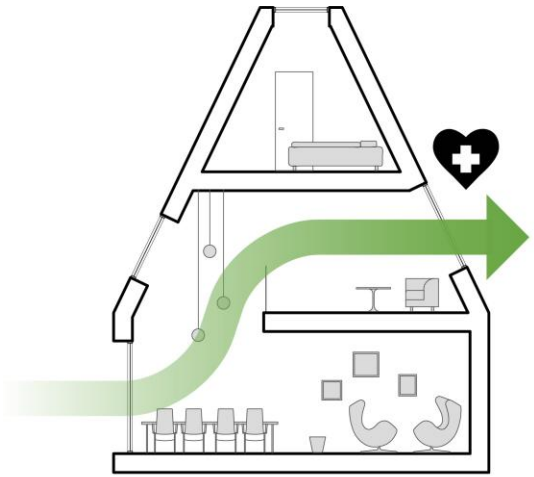
ADD ON - BUILDING COMPONENTS

In order to ensure maximum flexibility and the ability to comply with building regulations we have created a list of building components and benchmarked these against the 5 points, to ensure compliance with the overall mission for the concept.

TECHNICAL COMPONENTS

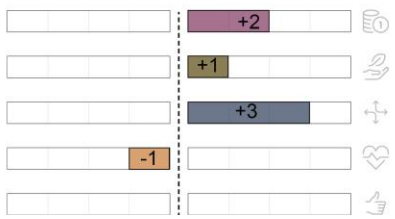
In order to ensure maximum flexibility and the ability to comply with building regulations we have created a list of technical components and benchmarked these against the 5 points, to ensure compliance with the overall mission for the concept.

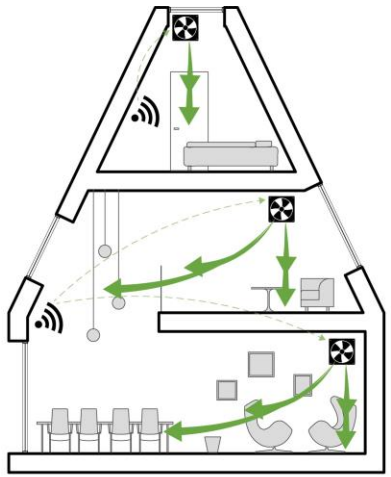
Components
Ventilation



NATURAL VENTILATION

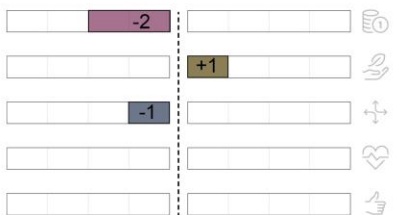
House that only has natural ventilation

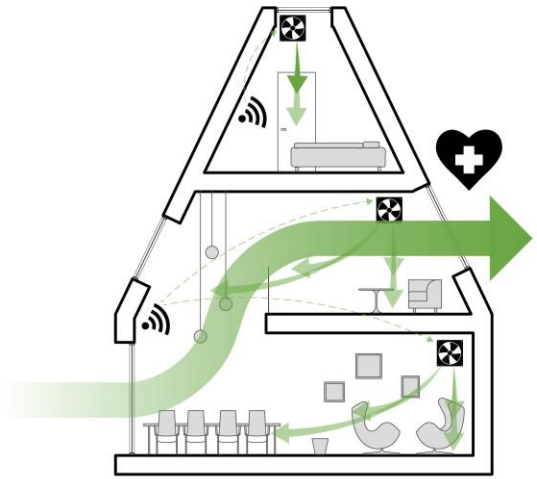




MECHANICAL VENTILATION

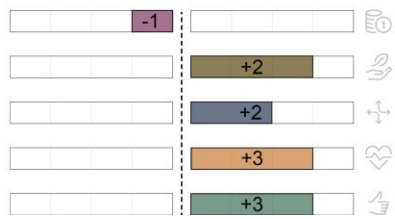
House that only has mechanical ventilation



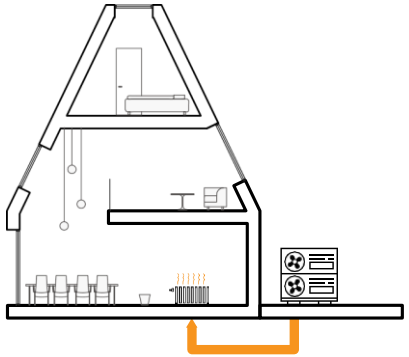


HYBRID VENTILATION

House that only both natural and mechnical ventilation that interacts, using each others strenghts.

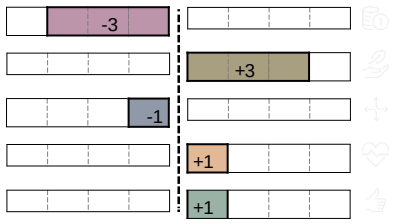


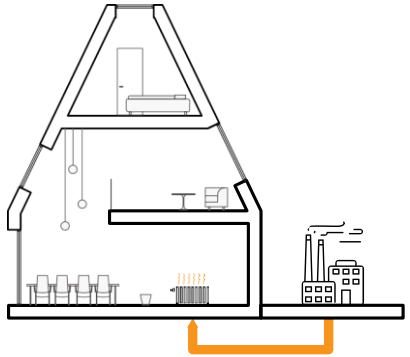
Components
Heating system



INDIVIDUAL HEAT PUMP - AIR TO WATER

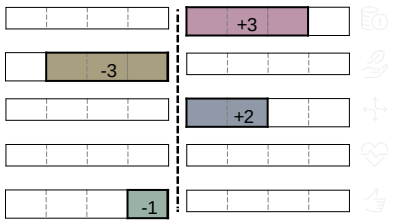
Performance benchmarked based on individual heat pump

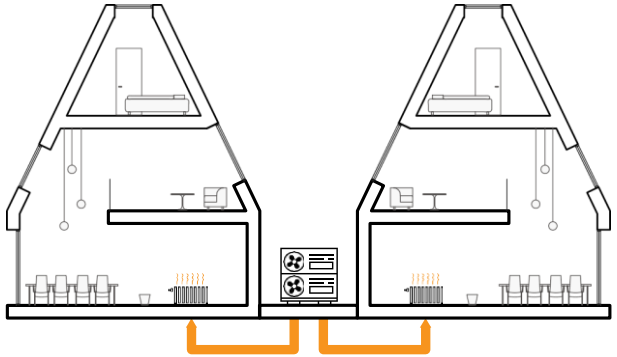




DISTRICT HEATING

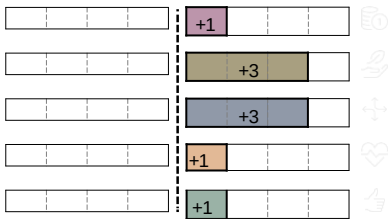
Performance benchmarked based on district heating

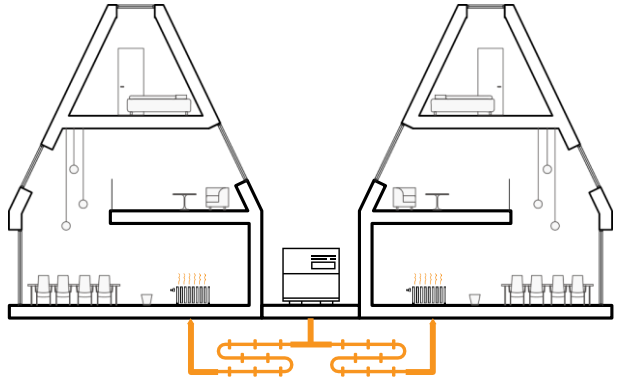




ENERGY COMMUNITY HEAT PUMP - AIR TO WATER

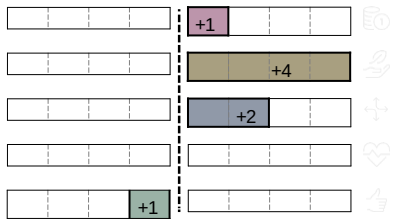
Performance benchmarked based an energy community - heat pump

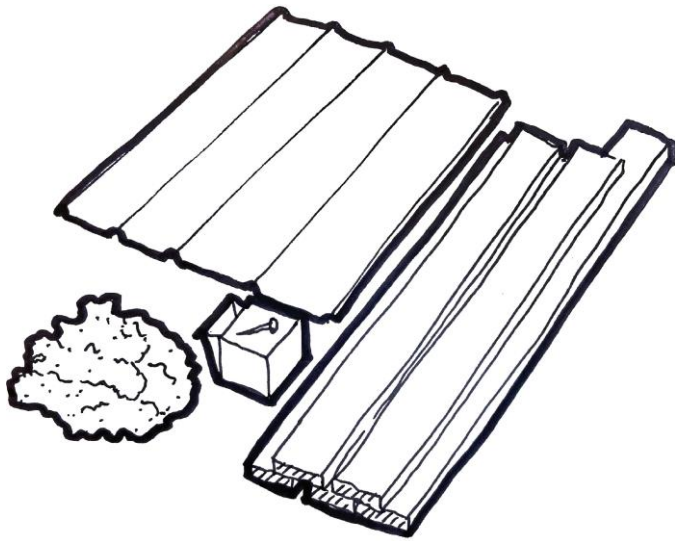




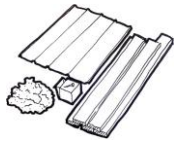
ENERGY COMMUNITY GROUND HEATING

Performance benchmarked based an energy community - ground heating



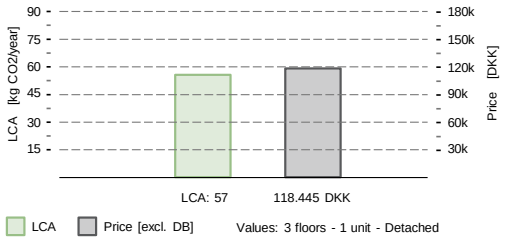


Materials



Materials

Starting point
Untreated wood +
Metal plates



Ma

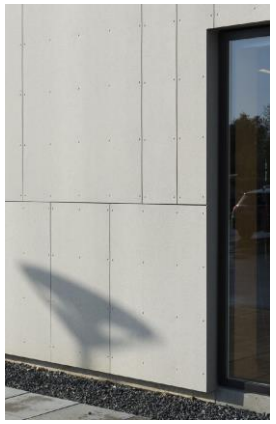
Facade cladding

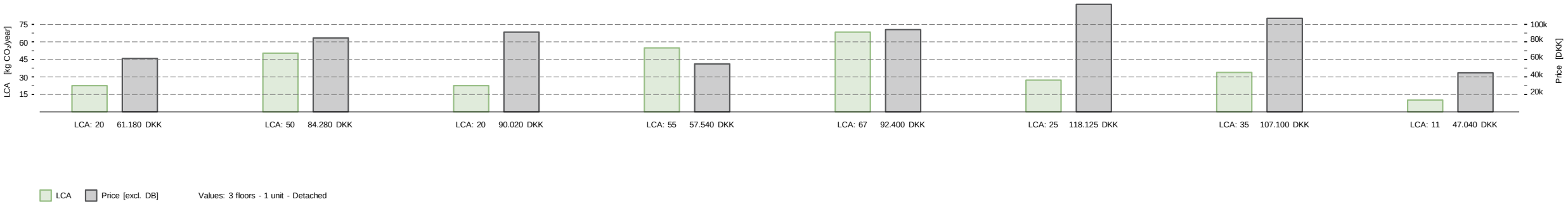
Wood	Wood	Wood	Steel plate	Facade tiles	Slate	Fibercement	Pl as ter
untrea ted	heat treated	painted					

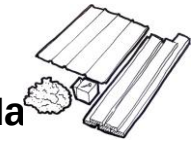










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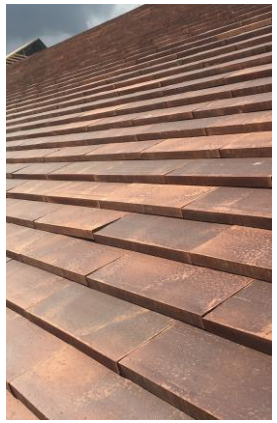
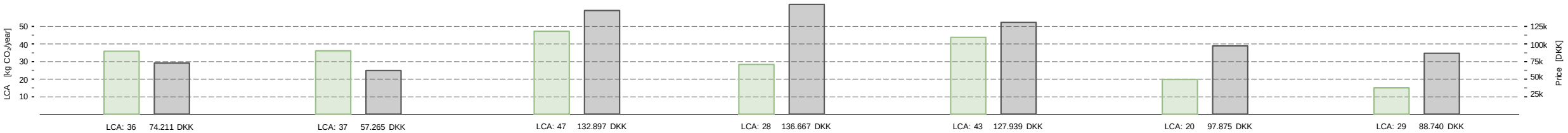
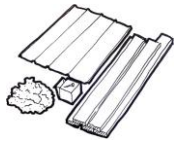
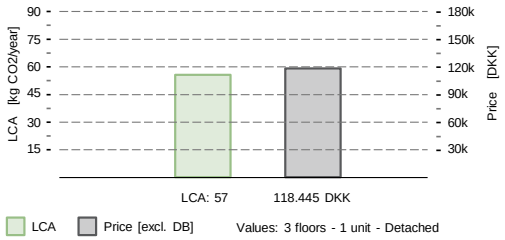
Roof cladding

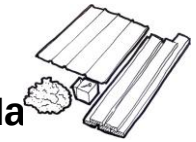
Roof film	Metal plate	Metal plate	Roof tile	Wooden slats	Slate	Fiberc ement
						
Steel	Zink					





Materials
Untreated wood +
Metal plates





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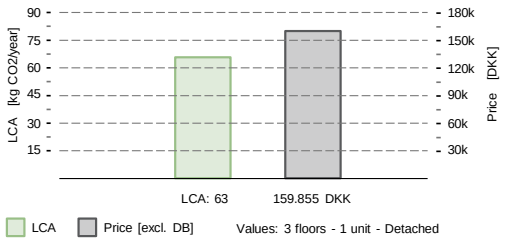
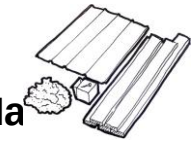
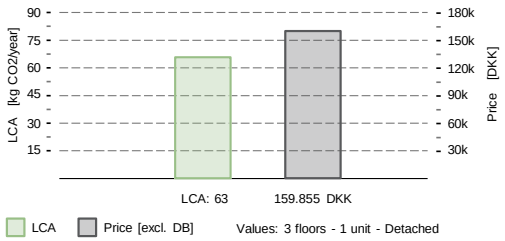
Untreated wood

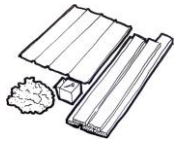




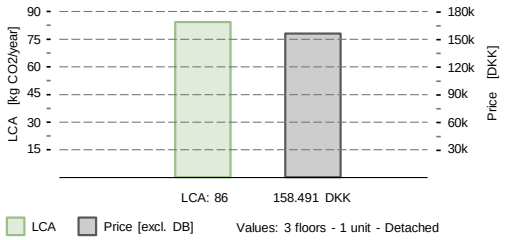
Ma

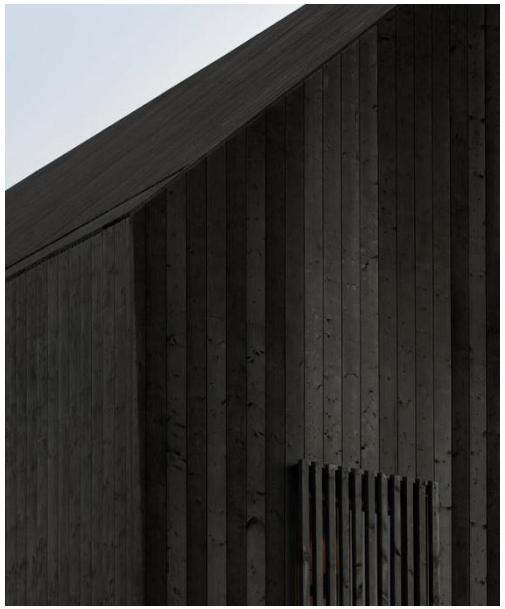
Untreated wood

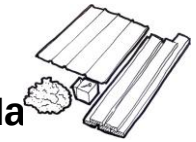




Materials
Black wood +
Roofing paper







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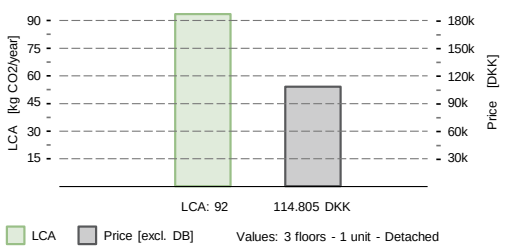
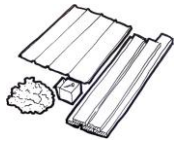
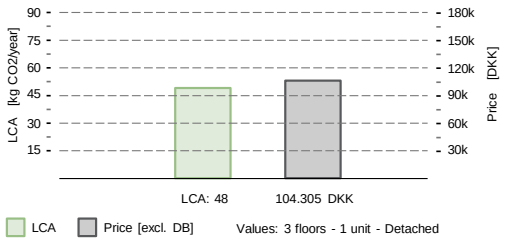
Metal plates

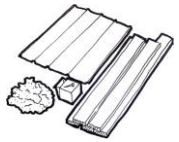




Materials

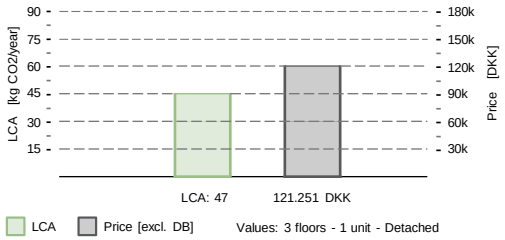
Plastered facade +
Metal plates

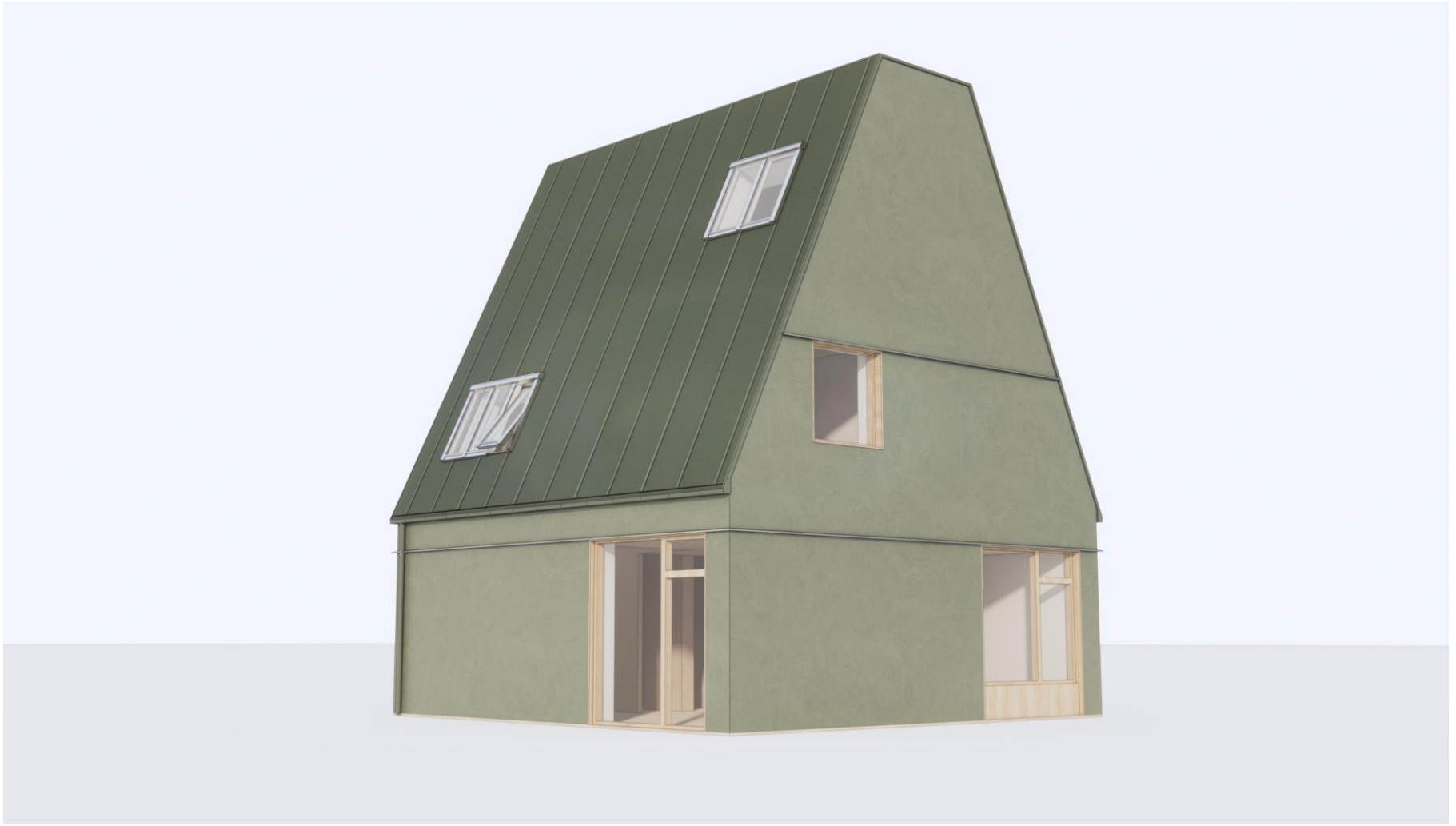


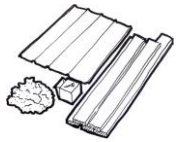


Materials

Plastered facade +
Green roofing paper

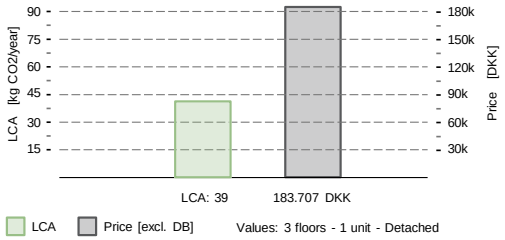


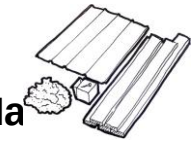




Materials

Plastered facade +
Roof tiles





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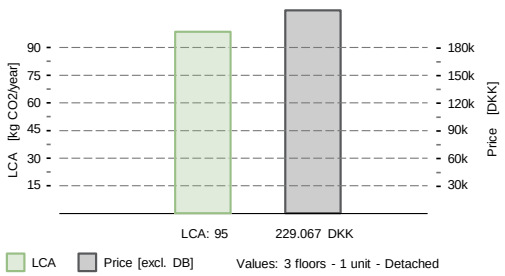
Roof/facade tiles



Materials
Comparison





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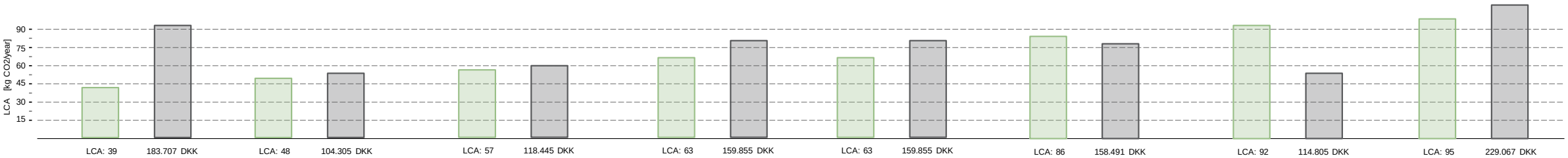
Comparison - LCA





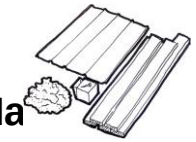



Plastered facade Roof tiles	Plastered facade Metal plates	Untreated wood Metal plates	Untreated wood	Untreated wood	Black wood Roofing paper	Metal plates	Facade/roof tiles
LCA: 39	LCA: 48	LCA: 57	LCA: 63	LCA: 63	LCA: 86	LCA: 92	LCA: 95
183.707 DKK	104.305 DKK	118.445 DKK	159.855 DKK	159.855 DKK	158.491 DKK	114.805 DKK	229.067 DKK



STARTING POINT

LCA Price [excl. DB] Values: 3 floors - 1 unit - Detached



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Comparison - Price

Plastered facade Metal plates	Metal plates	Untreated wood Metal plates	Black wood Roofing paper	Untreated wood	Untreated wood	Plastered facade Roof tiles	Facade/roof tiles
LCA: 48	LCA: 92	LCA: 57	LCA: 86	LCA: 63	LCA: 63	LCA: 39	LCA: 95
104.305 DKK	114.805 DKK	118.445 DKK	158.491 DKK	159.855 DKK	159.855 DKK	183.707 DKK	229.067 DKK

Price [DKK]

180k
150k
120k
90k
60k
30k

STARTING POINT

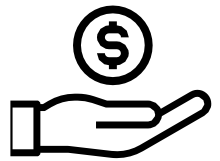
LCA Price [excl. DB] Values: 3 floors - 1 unit - Detached

Status and reductions

How We Selected Value For Money

Lowest LCA

Value For Money (Selected)



Lowest Price

Original typology
Starting point

The original typology is the 3 level detached house, this is the benchmark typology since it's the typology that is the hardest to get down in LCA and price, therefore this was the benchmark.

Selected
LCA:
3,8 kg CO^2 eq / m^2 / year
Price:
13.570 kr / m^2

Lowest LCA
LCA: 2,8 kg CO2 eq / m2 / year
Price: 14.323 kr / m2

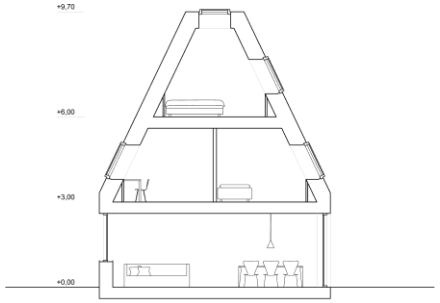
Lowest Price
LCA: 4,3 kg CO2 eq / m2 / year
Price: 11.486 kr / m2

Axonometric

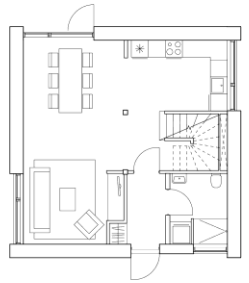
Area:
147 m2 brutto

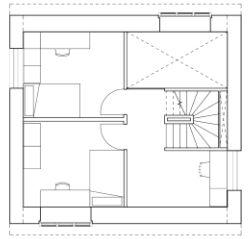
1) 1 x 147 m2 homes

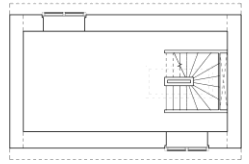
Section



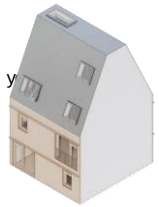
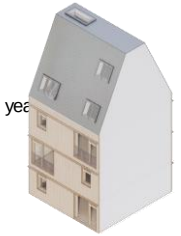
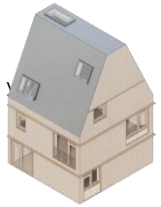
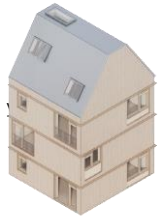
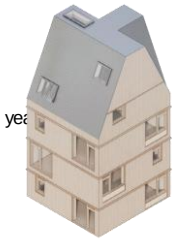
Plans







Modules
Further reduction

	2 levels 1 home (102 m2)	3 levels 1 home (147 m2)	3 levels 2 homes (62,4+102 m2)	4 levels 2 homes (62,4+147 m2)	4 levels 3 homes (2x62,4+102 m2)	5 levels 3 homes (2x62,4+147 m2)
Middle-house	 LCA: **3,2 kg** CO2 eq / m² / year Price: **11.651 kr** / m²	 LCA: **2,8 kg** CO2 eq / m² / year Price: **10.104 kr** / m²	 LCA: **3,0 kg** CO2 eq / m² / y Price: **11.871 kr** / m²	 LCA: **2,8 kg** CO2 eq / m² / year Price: **10.921 kr** / m²	 LCA: **3,0 kg** CO2 eq / m² / yea Price: **12.012 kr** / m²	 LCA: **2,8 kg** CO2 eq / m² / year Price: **11.258 kr** / m²
Gable-house	 LCA: **3,5 kg** CO2 eq / m² / year Price: **13.360 kr** / m²	 LCA: **3,1 kg** CO2 eq / m² / year Price: **11.490 kr** / m²	 LCA: **3,3 kg** CO2 eq / m² / y Price: **13.527 kr** / m²	 LCA: **3,1 kg** CO2 eq / m² / y Price: **12.401 kr** / m²	 LCA: **3,0 kg** CO2 eq / m² / yea Price: **13.719 kr** / m²	 LCA: **3,0 kg** CO2 eq / m² / year Price: **12.788 kr** / m²
Corner-house	 LCA: **3,3 kg** CO2 eq / m² / year Price: **12.622 kr** / m²	 LCA: **2,8 kg** CO2 eq / m² / year Price: **10.818 kr** / m²	 LCA: **3,1 kg** CO2 eq / m² / y Price: **12.726 kr** / m²	 LCA: **2,8 kg** CO2 eq / m² / year Price: **11.664 kr** / m²	 LCA: **3,0 kg** CO2 eq / m² / yea Price: **12.883 kr** / m²	 LCA: **2,8 kg** CO2 eq / m² / year Price: **12.010 kr** / m²

+ light foundation

- heavy foundation
NOTE: not including outside accesstiar to top appartment

- heavy foundation
NOTE: not including lift or balcony acces

Detached house
1 unit / 3 stories

The new 3 level detached house with the price reductions we made, during the process.

Selected

LCA:

3,3 kg CO^2 eq / m^2 / year

Price:

12.922 kr / m^2

Lowest LCA
LCA: 2,9 kg CO2 eq / m2 / year
Price: 13.651 kr / m2

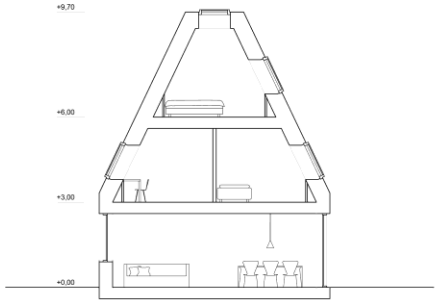
Lowest Price
LCA: 3,7 kg CO2 eq / m2 / year
Price: 12.197 kr / m2

Axonometric

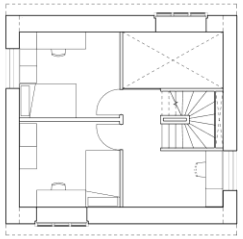
Area:
147 m2 brutto

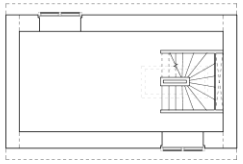
1) 1 x 147 m2 homes

Section



Plans





Double house
4 units / 3 stories

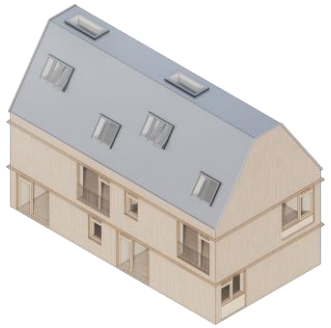
The Double House is made in 3 levels, and allows for the concept to have a small apartment in the bottom, that is useful for senior citizens or young professionals. This allows us to create a wider variety of housing options.

Selected
LCA:
3,3 kg CO2 eq / m2 / year
Price:
13.708 kr / m2

Lowest LCA
LCA: 3,0 kg CO2 eq / m2 / year
Price: 15.115 kr / m2

Lowest Price
LCA: 3,7 kg CO2 eq / m2 / year
Price: 13.128 kr / m2

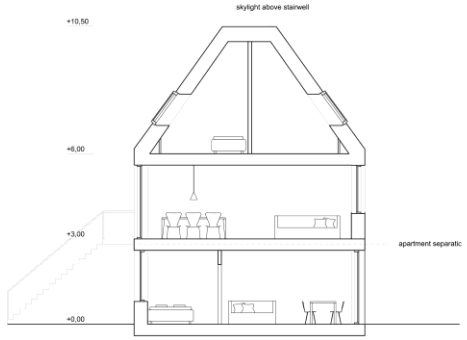
Axonometric



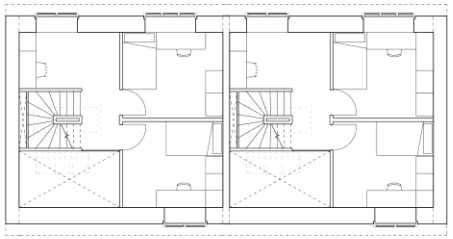
Area:
330 m2

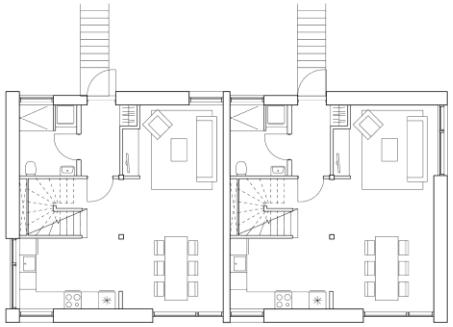
1) 2 x 63 m2 homes
2) 2x 102 m2 homes

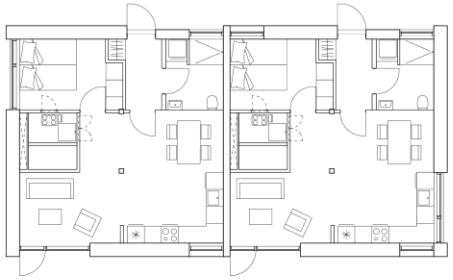
Section



Plans







Rowhouse
4 units / 2 stories

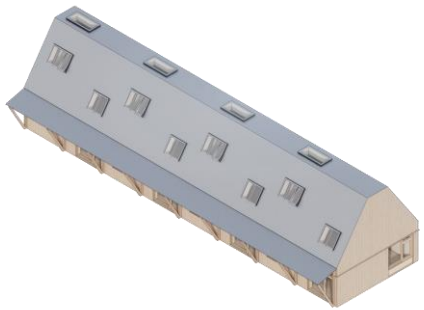
A rowhouse with a low height and a covered entrance situation allows for garden houses and smaller rowhouses for younger families or elderly.

Selected
LCA:
3,35 kg CO2 eq / m2 / year
Price:
12.506 kr / m2

Lowest LCA
LCA: 3,0 kg CO2 eq / m2 / year
Price: 13.981 kr / m2

Lowest Price
LCA: 3,75 kg CO2 eq / m2 / year
Price: 11.841 kr / m2

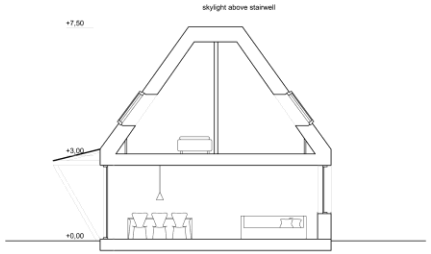
Axonometric



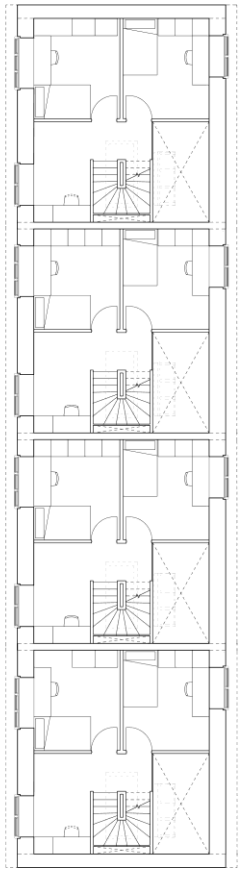
Area:
408 m2

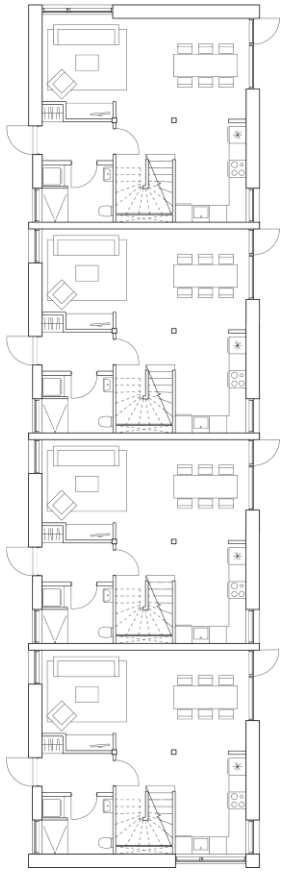
1) 4 x 102 m2 homes

Section



Plans





Short linear block
12 units / 5 stories

The short linear block is made in 5 storeys, is only aprox 35 meters long and would be ideal as a fill in project in urban contexts. It consists of 2 layers of smaller appartments and a 3 storey typology for co-housing or penthouse.

Selected

LCA:

2,95 kg CO2 eq / m2 / year

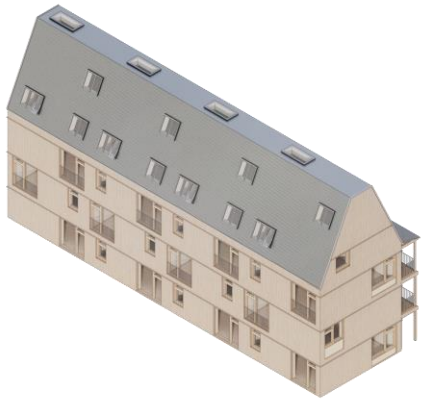
Price:

12.470 kr / m2

Lowest LCA
LCA: 2,7 kg CO2 eq / m2 / year
Price: 13.567 kr / m2

Lowest Price
LCA: 3,5 kg CO2 eq / m2 / year
Price: 11.995 kr / m2

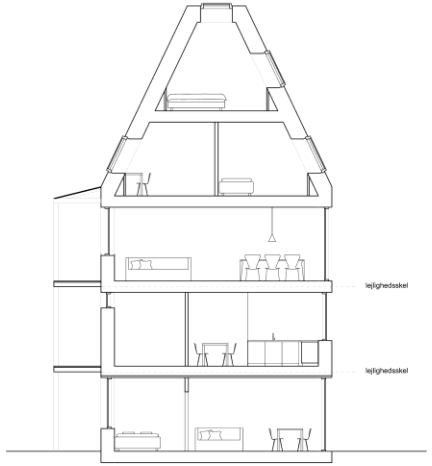
Axonometric



Area:
1211,7 m2

1) 8 x 63 m2 homes
2) 4 x 147 m2 homes

Section



Plans

Long linear block
24 units / 5 stories

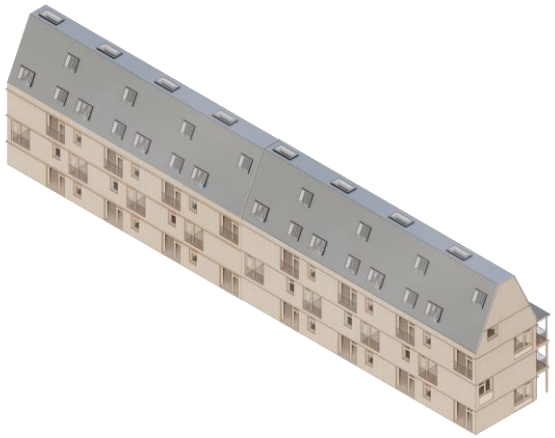
The long linear block is made in 5 storeys and is optimized in both price and LCA due to minimizing shafts, lifts and gables. It consists of 2 layers of smaller appartments and a 3 storey typology for co-housing or penthouse.

Selected
LCA:
2,8 kg CO2 eq / m2 / year
Price:
11.732 kr / m2

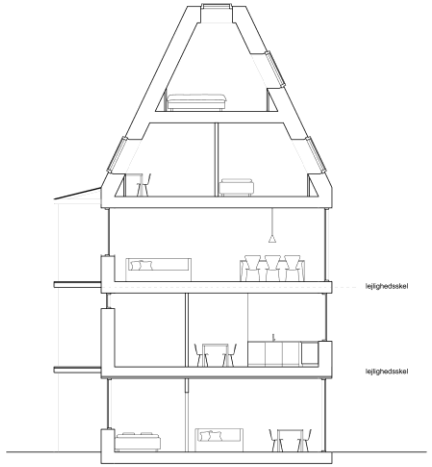
Lowest LCA
LCA: 2,5 kg CO2 eq / m2 / year
Price: 12.866 kr / m2

Lowest Price
LCA: 3,2 kg CO2 eq / m2 / year
Price: 11.307 kr / m2

Axonometric



Section



Area:
2464 m2 brutto

1) 16 x 63 m2 homes
2) 8 x 147 m2 homes

Plans

Courtyard block
48 units / 4 stories

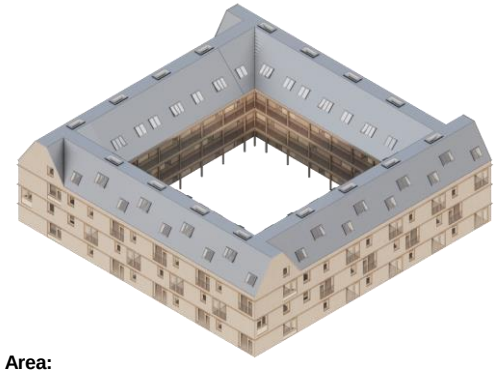
The courtyard block is the most urban typology, that fits into most urban contexts, making a clear courtyard and streetscape motive. It consists like the linear block of two layers of smaller appartments and a 2 storey typology on top for larger appartments. The social aspect of this typology is high.

Selected
LCA:
2,9 kg CO2 eq / m2 / year
Price:
12.533 kr / m2

Lowest LCA
LCA: 2,7 kg CO2 eq / m2 / year
Price: 13.726 kr / m2

Lowest Price
LCA: 3,5 kg CO2 eq / m2 / year
Price: 11.863 kr / m2

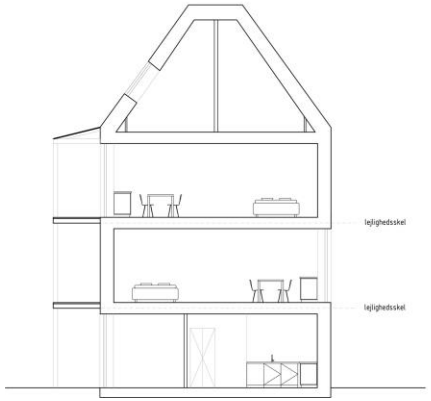
Axonometric



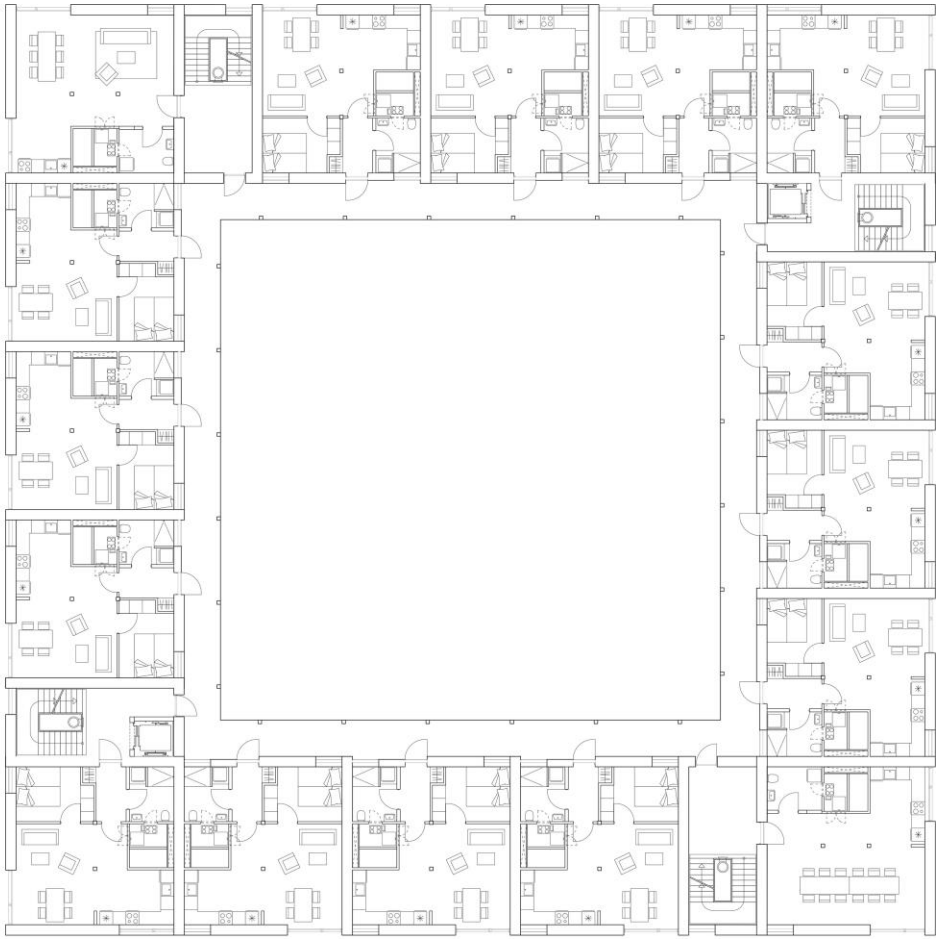
Area:
4280 m2 brutto

1) 32 x 63 m2 homes
2) 16 x 102 m2 homes

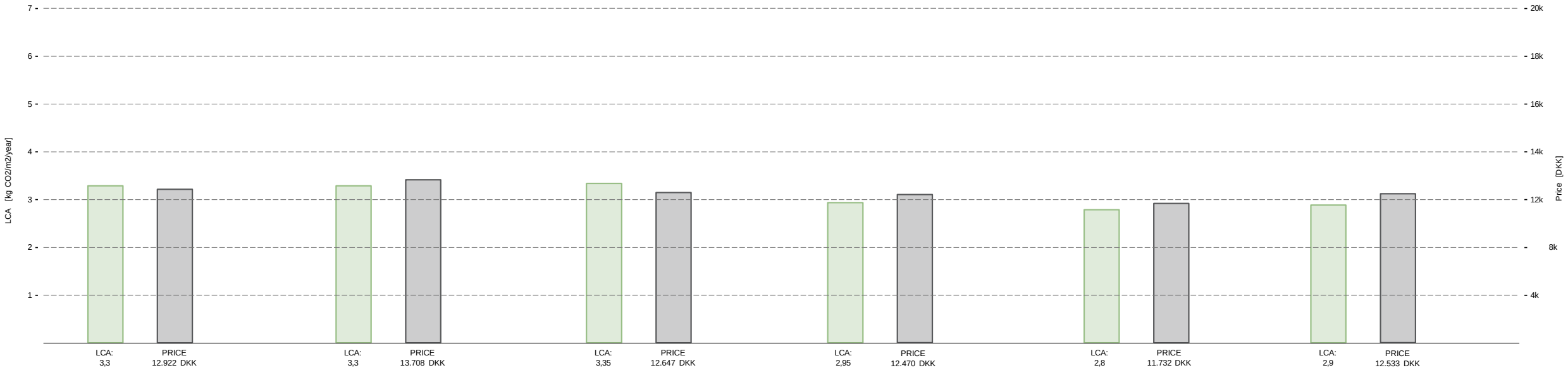
Section



Plans

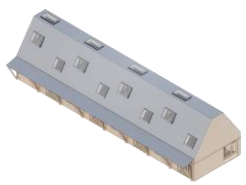


Typologies comparison



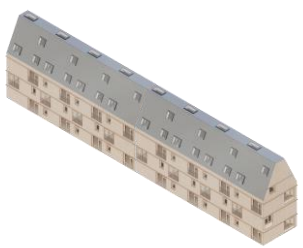
Selected
LCA:
3,3 kg CO2 eq / m2 / year
Price:
12.922 kr / m2

Selected
LCA:
3,3 kg CO2 eq / m2 / year
Price:
13.708 kr / m2

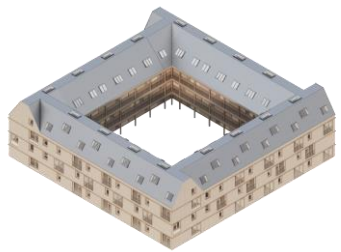


Selected
LCA:
3,35 kg CO2 eq / m2 / year
Price:
12.647 kr / m2

Selected
LCA:
2,95 kg CO2 eq / m2 / year
Price:
12.470 kr / m2

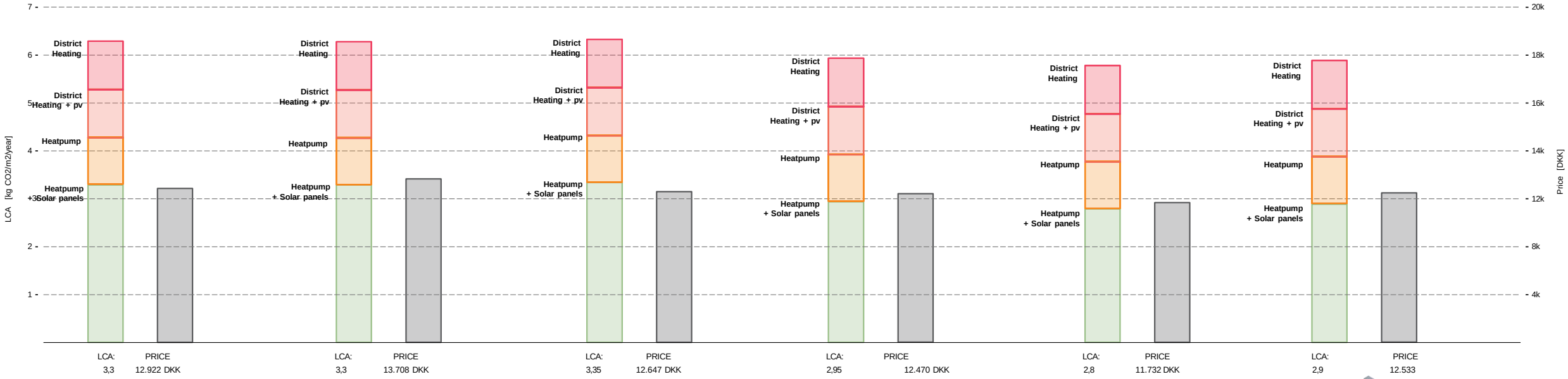


Selected
LCA:
2,8 kg CO2 eq / m2 / year
Price:
11.732 kr / m2



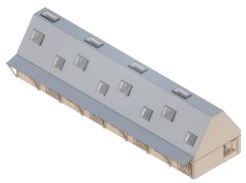
Selected
LCA:
2,9 kg CO2 eq / m2 / year
Price:
12.533 kr / m2

Typologies comparison



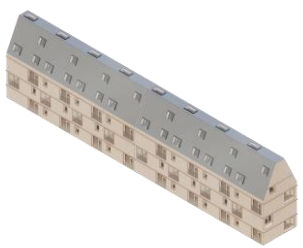
Selected
LCA:
3,3 kg CO2 eq / m2 / year
Price:
12.922 kr / m2

Selected
LCA:
3,3 kg CO2 eq / m2 / year
Price:
13.708 kr / m2

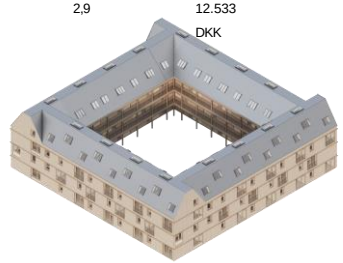


Selected
LCA:
3,35 kg CO2 eq / m2 / year
Price:
12.647 kr / m2

Selected
LCA:
2,95 kg CO2 eq / m2 / year
Price:
12.470 kr / m2



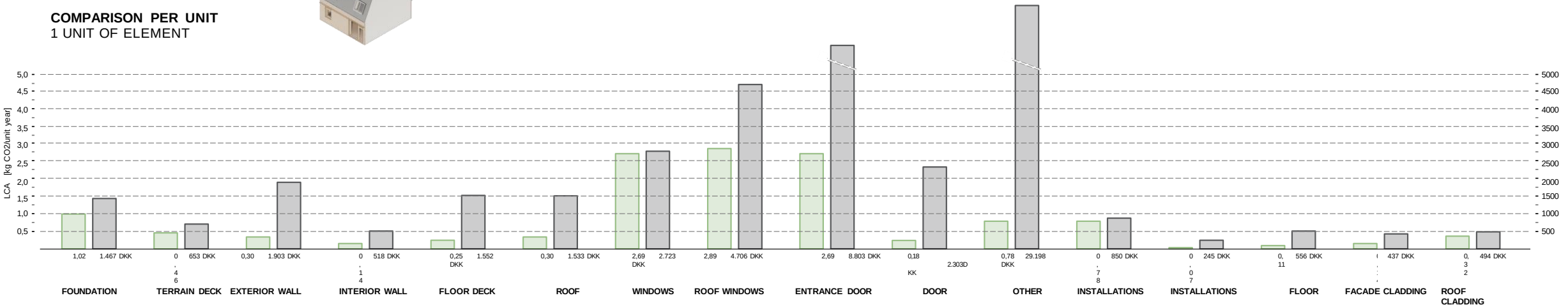
Selected
LCA:
2,8 kg CO2 eq / m2 / year
Price:
11.732 kr / m2



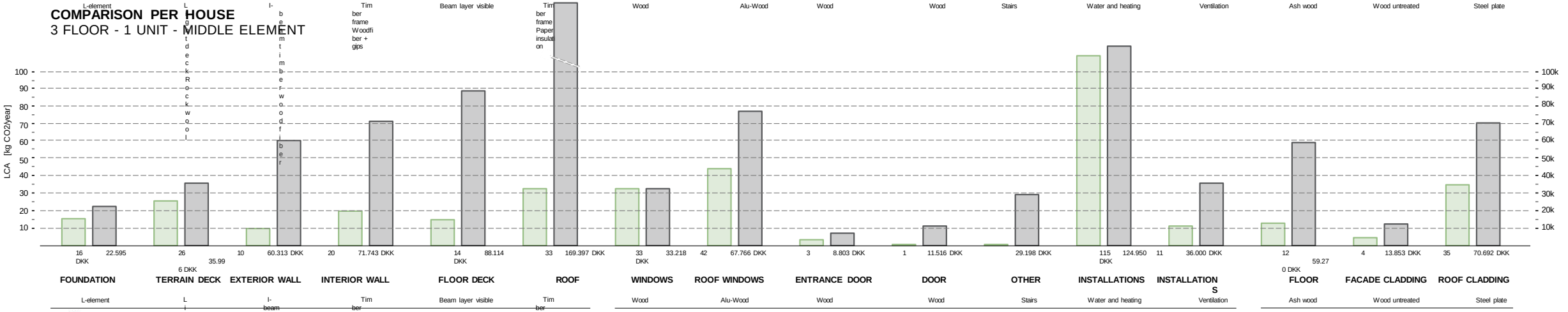
Selected
LCA:
2,9 kg CO2 eq / m2 / year
Price:
12.533 kr / m2

Comparison
Selected solution

COMPARISON PER UNIT
1 UNIT OF ELEMENT



COMPARISON PER HOUSE
3 FLOOR - 1 UNIT - MIDDLE ELEMENT



BUILD-UP

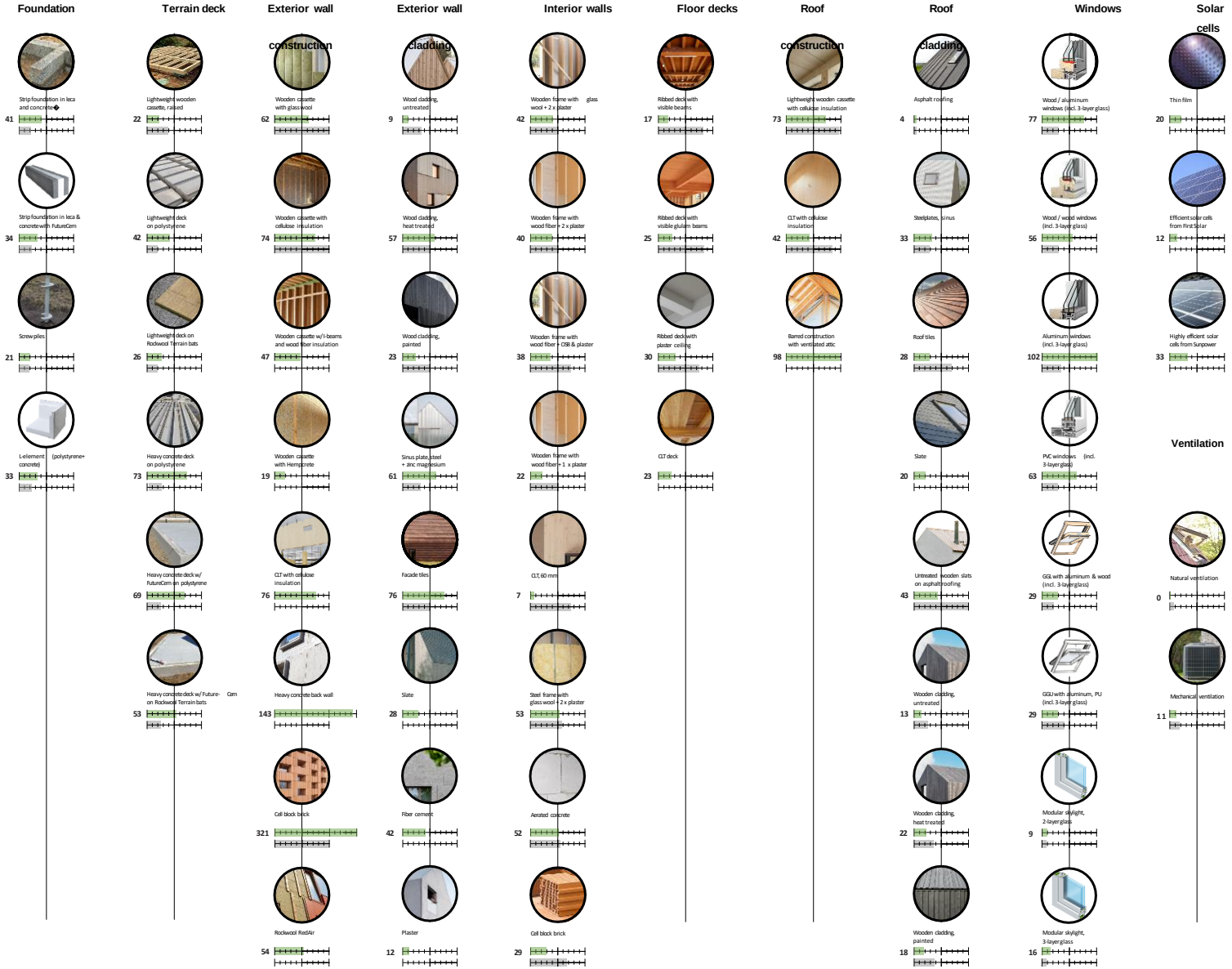
COMPONENTS

MATERIALS

LCA Price [excl. DB] Values: 3 floors - 1 unit - Middle element

Tool and ongoing process

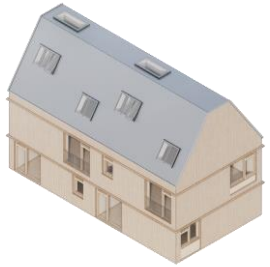
LCA & Price tool
Comparation tool



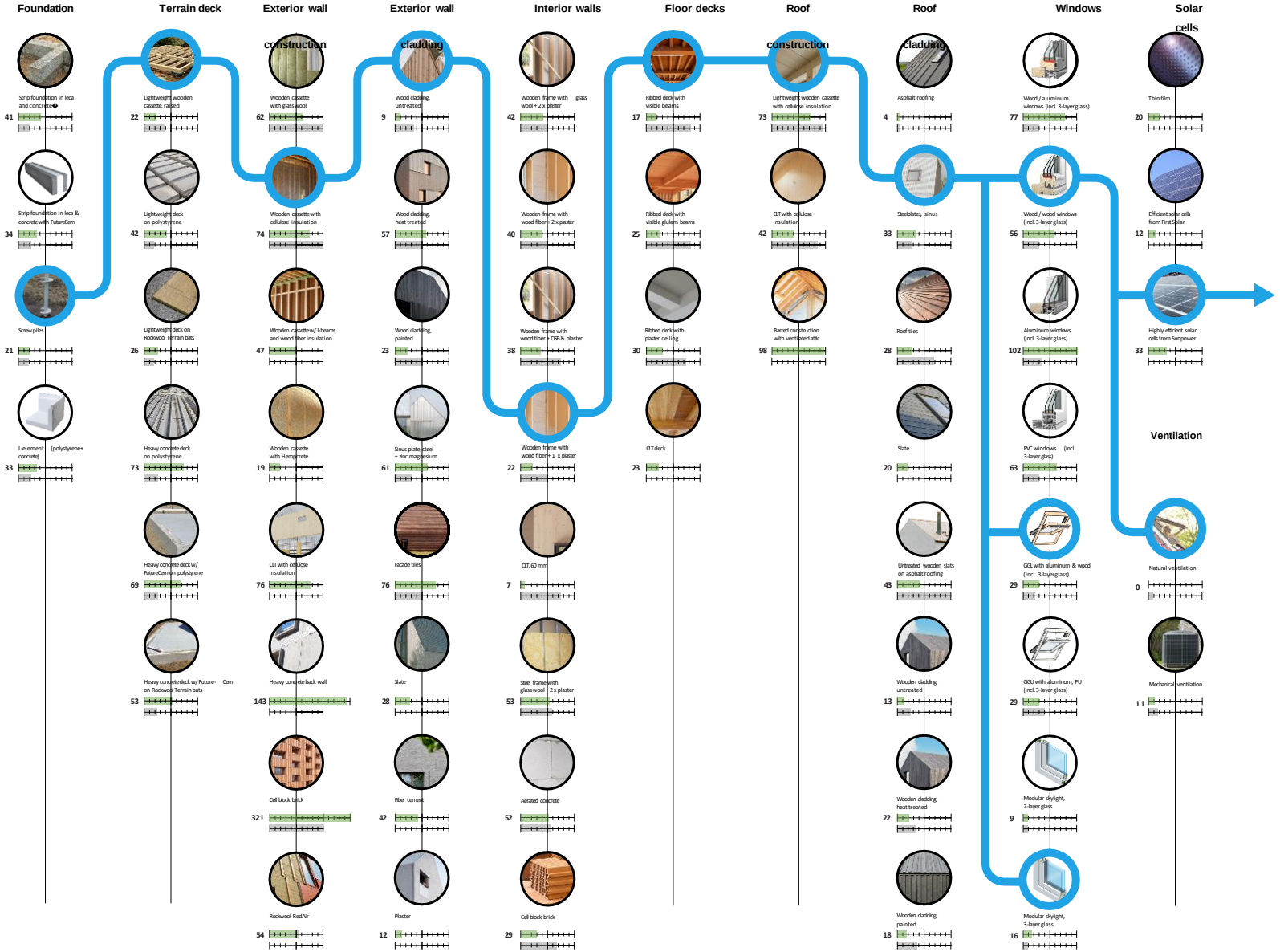
LCA (Kg CO2/year/unit)
Price (DKK/unit)

LCA & Price tool
Double house

2 units / 3 floors



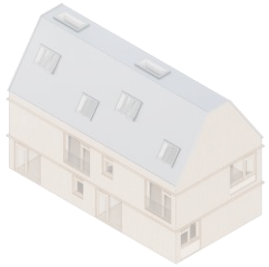
Foundation	46 m
Terrain deck	107 m²
Facade	266 m²
Roof	186 m²
Deck	79 m²
Interior wall	340 m²
Division deck	107 m²
Division wall	62 m²
Windows	60 m²



LCA (Kg CO2/year/unit)
Price (DKK/unit)

LCA & Price tool
Double house

2 units / 3 floors



Foundation 46 m
Terrain deck 107 m²
Facade 266 m²
Roof 186 m²
Deck 79 m²
Interior wall 340 m²
Division deck 107 m²
Division wall 62 m²
Windows 60 m²

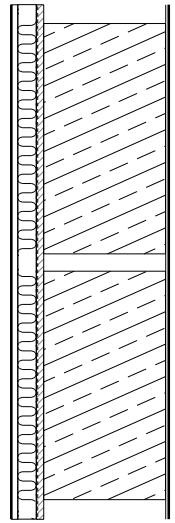
LCA (Kg CO2/year/unit)
Price (DKK/unit)

Foundation | Terrain deck | Exterior wall construction | Exterior wall cladding | Interior walls | Floor decks | Roof construction | Roof cladding | Windows | Solar cells

Exterior Wall Construction
Wooded Cassette
Paper Wool Insulation

LCA: 0,33 kg CO2/unit year

Price: 1750 DKK/m2



Layers

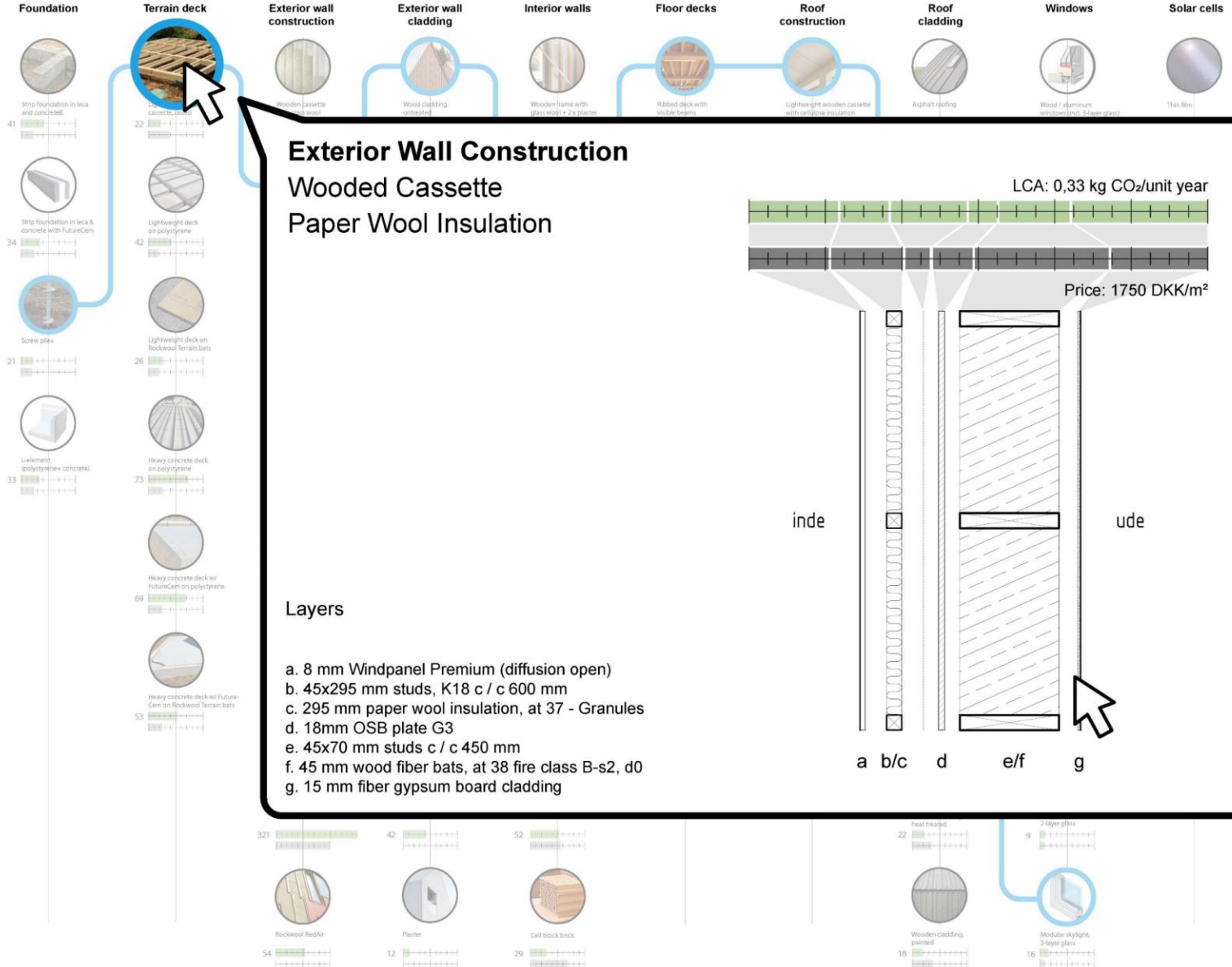
a. 8 mm Windpanel Premium (diffusion open)
b. 45x295 mm studs, K18 c / c 600 mm
c. 295 mm paper wool insulation, at 37 - Granules
d. 18mm OSB plate G3
e. 45x70 mm studs c / c 450 mm
f. 45 mm wood fiber bats, at 38 fire class B-s2, d0
g. 15 mm fiber gypsum board cladding

LCA: 3,10 kgCO2/m² year
Price: 11385,00 DKK/m²

LCA & Price tool
Double house

2 units / 3 floors

Foundation	46 m
Terrain deck	107 m²
Facade	266 m²
Roof	186 m²
Deck	79 m²
Interior wall	340 m²
Division deck	107 m²
Division wall	62 m²
Windows	60 m²



LCA (Kg CO_2/year/unit)
Price (DKK/unit)

LCA & Price tool
Double house

2 units / 3 floors

Foundation	46 m
Terrain deck	107 m²
Facade	266 m²
Roof	186 m²
Deck	79 m²
Interior wall	340 m²
Division deck	107 m²
Division wall	62 m²
Windows	60 m²

LCA (Kg CO_2/year/unit)
Price (DKK/unit)

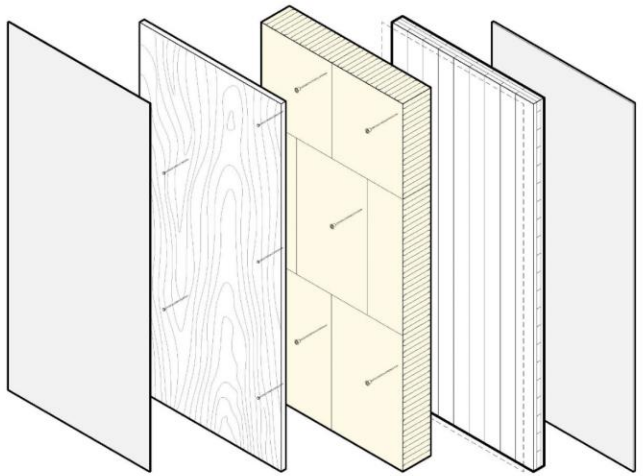
Foundation | Terrain deck | Exterior wall construction | Exterior wall cladding | Interior walls | Floor decks | Roof construction | Roof cladding | Windows | Solar cells

Exterior Wall Construction

Wooded Cassette
Paper Wool Insulation

LCA: 0,33 kgCO_2/unit year

Price: 1750 DKK/m²



Layers

a. 8 mm Windpanel Premium (diffusion open)
b. 45x295 mm studs, K18 c / c 600 mm
c. 295 mm paper wool insulation, at 37 - Granules
d. 18mm OSB plate G3
e. 45x70 mm studs c / c 450 mm
f. 45 mm wood fiber bats, at 38 fire class B-s2, d0
g. 15 mm fiber gypsum board cladding

LCA: 3,10 kgCO2/m² year

Price: 11385,00 DKK/m²

Fire restrictions

A multi-storey residential building placed in fire class 2 must be constructed in accordance with the Building Regulations' guidelines for Chapter 5 - Fire and the pre-accepted solutions specified in the accompanying Appendix 2 "Pre-accepted solutions - Multi-storey residential construction".

This includes e.g. does not deviate from the following:

In buildings with a floor on the upper floor more than 5.1 m above ground, where the load-bearing structures are not made of materials that are at least class A-s1, d0 (non-combustible material), insulating materials that are inferior to material class must not be used. B-s1, d0 (class 1 material) in connection with these load-bearing building components
In fire cells (dwellings) on two floors, in order to prevent people being trapped in the fire cell, it will be necessary for there to be exits from both floors.
It can be seen from the above that placement in fire class 2 e.g. makes the use of bio-based insulation material inferior to B-s1, d2 impossible in buildings with load-bearing wooden structures. Furthermore, it is not possible to furnish dwellings on two floors, of which only the lower floor has access to an escape route.

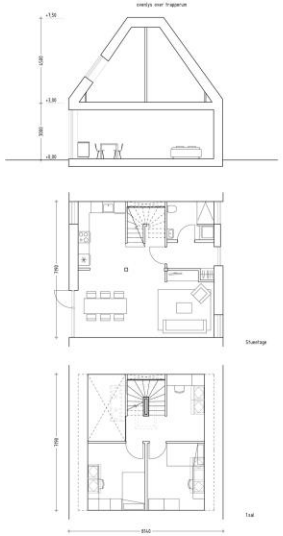
If it is desired to deviate from the pre-accepted solutions, the building must be placed in fire class 3 or 4. This allows the pre-accepted solutions to be deviated from if the safety level can be documented using comparative analyzes or fire-technical reasoned assessments.

Fire input
2 levels / rowhouse

Enfamilieshus indrettet efter Bilag 1a uden afvigelser => BK1, under forudsætning af at rækkehuse opdeles i brandmæssigt fritliggende bygningsafsnit på maksimalt 600 m2 - det vil sige 5 rækkehuse med denne typologi kan sammenbygges i BK1. Sammenbygges flere skal byggeriet henføres til BK2.Afviges der fra Bilag 1a er der tale om BK3. A = 118 m2Gulv i øverste etage < 5,1 m over terræn

Bærende konstruktioner: R 30OBS! Skærpede krav til bygningsdele, der støtter eller stabilisere brandcelleadskillelser og brandsektioner!

Adskillende bygningsdele: Brandcelleadskillelser (mellem boliger): EI60Brandsektionsadskillelser (til opdeling af bygningsafsnit større end 1200 m2): EI60 / A2-s1,d0Det ses at den brandcelleadskillende bygningsdel kan indeholder træ, mens det ikke er tilfældet for den brandsektionsadskillende bygningsdel.
Udvendige overflader: K1 10
/ D-s2,d2 - Alternativt materialeklasse D-s2,d2. Hvis der anvendes regnskærm skal beklædning være K1 10 / B-s1,d0 mens regnskærm skal være Ds-2,d2 - Husk brandstop!Tag som BROOF(t2).
Indvendige overflader:
K1 10 / D-s2,d2Isolering: D-s2,d2 - OBS på adskillende bygningsdele.



Fire input
3 levels / rowhouse

BK3: Enfamilieshus indrettet efter Bilag 1a men med afvigelser => BK3. A < 150 m2Gulv i øverste etage > 5,1 m over terræn

Bærende konstruktioner:
R 30OBS! Skærpede krav til bygningsdele, der støtter eller stabilisere brandcelleadskillelser og brandsektioner!

Adskillende bygningsdele:
Brandcelleadskillelser (mellem boliger): EI60
Brandsektionsadskillelser (til opdeling af bygningsafsnit større end 1200 m2): EI60 / A2-s1,d0
Det ses at den brandcelleadskillende bygningsdel kan indeholder træ, mens det ikke er tilfældet for den brandsektionsadskillende bygningsdel.

Udvendige overflader:
K1 10 / D-s2,d2 - Alternativt materialeklasse D-s2,d2.
Hvis der anvendes regnskærm skal beklædning være K1 10 / B-s1,d0 mens regnskærm skal være Ds-2,d2 - Husk brandstop! Tag som BROOF(t2).

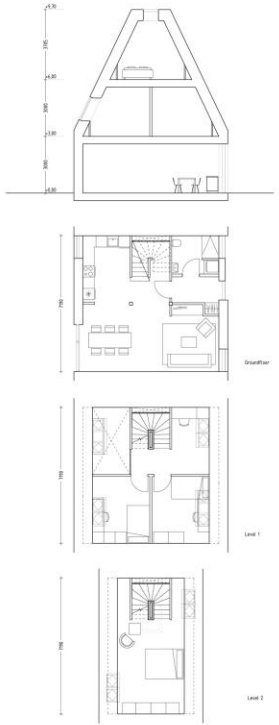
Indvendige overflader: K1 10 / D-s2,d2

Isolering:B-s2,d0 - Det vil sige kan være brandimprægneret papirgranulat eller tilsvarende - AFVIGELSE.

Brandinput - BK1-2:
Enfamilieshus indrettet efter Bilag 1a uden afvigelser => BK1, under forudsætning af at rækkehuse opdeles i brandmæssigt fritliggende bygningsafsnit på maksimalt 600 m2 - det vil sige 3 rækkehuse med denne typologi kan sammenbygges i BK1.

Sammenbygges flere skal byggeriet henføres til BK2.

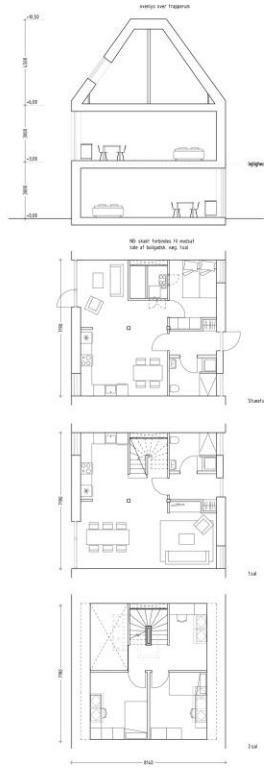
Isolering:
B-s1,d0 - Brandimprægneret papirgranulat eller tilsvarende kan ikke anvendes, idet her ikke kan opnås tillægsklasse s1.
I øvrigt krav som angivet i ovenstående.



Fire input
3 levels / apartment building

Etagebolig indrettet efter Bilag 2 uden afvigelser => BK2Afviges der fra Bilag 2 er der tale om BK3.OBS! Med nuværende indretning (bolig i to etage, kun flugtvej fra nederste etage) afviges der fra Bilag 2 => BK3. Gulv i øverste etage > 5,1 m over terræn

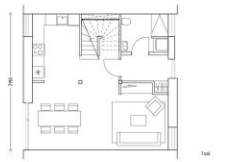
Bærende konstruktioner: Øverste etage: R 30Øvrige: R 60 / D-s2,d2, hvor de bærende konstruktioners samlede brandeksponerede overflade, indenfor de første 60 minutter af standardbrandforløbet udgør højst 20 % af rummets samlede væg- og loftoverflader.Hvor den bærende konstruktions
samledebrandeksponerede overflade overstiger 20% inddækkes den del, der over stiger 20% på en af følgende måder:• Brandbeskyttende beklædning udført af materiale klasse A2-s1,d0, hvor det dokumenteres ifølge DS/EN 1995-1-2, at der ikke sker indbrænding af træet i de første 60 minutter af en standardbrandpåvirkningen• Brandbeskyttelsessystem klasse K2 60 /A2Trapper: Materiale klasse D-s2,d2Kravet er en vurdering ift. kapitel 3, som angiver at det kun er trapper i bygninger med gulv i øverste etage < 5,1 m over terræn som kan udføres i materiale klasse D-s2,d2 - her er der i stedet set på gulv i øverste boligenhed - OK med vurdering, da der er tale om BK3-sag.
Adskillende bygningsdele: Brandcelleadskillelser (mellem boliger): EI60Brandsektionsadskillelser (til opdeling af bygningsafsnit større end 600 m2): Bygningsdel klasse EI 60 / D-s2,d2 udførtmed mindst beklædning klasse K2 60 / A2-s1,d0 ellerBygningsdel klasse EI 60
/ D-s2,d2 udførtmed mindst brandbeskyttende beklædning udført af materialeklasse A2-s1,d0, og detdokumenteres, jf. DS/EN 1995-1-2, at der ikke sker indebrænding af træet i de første60 minutter af en standardbrandpåvirkning. Udvendige overflader: K1 10 / B-s1,d0Evt. regnskærm skal opfylde krav til B-s2,d0.Mindre partier med et samlet areal på højst 20 % afydervæggens areal og jævnt fordelt, kan udføres med regnskærm som materiale klasse D-s2,d2. Partierne placeres, så risikoen for brandspredning fra en brandmæssig enhed til en anden enhed minimeres. Tag som BROOF(t2).
Indvendige overflader: Vægge: K1 10 / D-s2,d2Loft: K1 10
/ B-s1,d0Isolering: B-s1,d0

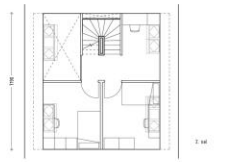


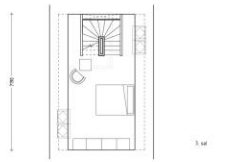
Fire input
4 levels / apartment building

Etagebolig indrettet efter Bilag 2 uden afvigelser =>
BK2 Afviges der fra Bilag 2 er der tale om BK3.
OBS! Med nuværende indretning (bolig i tre etager (1.+2.+3.),
kun flugtvej fra nederste etage) afviges der fra Bilag 2 => BK3.
Gulv i øverste etage < 12 m over terræn

Bærende konstruktioner:
Øverste etage: R 30
Øvrige: R 60 / D-s2,d2, hvor de bærende konstruktioners samlede brandeksponerede overflade, indenfor de første 60 minutter af standardbrandforløbet udgør højst 20 % af rummets samlede væg- og loftoverflader.
Hvor den bærende konstruktions samlede brandeksponerede overflade overstiger 20% inddækkes den del, der over stiger 20% på en af følgende måder:
• Brandbeskyttende beklædning udført af materiale klasse A2-s1,d0, hvor det dokumenteres ifølge DS/EN 1995-1-2, at der ikke sker indbrænding af træet i de første 60 minutter af en standardbrandpåvirkningen
• Brandbeskyttelsessystem klasse K2 60 /A2-s1,d0
Adskillende bygningsdele:
Brandcelleadskillelser (mellem boliger): EI60
Brandsektionsadskillelser (vandret + lodret hvis nødvendigt aht. til opdeling af bygningsafsnit større end 600 m2):
Bygningsdel klasse EI 60 / D-s2,d2 udført
med mindst beklædning klasse K2 60 / A2-s1,d0
eller
Bygningsdel klasse EI 60 / D-s2,d2 udført
med mindst brandbeskyttende beklædning udført af materialeklasse A2-s1,d0, og det
dokumenteres, jf. DS/EN 1995-1-2, at der ikke sker indebrænding af træet i de første
60 minutter af en standardbrandpåvirkning.
Udvendige overflader:
K1 10 / B-s1,d0
Evt. regnskærm skal opfylde krav til B-s2,d0.
Mindre partier med et samlet areal på højst 20 % af ydervæggens areal og jævnt fordelt, kan udføres med regnskærm som materiale klasse D-s2,d2. Partierne placeres, så risikoen for brandspredning fra en brandmæssig enhed til en anden enhed minimeres.
Tag som BROOF(t2).
Indvendige overflader:
Vægge: K1 10 / D-s2,d2
Loft: K1 10 / B-s1,d0
Isolering:
B-s1,d0
Trapper:
Materiale klasse D-s2,d2



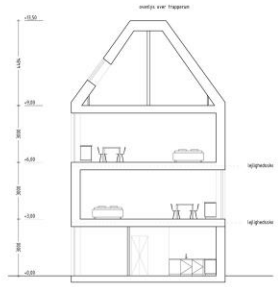


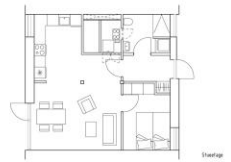


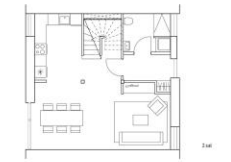
Fire input
4 levels / apartment building

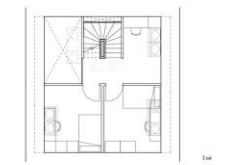
Etagebolig indrettet efter Bilag 2 uden afvigelser =>
BK2 Afviges der fra Bilag 2 er der tale om BK3.
OBS! Med nuværende indretning (bolig i to etager (2.+3.), kun flugtvej fra nederste etage) afviges der fra Bilag 2 => BK3. Gulv i øverste etage < 12 m over terræn

Bærende konstruktioner:
Øverste etage: R 30
Øvrige: R 60 / D-s2,d2, hvor de bærende konstruktioners samlede brandeksponerede overflade, indenfor de første 60 minutter af standardbrandforløbet udgør højst 20 % af rummets samlede væg- og loftoverflader.
Hvor den bærende konstruktions samlede brandeksponerede overflade overstiger 20% inddækkes den del, der over stiger 20% på en af følgende måder:
• Brandbeskyttende beklædning udført af materiale klasse A2-s1,d0, hvor det dokumenteres ifølge DS/EN 1995-1-2, at der ikke sker indbrænding af træet i de første 60 minutter af en standardbrandpåvirkningen
• Brandbeskyttelsessystem klasse K2 60 /A2-s1,d0
Adskillende bygningsdele:
Brandcelleadskillelser (mellem boliger): EI60
Brandsektionsadskillelser (vandret + lodret hvis nødvendigt aht. til opdeling af bygningsafsnit større end 600 m2):
Bygningsdel klasse EI 60 / D-s2,d2 udført
med mindst beklædning klasse K2 60 / A2-s1,d0
eller
Bygningsdel klasse EI 60 / D-s2,d2 udført
med mindst brandbeskyttende beklædning udført af materialeklasse A2-s1,d0, og det
dokumenteres, jf. DS/EN 1995-1-2, at der ikke sker indebrænding af træet i de første
60 minutter af en standardbrandpåvirkning.
Udvendige overflader:
K1 10 / B-s1,d0
Evt. regnskærm skal opfylde krav til B-s2,d0.
Mindre partier med et samlet areal på højst 20 % af ydervæggens areal og jævnt fordelt, kan udføres med regnskærm som materiale klasse D-s2,d2. Partierne placeres, så risikoen for brandspredning fra en brandmæssig enhed til en anden enhed minimeres.
Tag som BROOF(t2).
Indvendige overflader:
Vægge: K1 10 / D-s2,d2
Loft: K1 10 / B-s1,d0
Isolering:
B-s1,d0
Altangange:
Bæreevne R 60 / D-s2,d2 - søjler kan evt. stå uinddækket og dimensioneres for indbrænding.
Dækket etableres med brandmodstandsevne EI60.
Gulve som gulvbelægning Dfl og loft som beklædning K1 10 / B-s1,d0
I de ender af altangangen, som ikke giver adgang til flugtvejstrappe, skal der være mulighed for redning. Altangange betyder at boliger kan indrettes uden redningsåbninger.
Flugtvejstrappe:
Placeres i selvstændig brandsektion og vejrligssikres (lukkes)
Trapper som bygningsdel R 30 / A2-s1,d0 eller R 30 / D-s2,d2 med beklædning som mindst klasse K2 30 / A2-s1,d0 på undersiden og langs siderne









Fire input
4 levels / apartment building

Etagebolig indrettet efter Bilag 2 uden afvigelser =>
BK2 Afviges der fra Bilag 2 er der tale om BK3.
OBS! Med nuværende indretning (bolig i tre etager (2.+3.+4.),
kun flugtvej fra nederste etage) afviges der fra Bilag 2 => BK3.
OBS! Hvis øverste lejlighed er større end 150 m2 skal det sikres at ganglængden fra ethvert sted i boligen til udgang er højst 30 m. Gulv i øverste etage < 12 m over terræn

Bærende konstruktioner:
Øverste etage: R 30
Øvrige: R 60 / D-s2,d2, hvor de bærende konstruktioners samlede brandeksponerede overflade, indenfor de første 60 minutter af standardbrandforløbet udgør højst 20 % af rummets samlede væg- og loftoverflader.
Hvor den bærende konstruktions samlede brandeksponerede overflade overstiger 20% inddækkes den del, der over stiger 20% på en af følgende måder:
• Brandbeskyttende beklædning udført af materiale klasse A2-s1,d0, hvor det dokumenteres ifølge DS/EN 1995-1-2, at der ikke sker indbrænding af træet i de første 60 minutter af en standardbrandpåvirkningen
• Brandbeskyttelsessystem klasse K2 60 /A2-s1,d0

Adskillende bygningsdele:
Brandcelleadskillelser (mellem boliger): EI60
Brandsektionsadskillelser (vandret + lodret hvis nødvendigt aht. til opdeling af bygningsafsnit større end 600 m2): Bygningsdel klasse EI 60 / D-s2,d2 udført med mindst beklædning klasse K2 60 / A2-s1,d0 eller Bygningsdel klasse EI 60 / D-s2,d2 udført
med mindst brandbeskyttende beklædning udført af materialeklasse A2-s1,d0, og det dokumenteres, jf. DS/EN 1995-1-2, at der ikke sker indebrænding af træet i de første 60 minutter af en standardbrandpåvirkning.

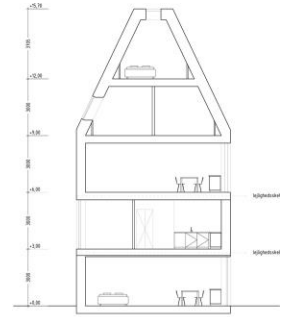
Udvendige overflader:
K1 10 / B-s1,d0
Evt. regnskærm skal opfylde krav til B-s2,d0.
Mindre partier med et samlet areal på højst 20 % af ydervæggens areal og jævnt fordelt, kan udføres med regnskærm som materiale klasse D-s2,d2. Partierne placeres, så risikoen for brandspredning fra en brandmæssig enhed til en anden enhed minimeres.
Tag som BROOF(t2).

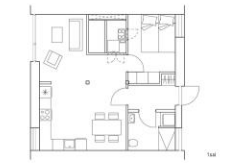
Indvendige overflader:
Vægge: K1 10 / D-s2,d2
Loft: K1 10 / B-s1,d0

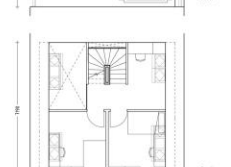
Isolering:
B-s1,d0

Altangange:
Bæreevne R 60 / D-s2,d2 - søjler kan evt. stå uinddækket og dimensioneres for indbrænding.
Dækket etableres med brandmodstandsevne EI60.
Gulve som gulvbelægning Dfl og loft som beklædning K1 10 / B-s1,d0
I de ender af altangangen, som ikke giver adgang til flugtvejstrappe, skal der være mulighed for redning. Altangange betyder at boliger kan indrettes uden redningsåbninger.

Flugtvejstrappe:
Placeres i selvstændig brandsektion og vejrligssikres (lukkes)
Trapper som bygningsdel R 30 / A2-s1,d0 eller R 30 / D-s2,d2 med beklædning som mindst klasse K2 30 / A2-s1,d0 på undersiden og langs siderne





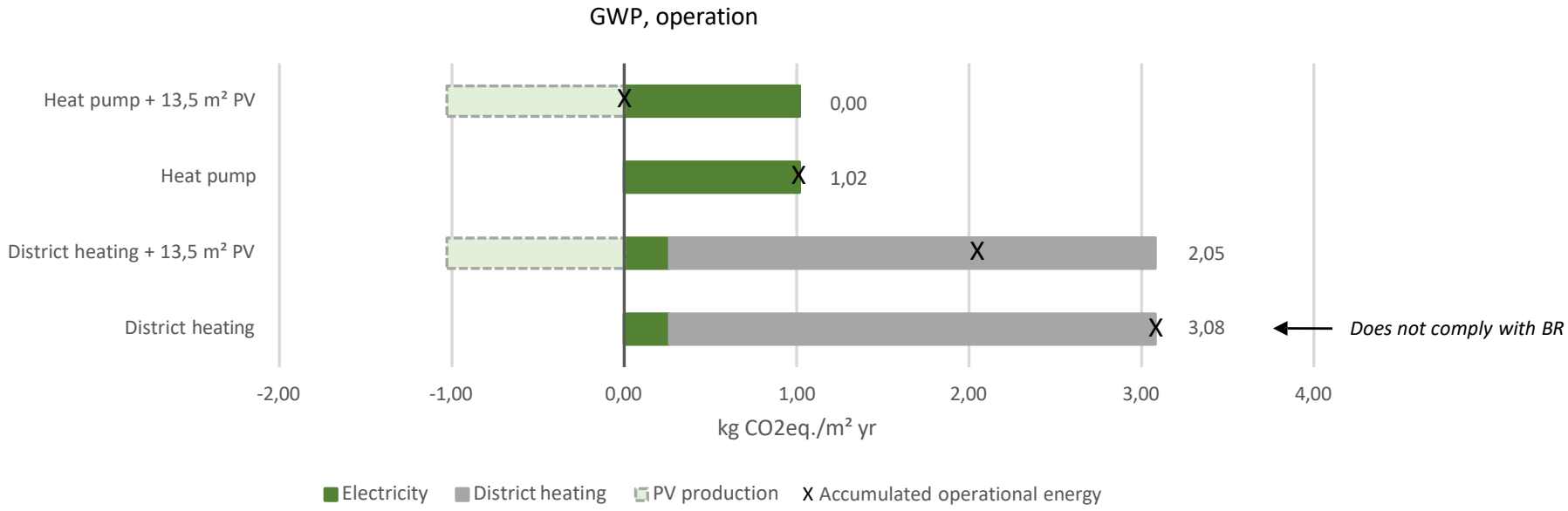


Operational energy

Operational energy
Calculated for a 3-story detached single family house

Operational energy during use highly affects the environmental profile of the building. Depending on location and site, different solutions are possible:

- District heating
- Heat pumps
- Contributions from PV-panels



Calculated for a 3-story detached single family house

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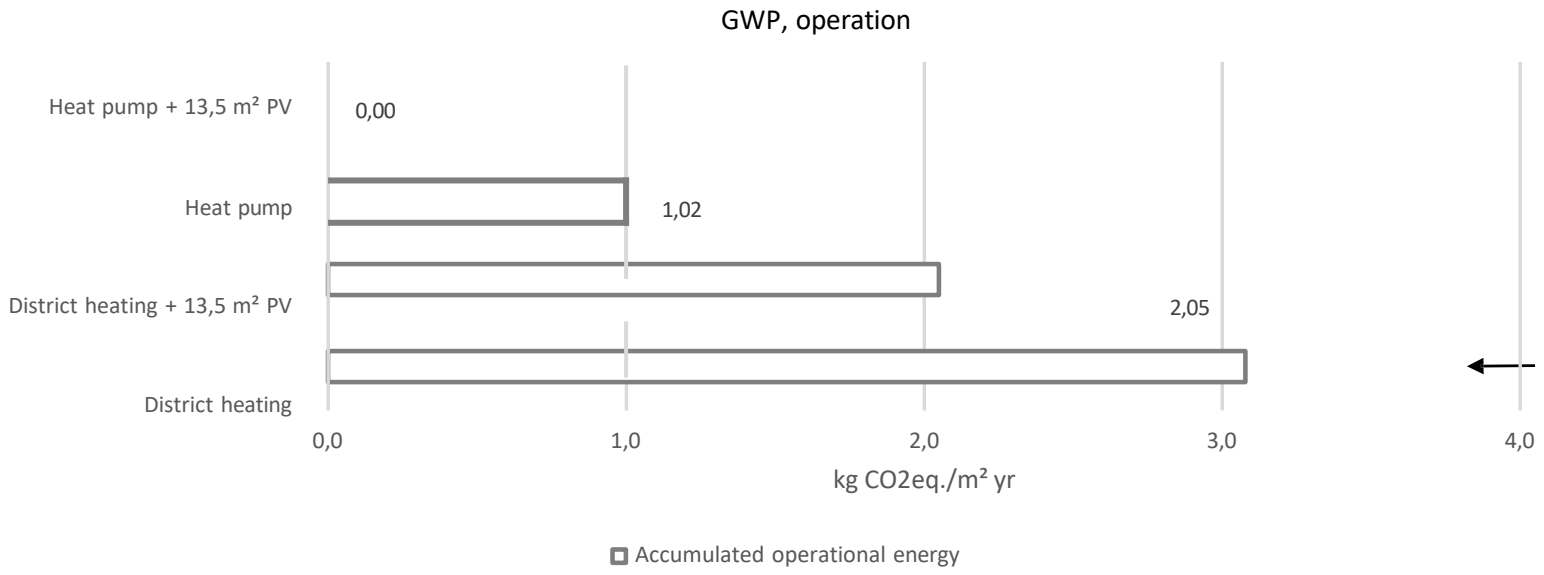

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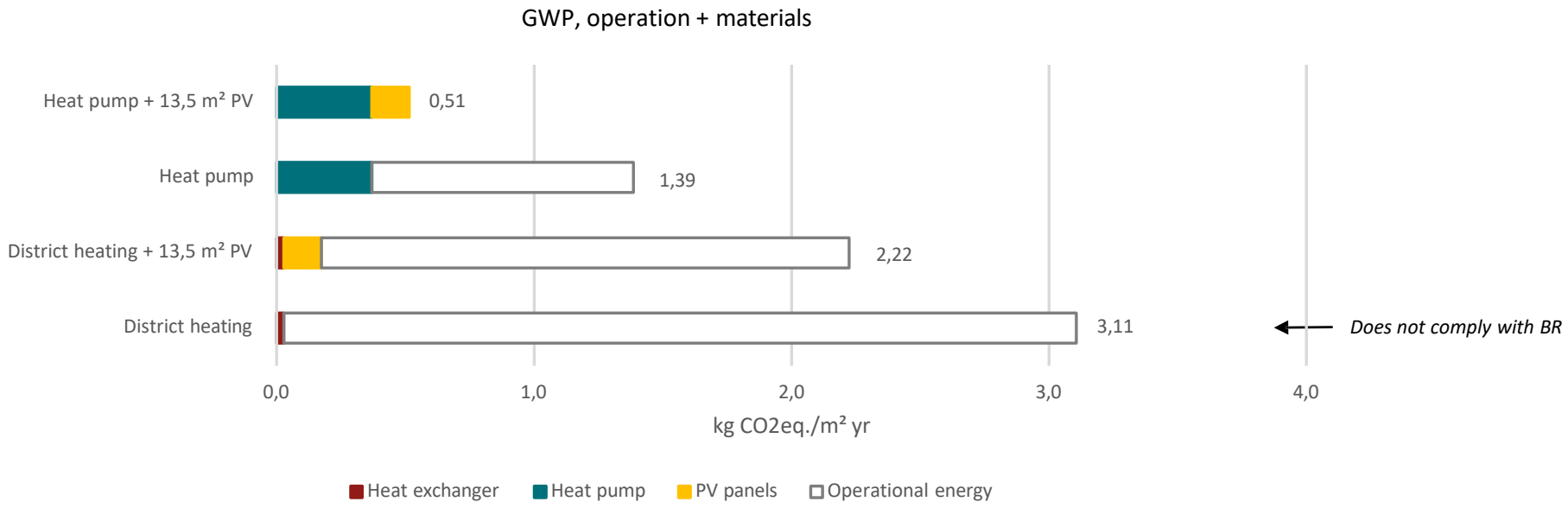

Calculated for a 3-story detached single family house