LIVING PLACES Copenhagen

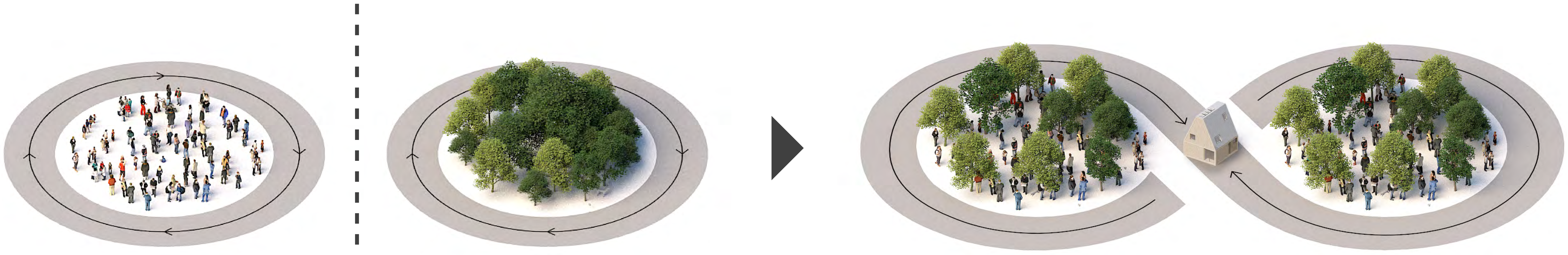
Case Study

Learnings & Next steps

Index //

Vision
Healthy homes for people and planet

At VELUX, we're taking action through Build for Life – a pioneering, multidisciplinary initiative that reconnects people and the planet through healthier, more sustainable buildings. Build for Life represents the VELUX Group's vision for buildings of the future. It is founded on the understanding that the way we build today has an enormous impact on people, as well as the ecosystems that sustain us. We must consider the use of buildings and buildings in use. Homes and communities should be centered around healthy building principles, both for people and the planet.



People | **Planet** | **People + Planet**

FROM A FRAGMENTED RELATIONSHIP WITH NATURE ...

... TO RECONNECTING WITH THE ECO-SYSTEMS THAT SUSTAIN US

Methodology
Healthy homes for people and planet

How we build today

TYPICAL SINGLE FAMILY HOUSE (BENCHMARK HOUSE)

Size:	184
Floors:	1
Building principle:	Brick
Foundation:	Concrete
Floor height:	2.7 m
Room height:	2.4 m
Heating application:	District heating
Heating source:	Floor heating
Ventilation:	Mechanical
Solar pannels:	7 m^2

How we might build in the future

LIVING PLACES CONCEPT HOUSE

Size:	147
Floors:	3
Building principle:	Timberframe construction
Foundation:	Screw pile foundation
Floor height:	3 m
Room height:	2.6 m
Heating application:	Air to water heat pump
Heating source:	Radiators
Ventilation:	Natural or hybrid
Solar pannels:	11 m^2

Results
Healthy homes for people and planet

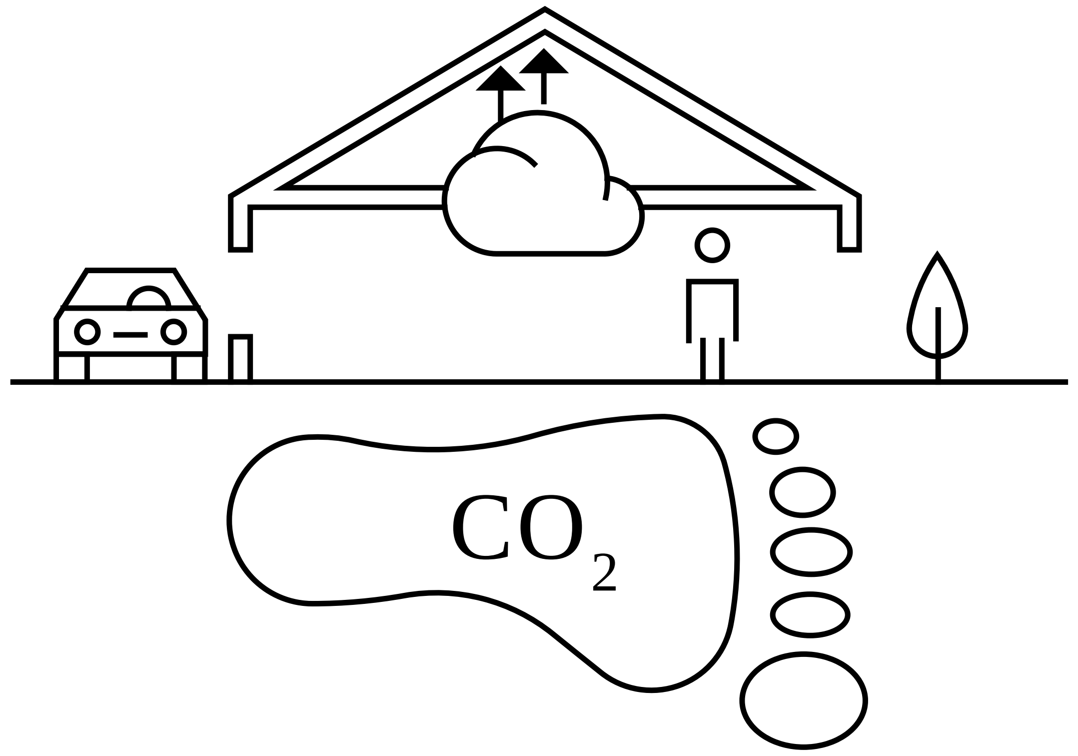
The Living Places concept has Denmark's lowest CO2 footprint and a first-class indoor climate, demonstrating that we don't have to wait for future technology to build far more sustainable homes that are healthy and beautiful to live in.

Starting from the ground up - each building component has been optimized for the best constellation of price, indoor climate and carbon footprint, with a special focus given to the envelope of the building where significant CO2 savings can be achieved.

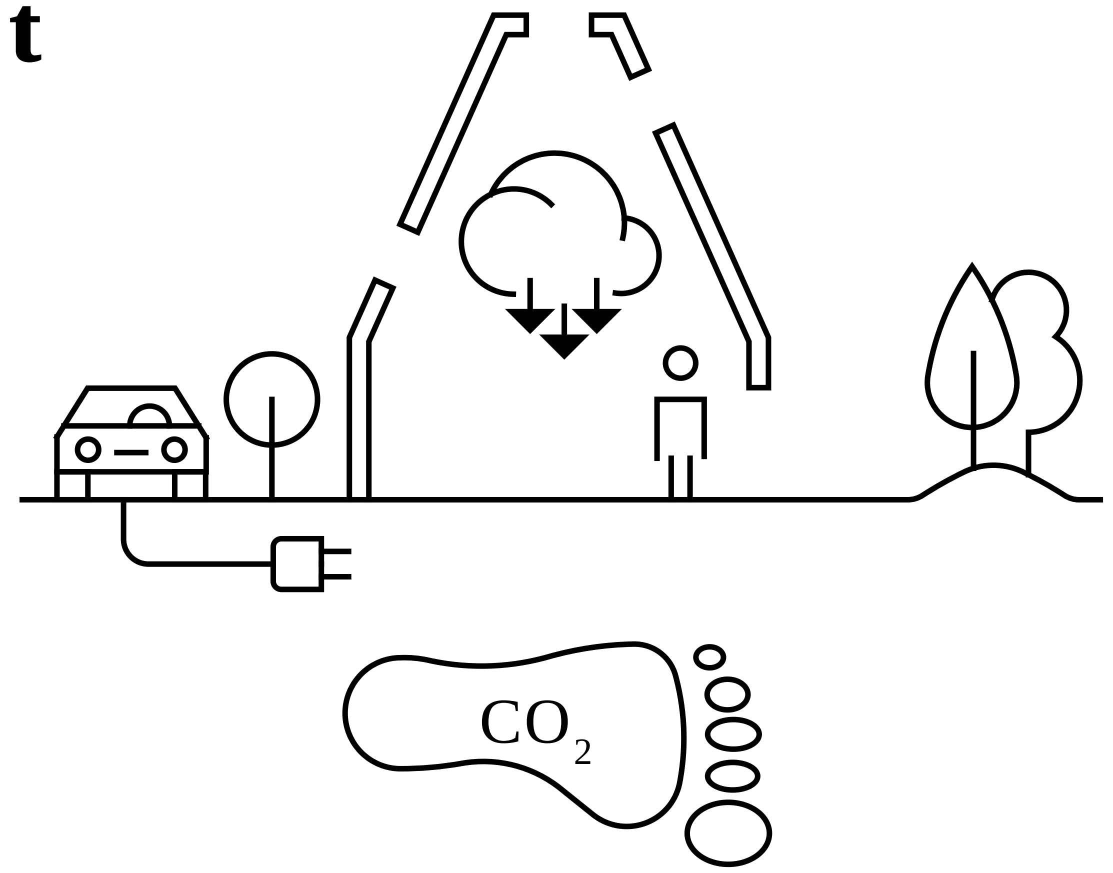
As a result, Living Places has received third-party verification from AAU BUILD to have almost 3x lower CO2 footprint than an average Danish single-family house at 3.85 kg CO2 e.q/m2/year compared to 11,1 kg CO2 equivalents per year for an average new build, Danish single-family house.

Furthermore, Living Places Copenhagen is designed with a strong focus on creating a healthy indoor climate using daylight and fresh air and has been awarded a best-in-class indoor climate.

Environmental impact
3x lower LCA

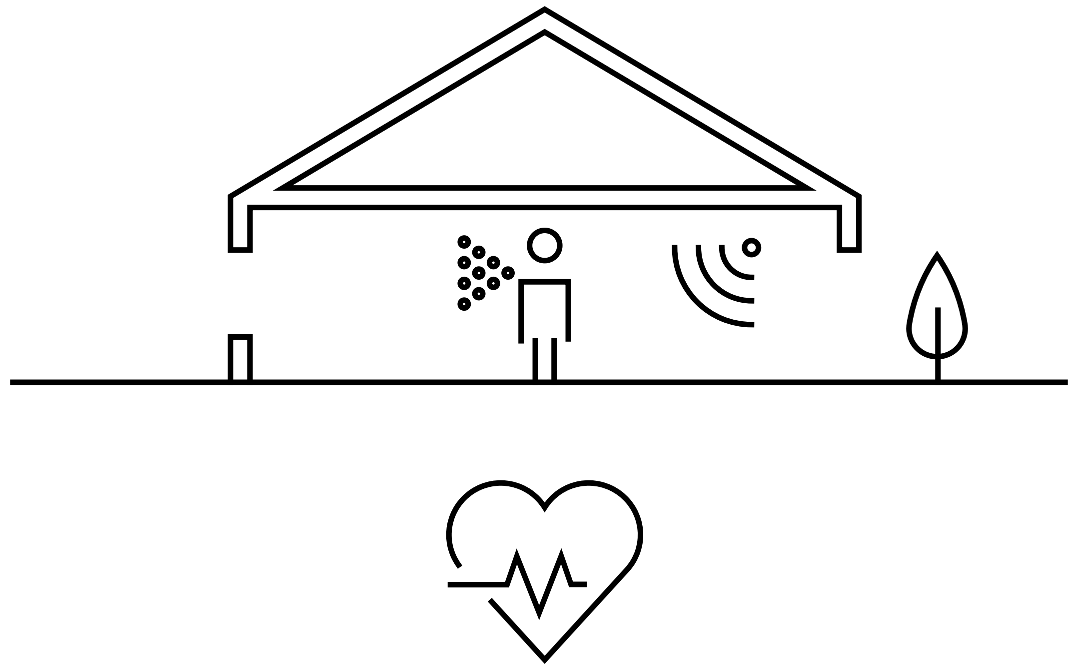


11.10 kg CO_2/m^2/year

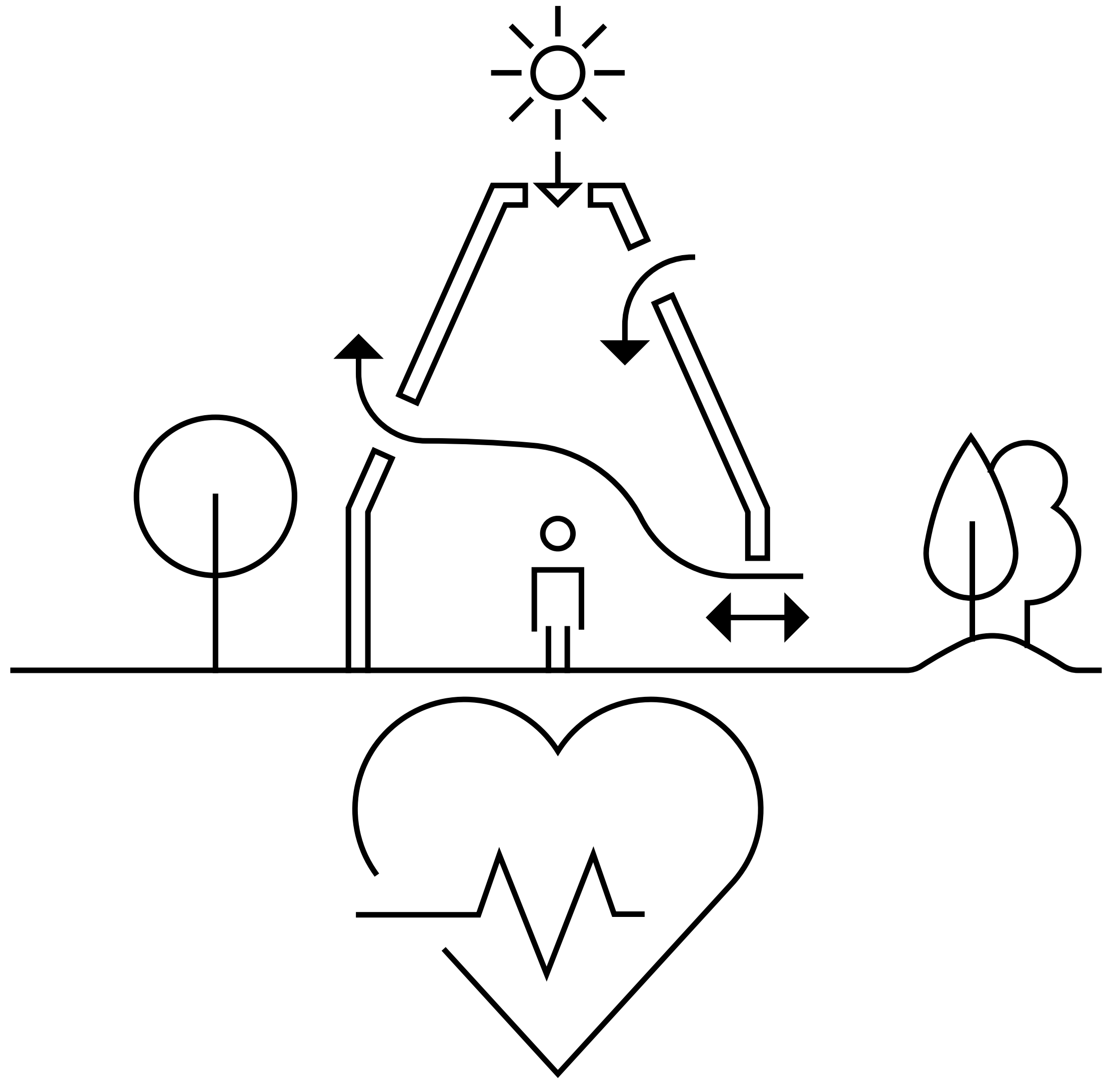


3,85 kg CO_2/m^2/year

Health impact
3x better indoor climate class



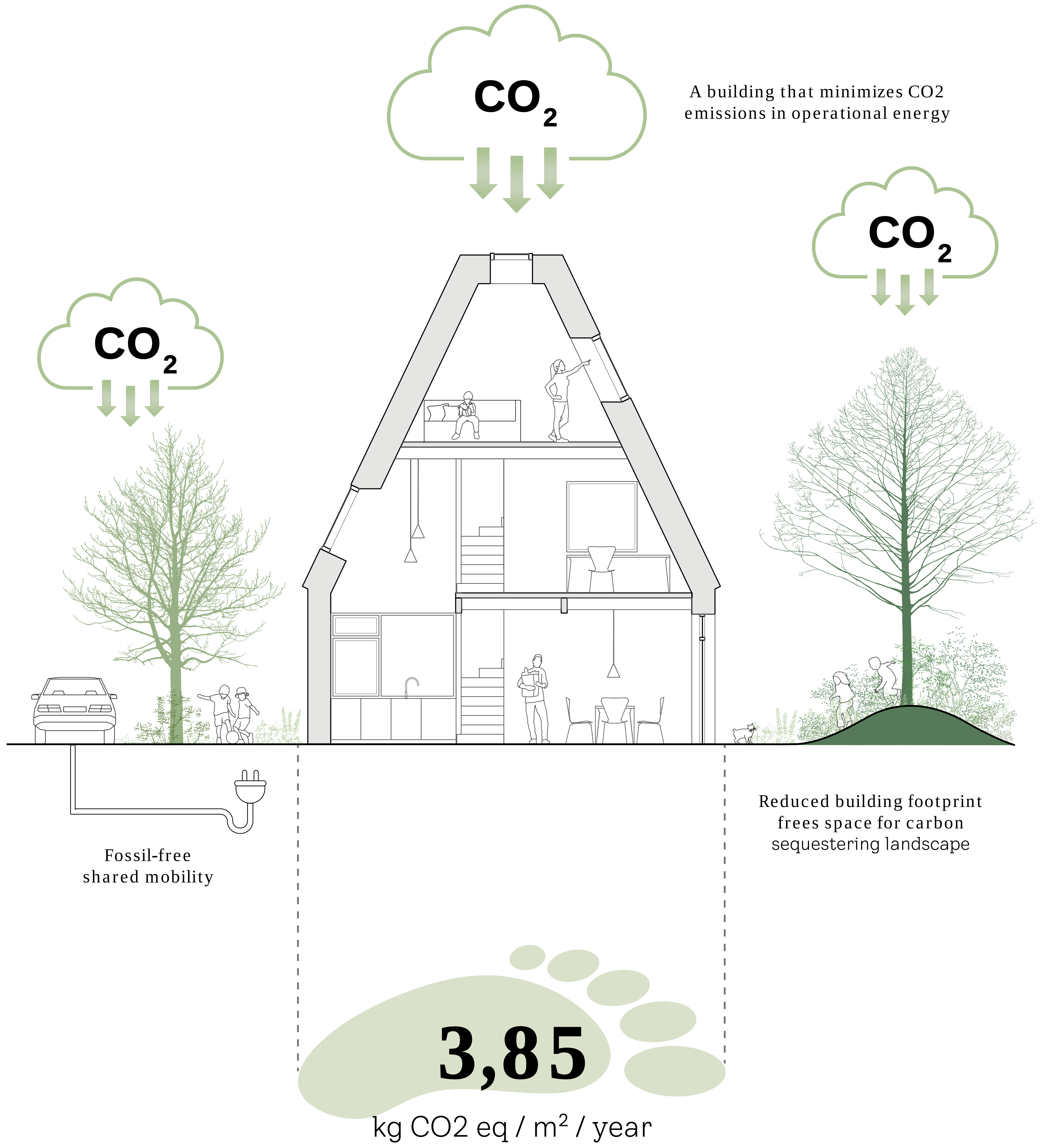
Class 3 Indoor climate



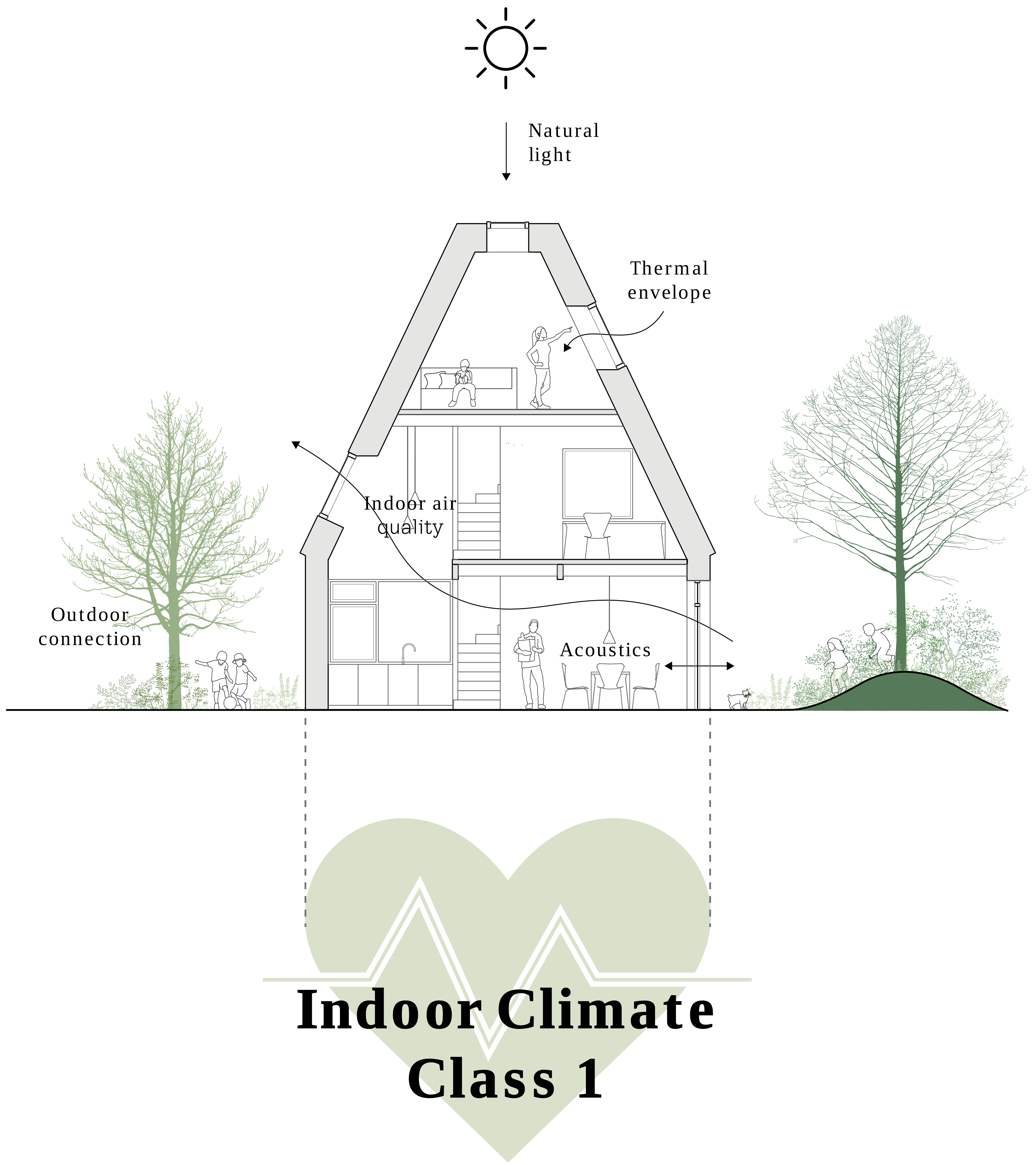
Class 1 Indoor climate

Results
Healthy homes for people and planet

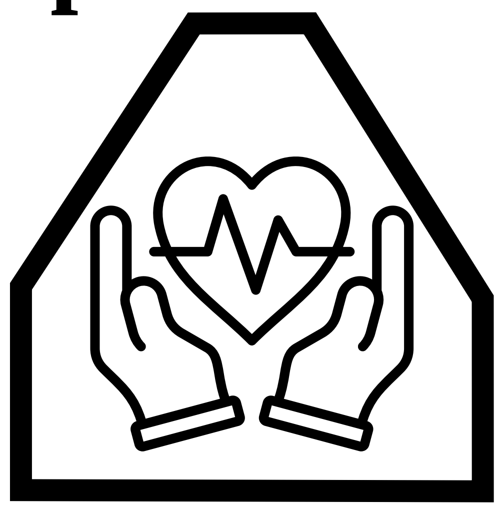
ENVIRONMENTAL IMPACT
of the Living Places typology



HEALTH IMPACT
of the Living Places typology

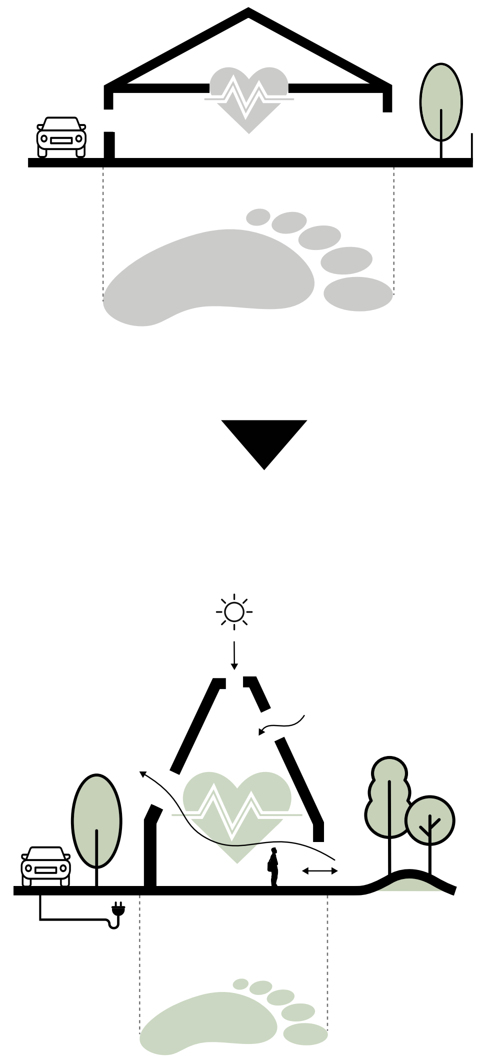


Principles

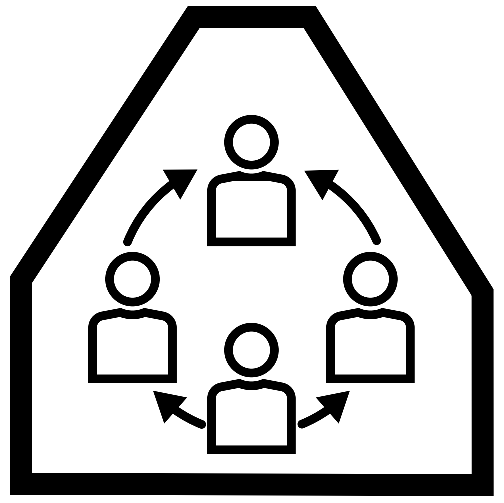


HEALTHY

Healthy for the people and the planet

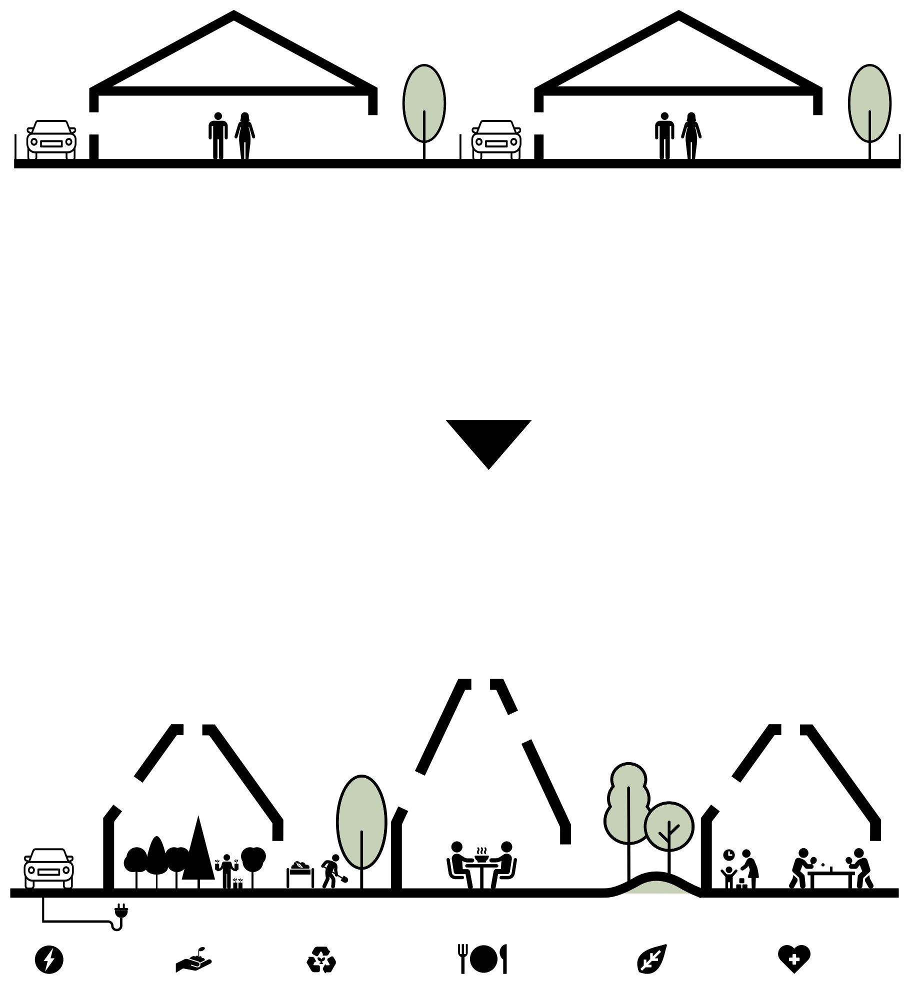


Benefiting both people and planet, through the careful selection of materials, building techniques, utilities, and design configuration of indoor and outdoor spaces

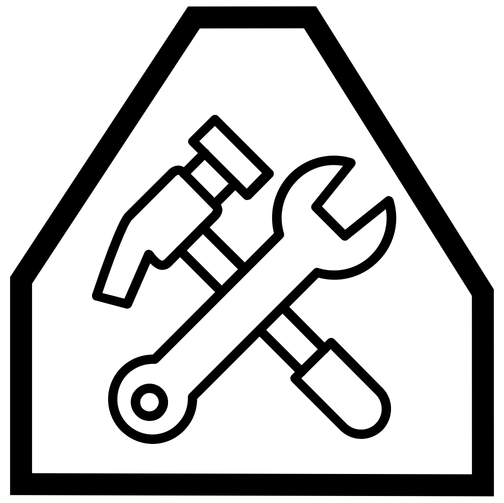


SHARED

Strengthen sense of community

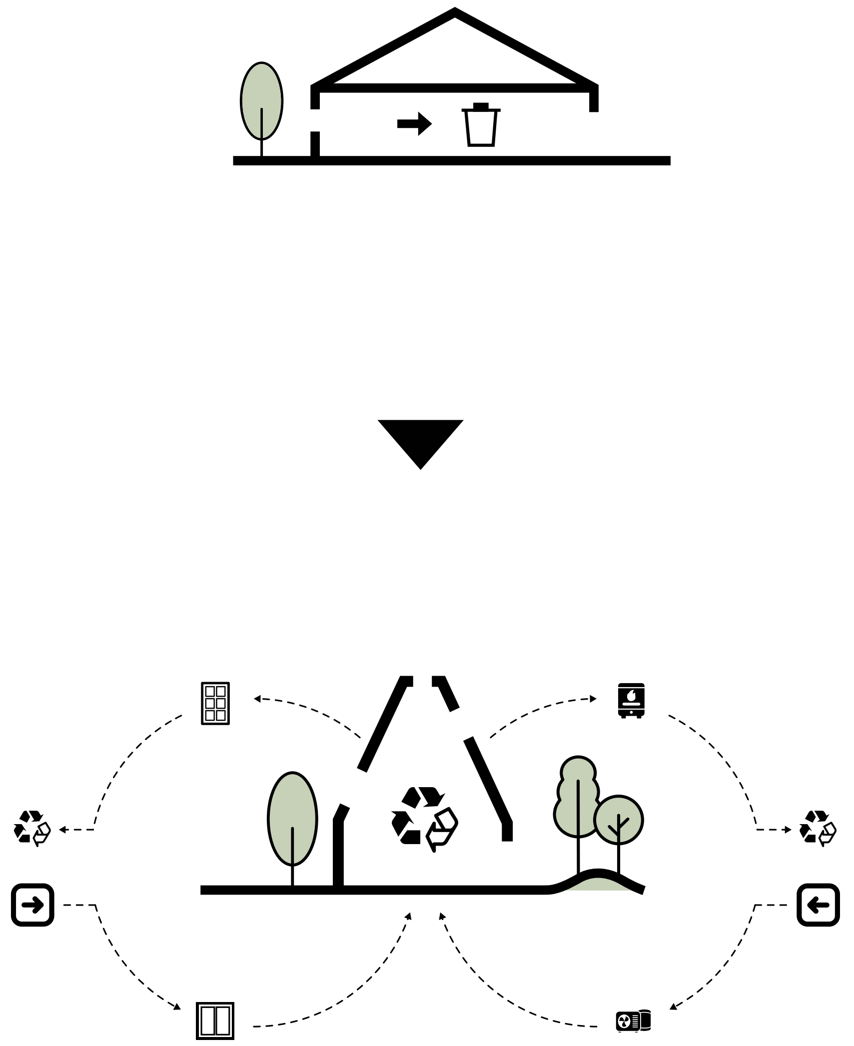


Strengthening the sense of community by combining private dwellings with shared spaces, resources, outdoor areas, and amenities.

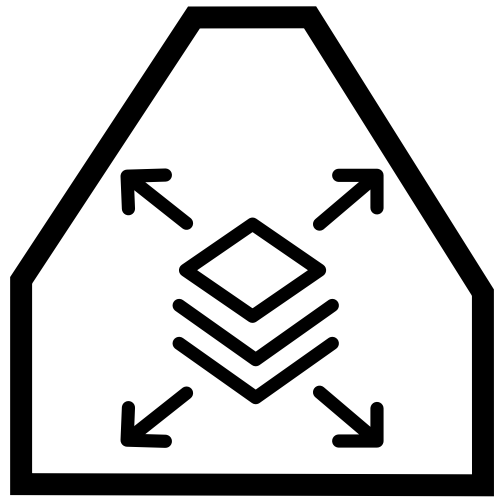


SIMPLE

Easy upgrades and longer lifespan

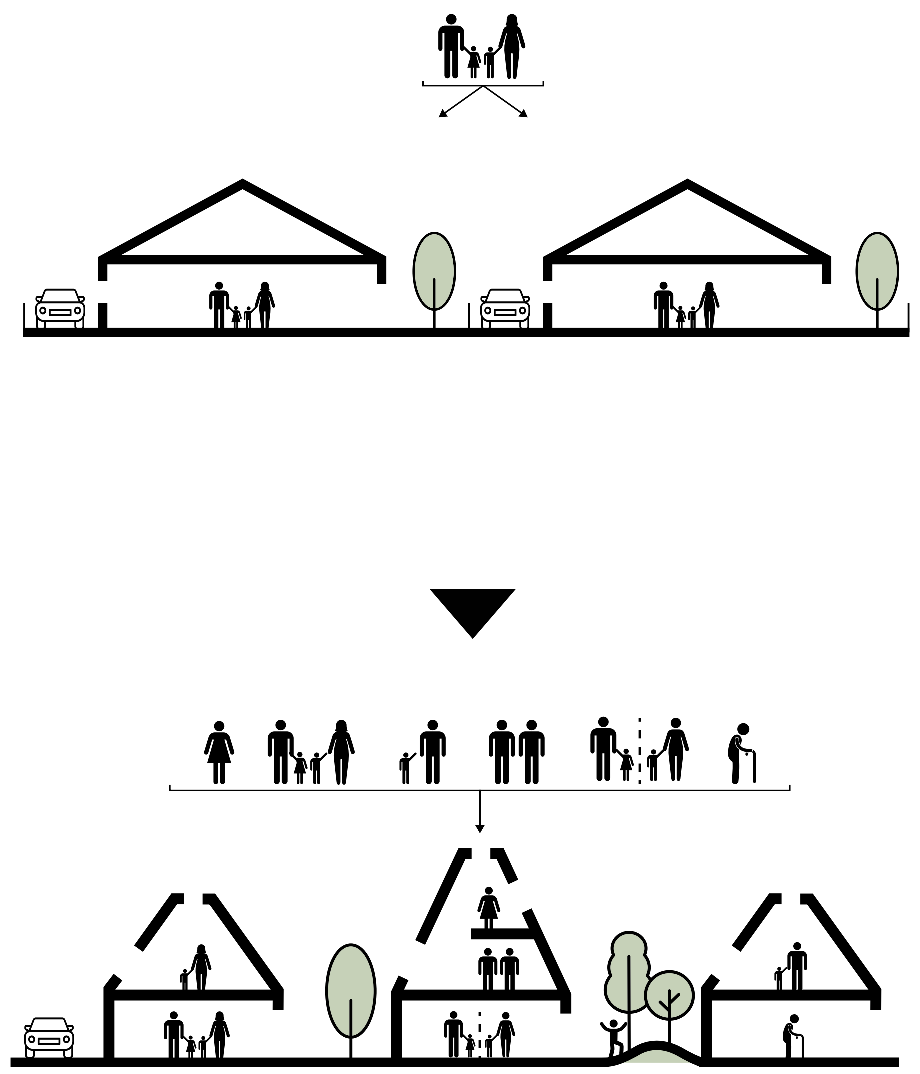


Offering a simple modular building system that requires little to no maintenance and can easily be upgraded, repaired and fitted with smart appliances

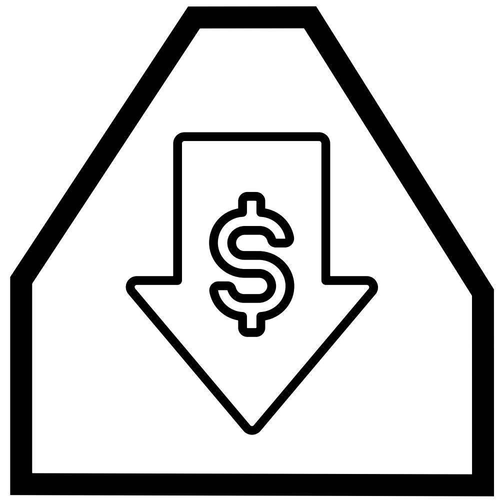


ADAPTIVE

Respond to more ways of living

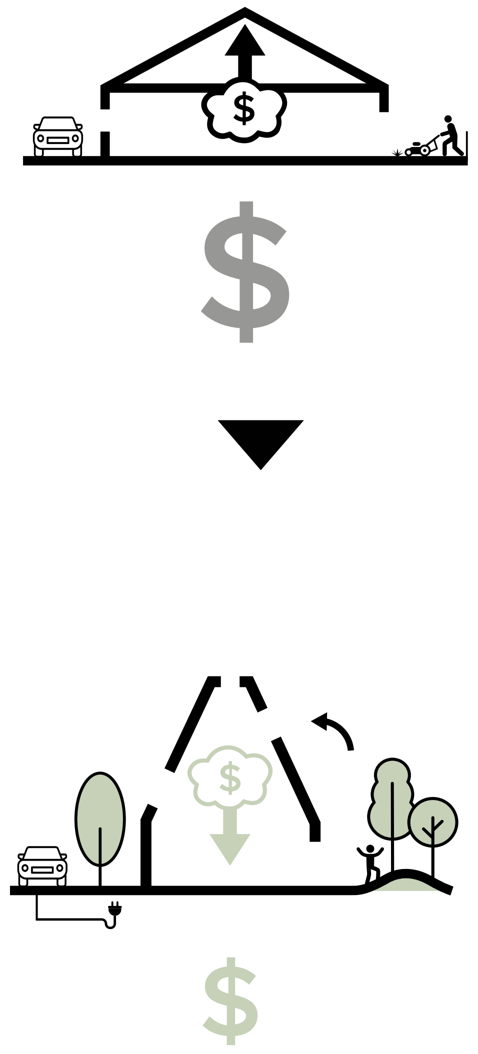


Creating a scalable solution that responds to the needs for more ways of living



SCALABLE

Rethink the design, plan and finance of homes



By creating homes that challenge the way we design, plan, and finance homes we can unlock housing for the many.

LIVING PLACES Copenhagen
A living lab for the world

The mission of this project was to create a temporary landmark to benefit our partners, the industry and the city the in conjunction with the designation of Copenhagen as the World Capital of Architecture.

This was based on our vision of creating better living environments that benefit both people and the planet, knowing this is the most effective way to create a thriving future for all of humanity.

The site is a living lab for VELUX and partners to investigate new solutions for future construction and living, to learn and gain insights valuable to partners and the industry.

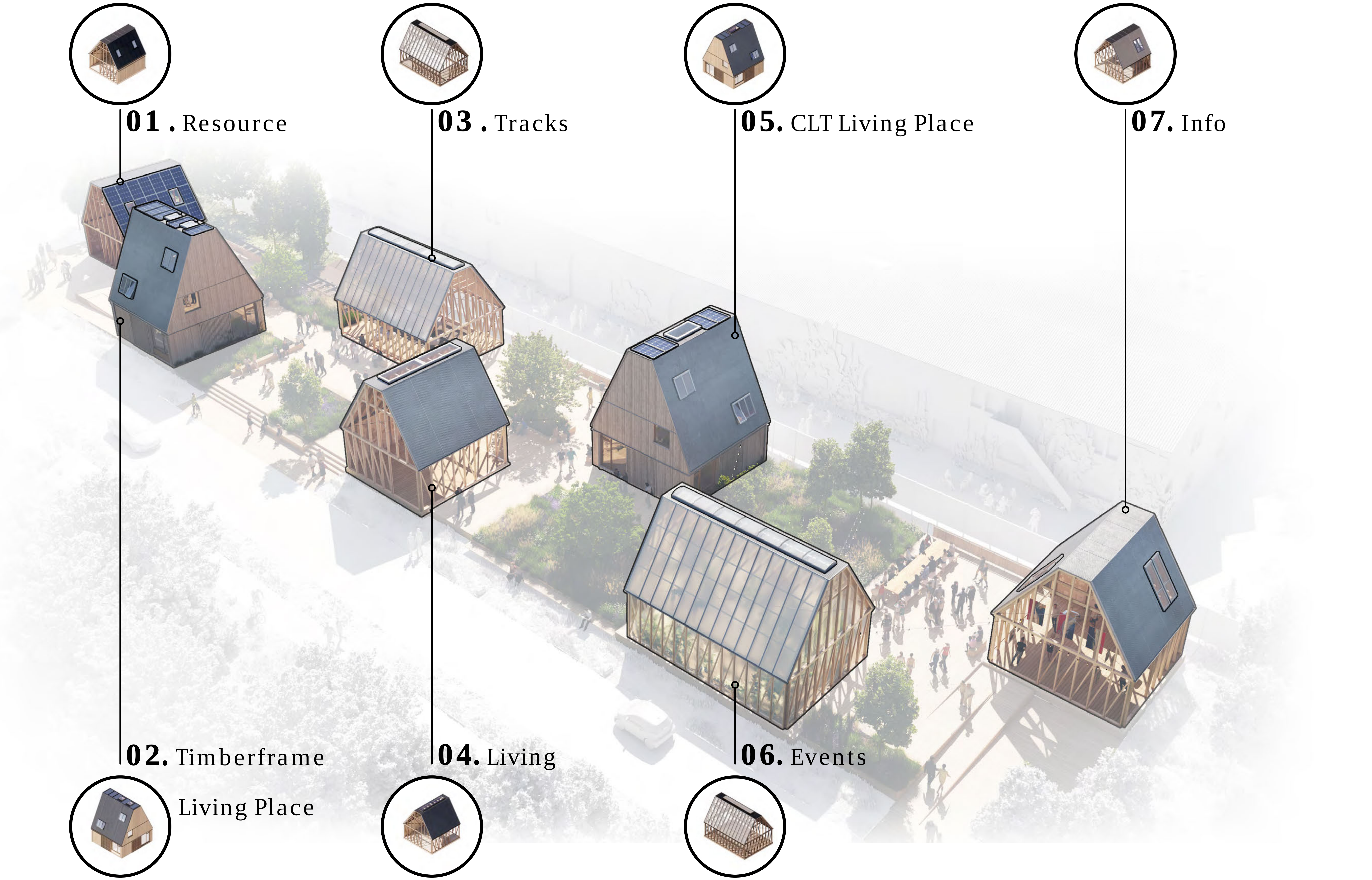
Furthermore, the project will test the desirability and the principle of design for disassembly, as the village will be deconstructed after 2-5 years and placed elsewhere afterwards. Thereby extending the life of the buildings and enabling placemaking somewhere else

@Adam Mork

Program

On 30th August 2022, construction of Living Places Copenhagen was initiated. The experimental project shows how we can build for both people and planet, showcasing ultra-low carbon housing with a best-in-class indoor climate using existing technologies without compromising on quality or architecture or incurring additional costs in construction.

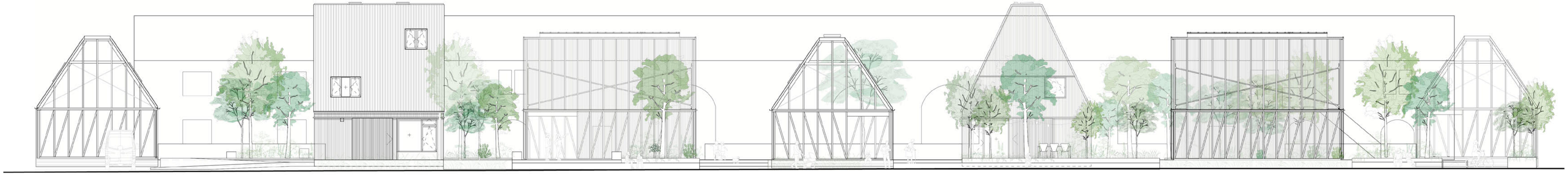
Working with partners EFFEKT architects, the engineering consultancy ARTELIA and contractor Enemarke & Petersen. The project includes seven full-scale prototypes – five open pavilions and two completed single-family houses. Each prototype is curated to show the synergy between how we live in homes and communities. The prototypes are built, using everyday techniques and materials, which have been tested to gain valuable insights and learnings for how we can develop new solutions for future construction and living.



Site plan


01
Resource
02
Timberframe
Living Place
03
Tracks
04
Living
05
CLT
Living Place
06
Events
07
Info

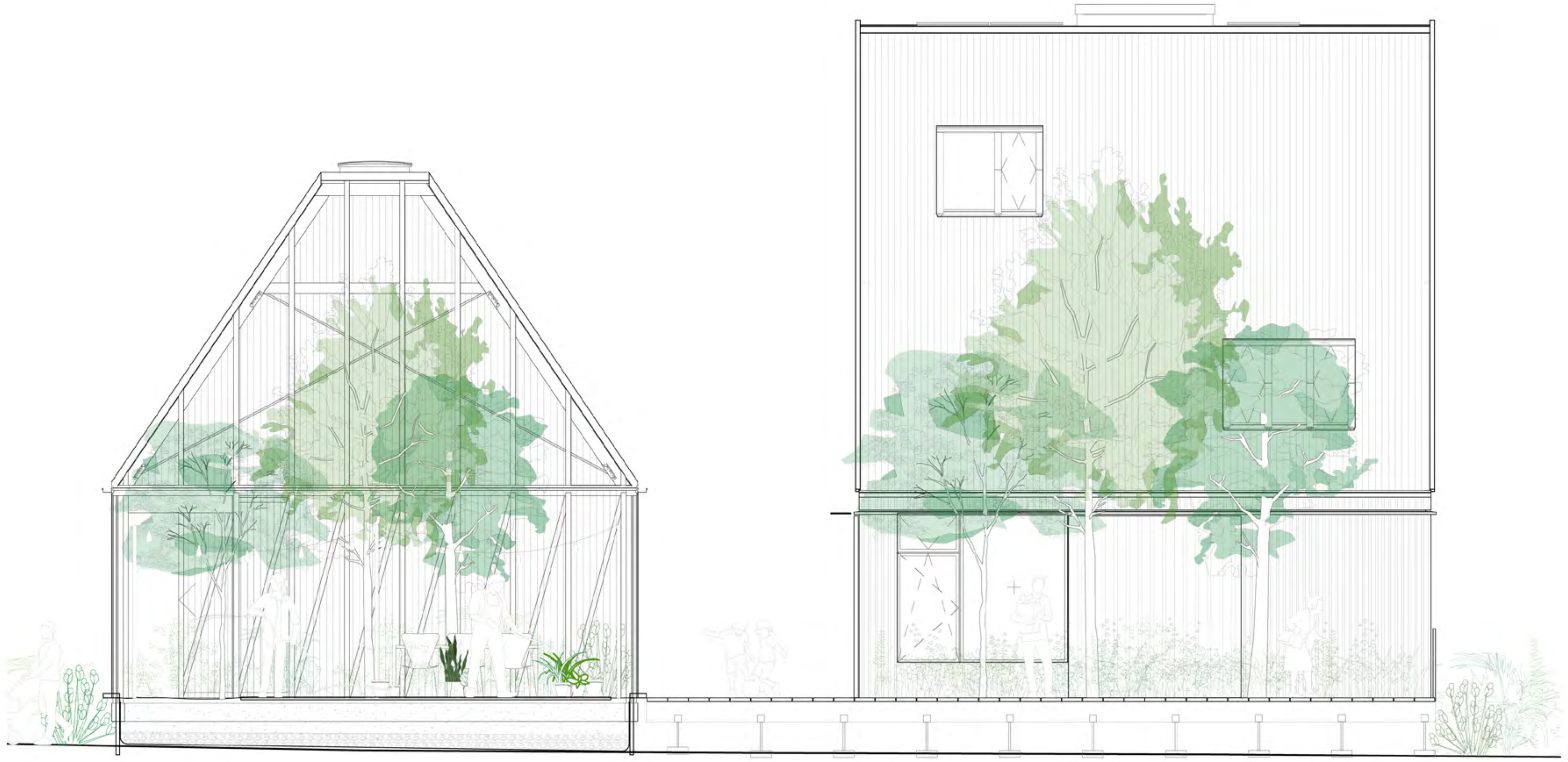
Elevations



South elevation

North elevation

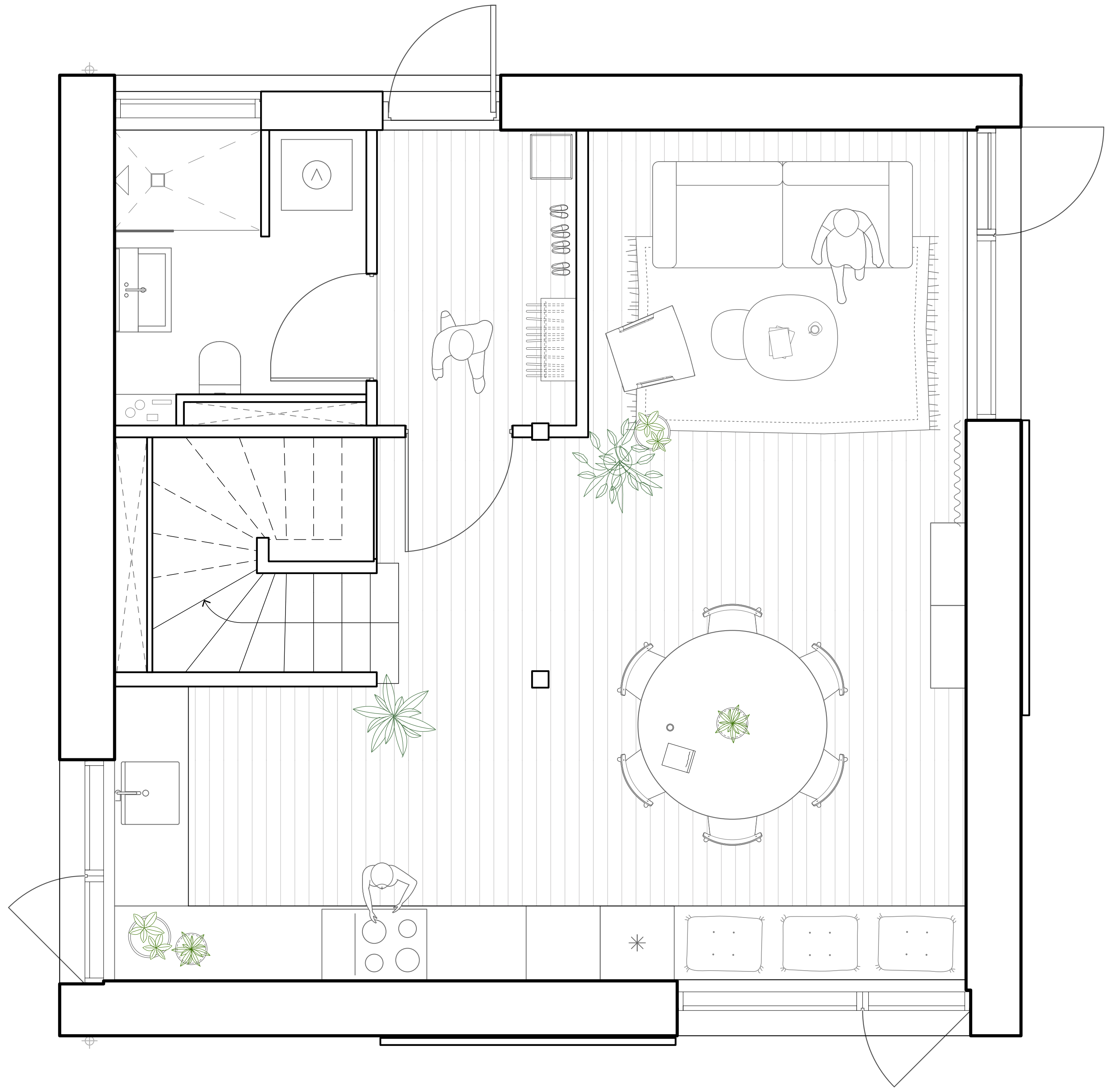
Sections



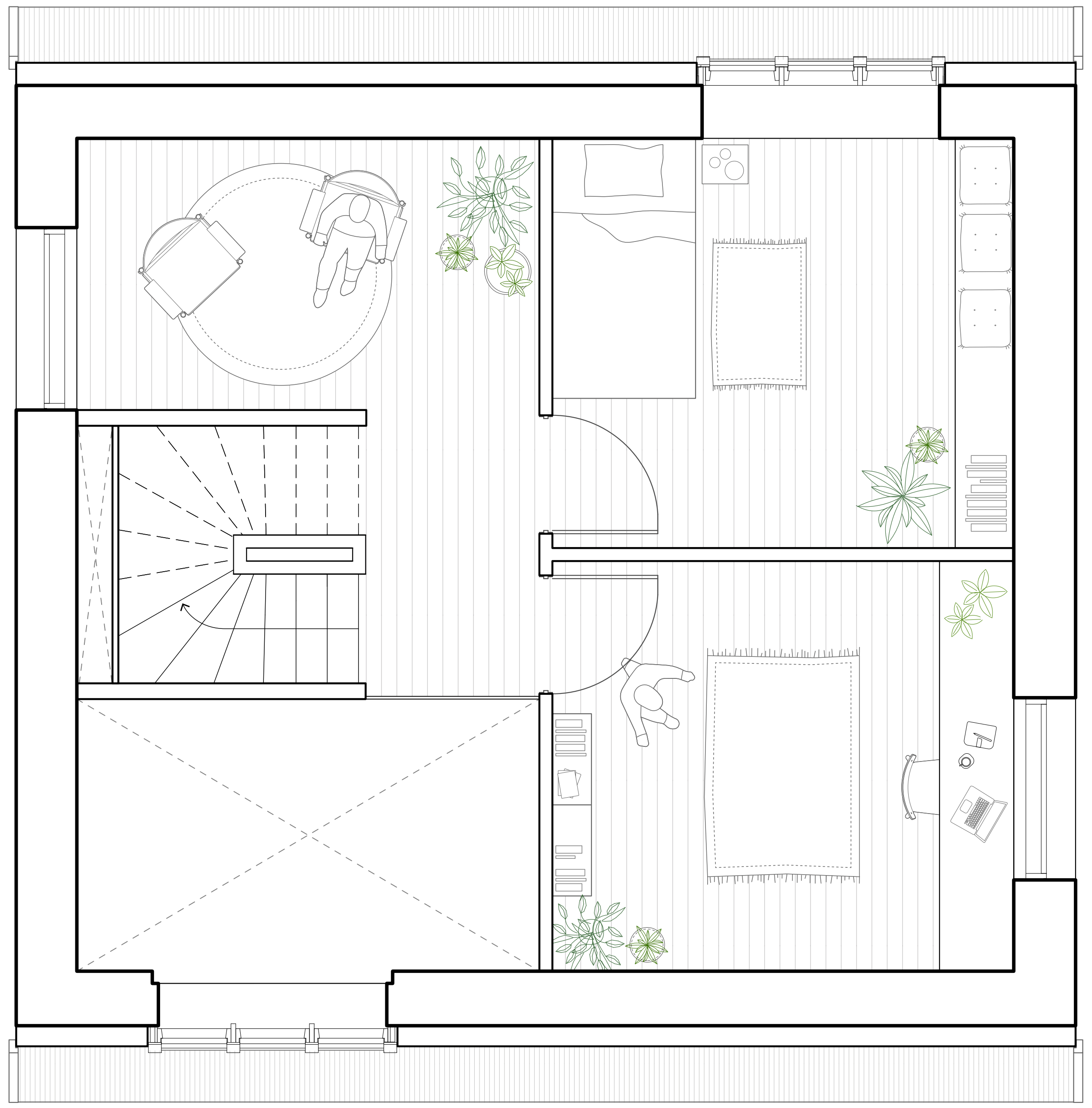
Section AA

Section BB

Floor plans



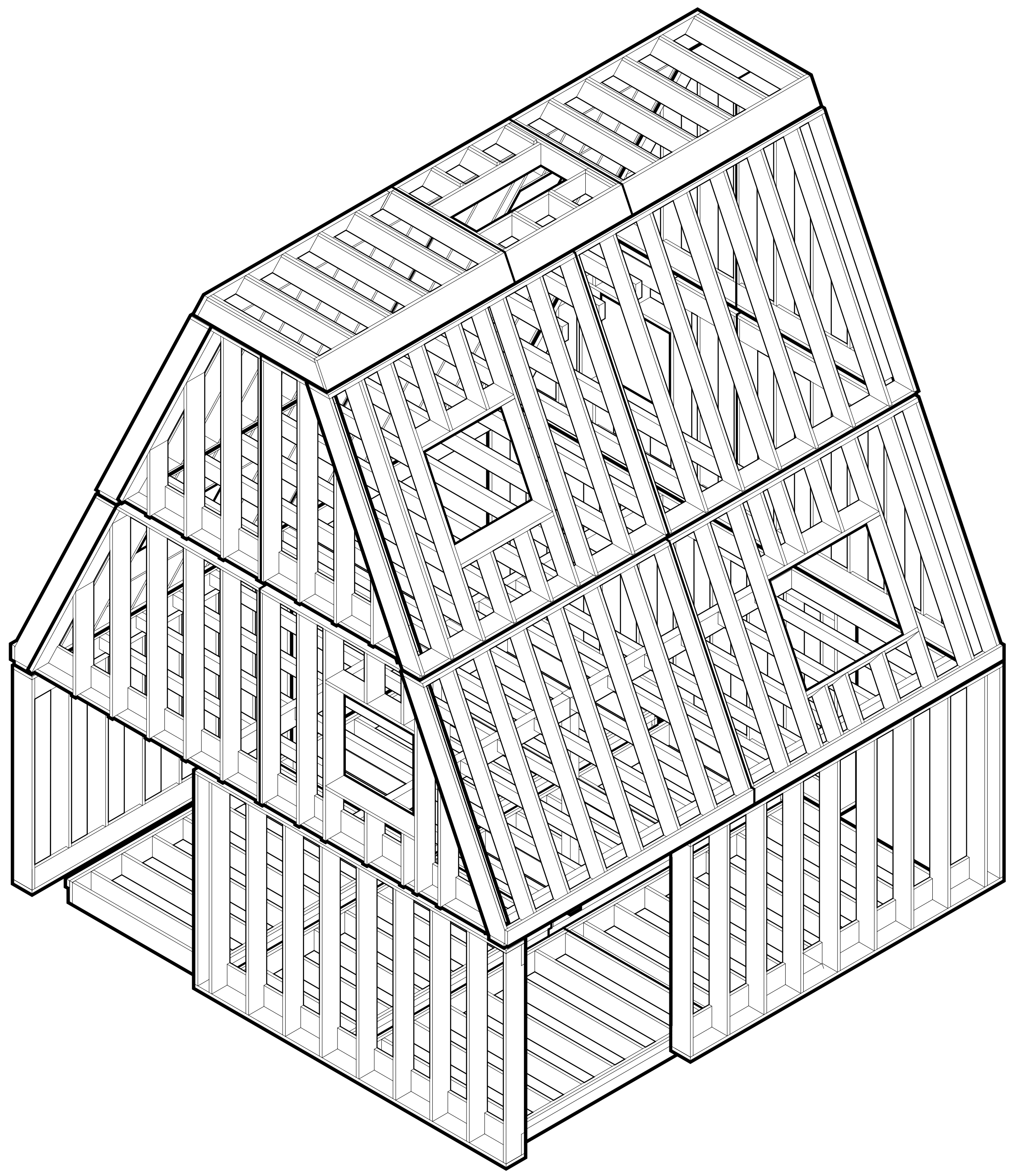
Ground floor



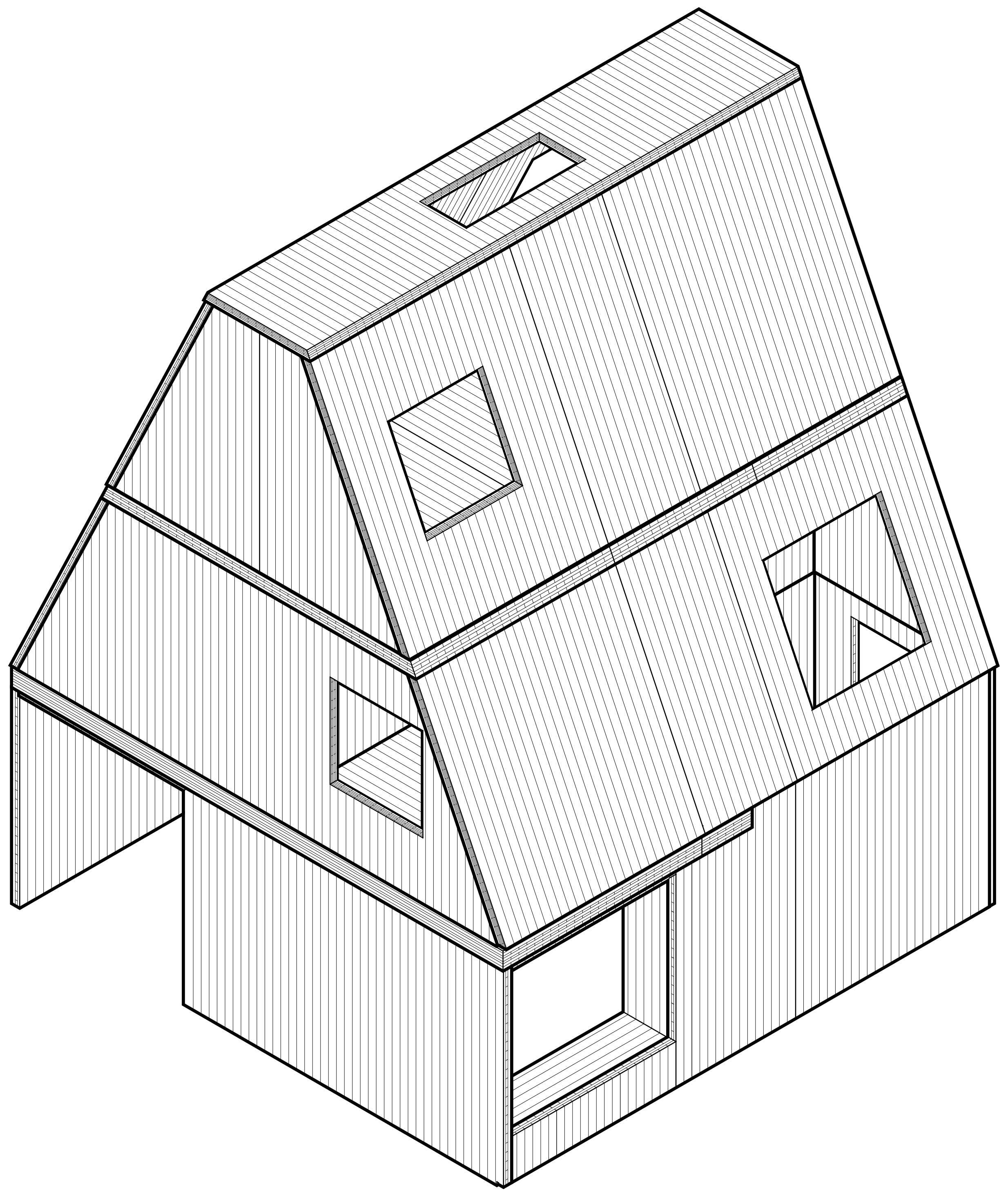
First floor

Second floor

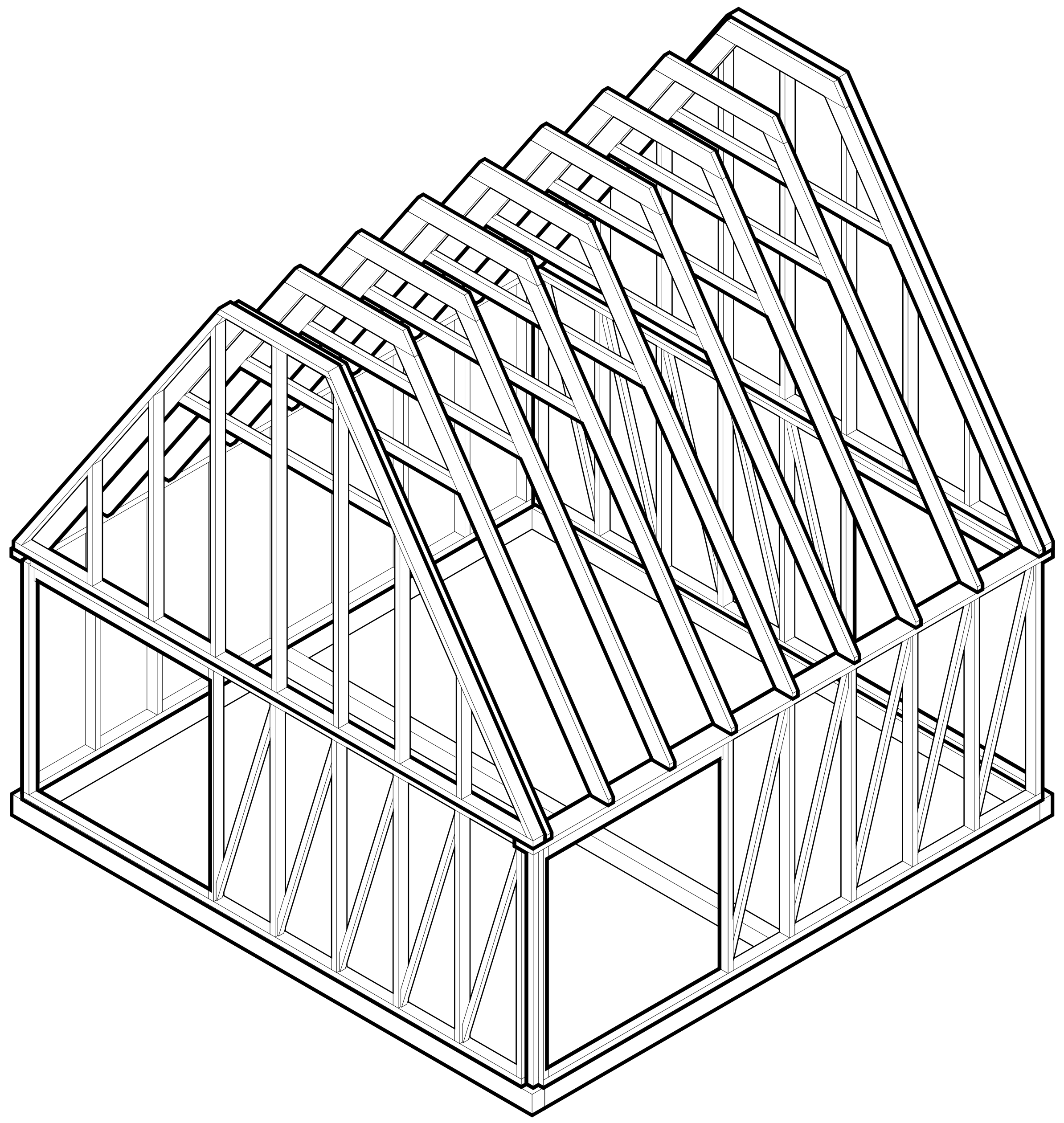
Building systems



Timber frame
structure
(house)



CLT
structure
(house)



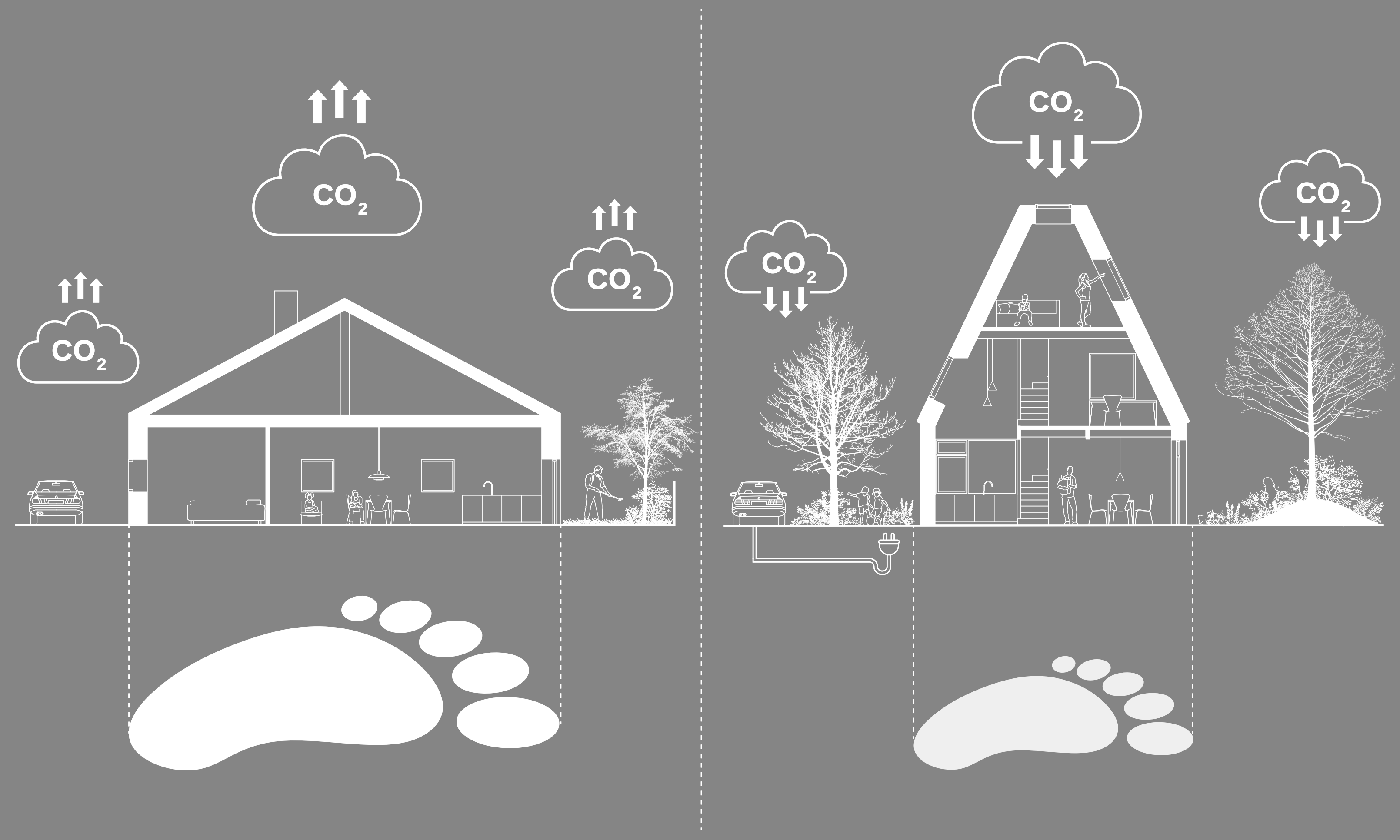
Timber frame
structure
(pavilions)

Case study
Principles & learnings

01. **HEALTHY**
    Building LCA
    Indoor climate
02. **SIMPLE**
    Design for disassembly
03. **ADAPTIVE**
    Prefabrication
04. **SCALABLE**
    Affordable
05. **SHARED**
    Sense of community

Healthy Principle

What if we could reduce the environmental impact, while enhancing the health and wellbeing for people?



01a. BUILDING LIFE CYCLE ASSESSMENT
A simple comparison tool to reduce LCA

More than 70% of the environmental impact of buildings comes from materials.

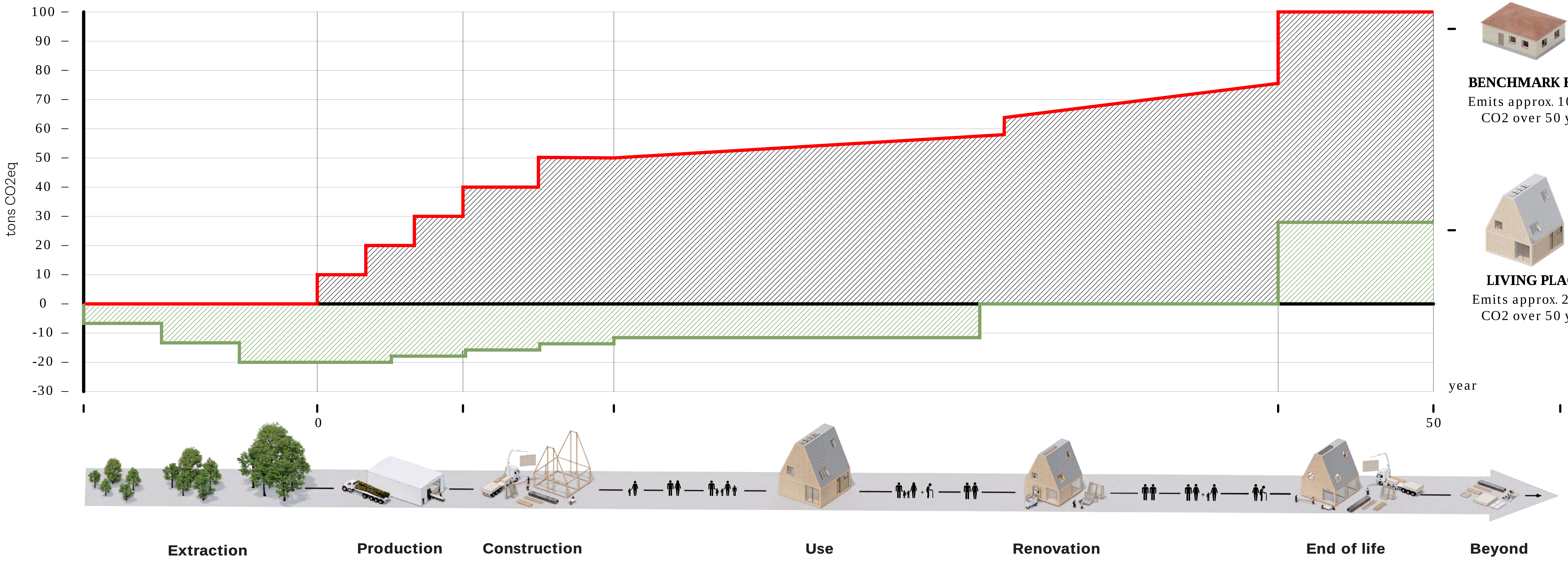
We have developed an LCA calculator tool that provides an overview of solutions and their environmental impact. The calculator simulates building performance based on material choices.

Then we could compare how the different building typologies perform and what elements each solution includes. This calculator gives us an easy way to understand the implications of each choice quickly. The Tool is intended as a process tool for the industry to make quick, informed decisions, thereby ensuring that emissions become a driver for the design process.

By carefully evaluating the necessity of each material and considering alternatives with lower Life Cycle Assessment (LCA), it is possible to reduce the overall LCA of a building by up to 70%. Challenging the current solutions and looking for ways to minimize the impact of materials on the environment can make a significant difference.

Building Life Cycle Assessment Learnings

The diagram compares the CO2 emissions of the full lifecycle of the Benchmark house and the Living Places house.



01b. INDOOR CLIMATE
A design for enhancing the health and wellbeing for people

We spend 90% of our time indoors, so how we build and live directly affects our physical and mental health. Living Places focuses not only on how we create a better living environment for our planet but also on creating a path towards a future-oriented society that enhances living conditions for people. Living Places Copenhagen showcases how we can build homes that not just make us less sick but also improve our health.

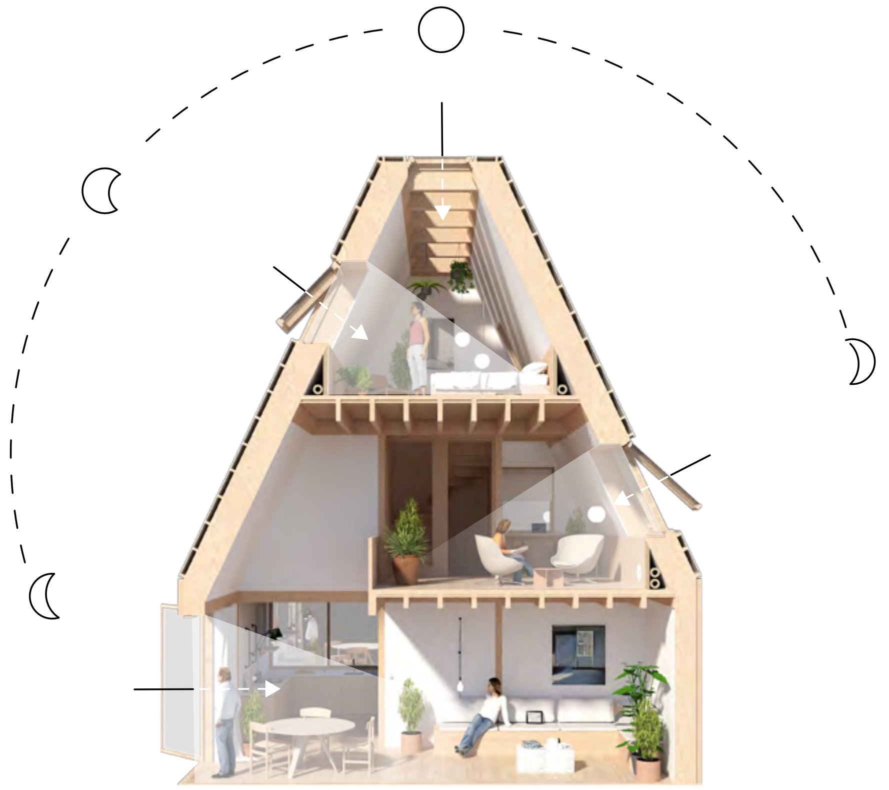
By combining mechanical ventilation and effective filtration of outdoor air with natural ventilation through windows and doors, a healthy indoor climate is secured throughout the year, even when the outside temperature drops. Both roof windows and mechanical ventilation are connected to sensors that automatically open the windows, activate blinds and increase the airflow to prevent overheating and bad indoor air quality. In addition, an effective cooker hood is also installed to remove particles from the indoor air.

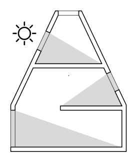
By installing roof windows both on the pitched and flat roof, more daylight is let into the rooms, increasing the feeling of well-being and, at the same time, reducing the need for artificial light.

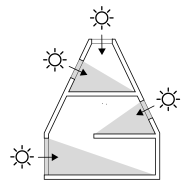
@Adam Mork

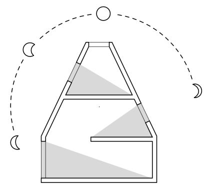
Indoor climate
Learnings

Light

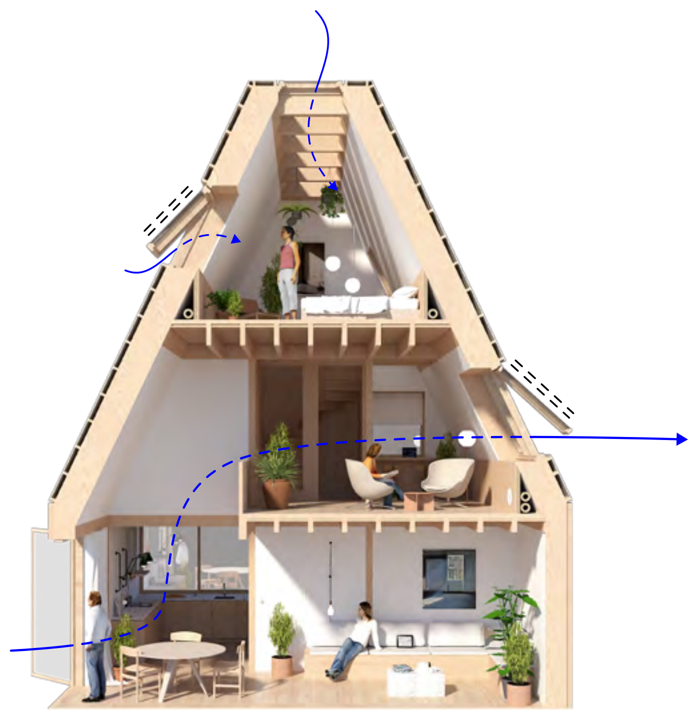


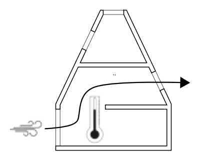
(01)  Daylight Provision

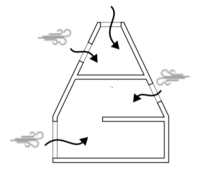
(02)  Daylight from multiple directions

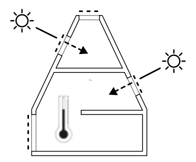
(03)  Daylight following the circadian rythms

Thermal environment

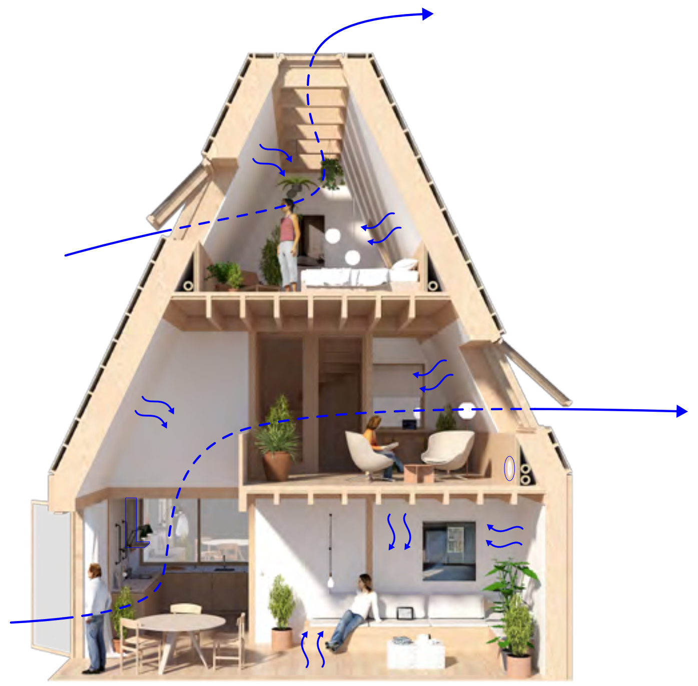


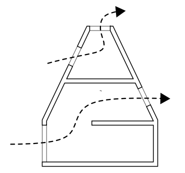
(01)  Ventilative cooling

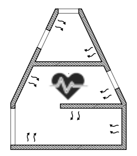
(02)  Fresh air

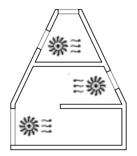
(03)  Dynamic shading

Indoor air quality

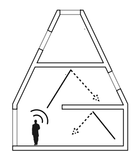


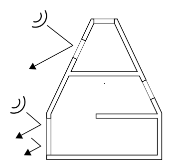
(01)  Cross and stack ventilation

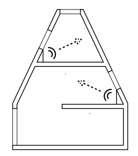
(02)  Healthy building materials

(03)  Removal of particles

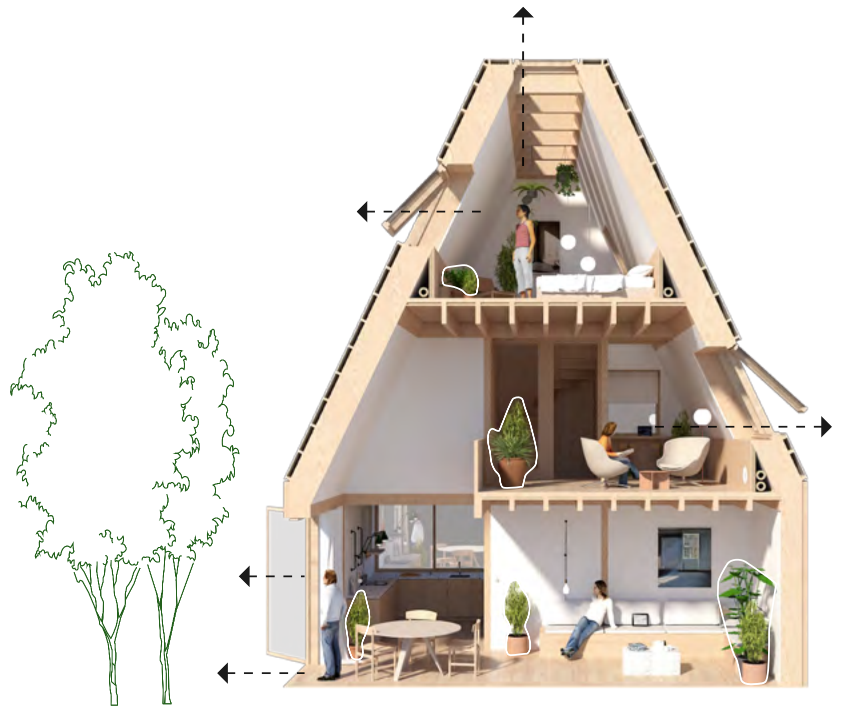
Acoustics

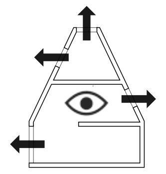
(01)  Noise insulation

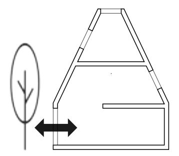
(02)  Controlled sound transmission

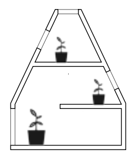
(03)  System noise

Outdoor connection



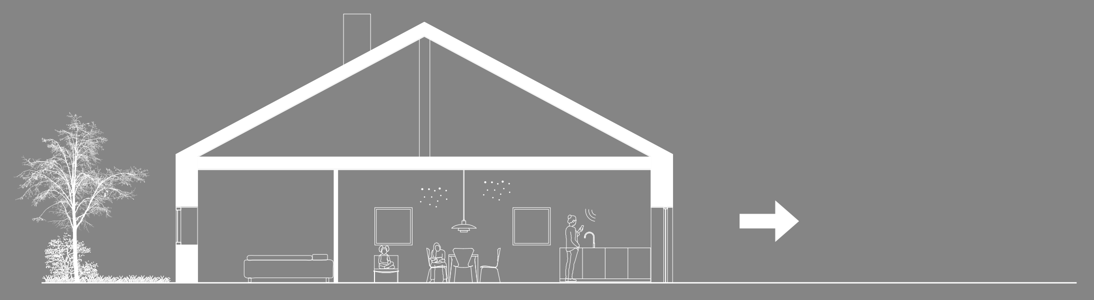
(01)  Direct view of nature

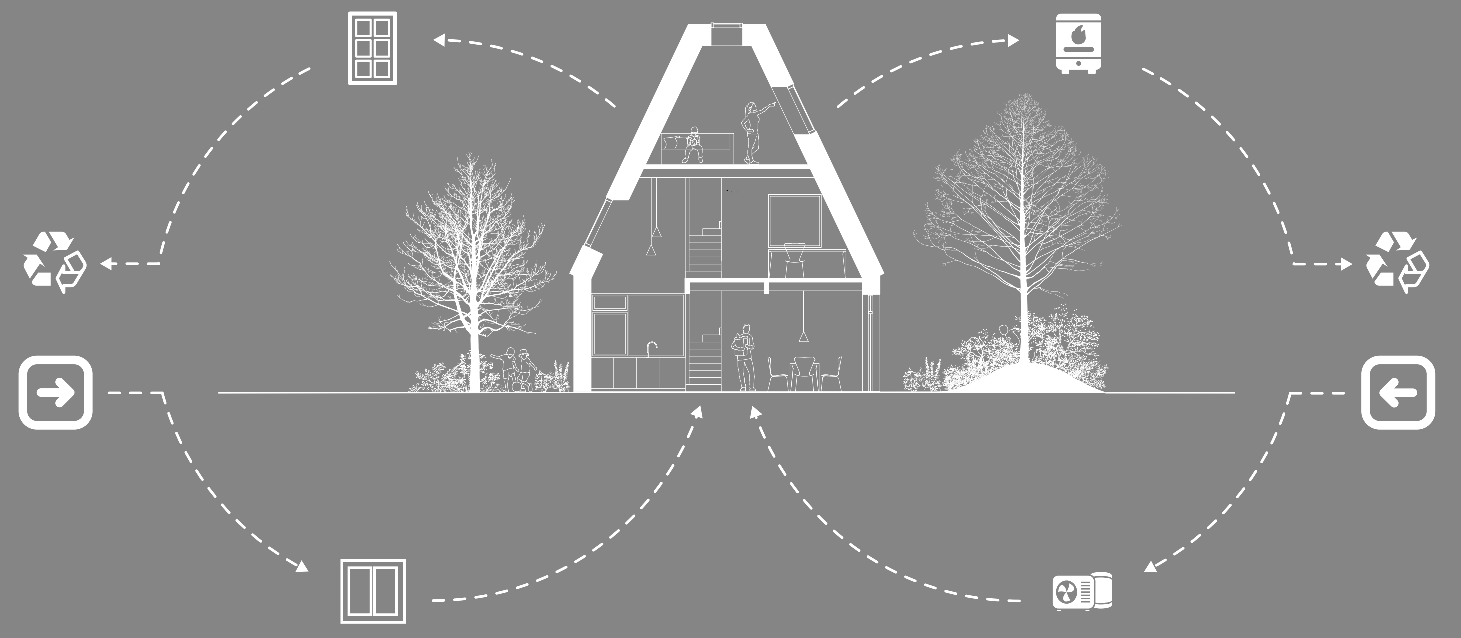
(02)  Direct access to nature

(03)  Bring the outdoor in

Simple Principle

Can a new way of building enable easy upgrades, repairs and a longer lifespan?





02. DESIGN FOR DISASSEMBLY
A new way of building that enables easy upgrades, repairs and a longer lifespan

Early in the design process, we focus on design for disassembly to achieve more sustainable buildings. Our focus was on the following areas:

- Separation of buildings system from the technical system.
- Avoid glued or non accessible connections.
- Use of standard size elements (increase possibility of second life)

We researched how to provide flexibility in the appliances and services within a house while ensuring the solution was affordable. After conducting our analysis, we determined that the best approach was to design a system in which the building and technical systems are independent.

This design allows users to customize the technical systems to their individual needs without affecting the overall structure of the building. This means that they can easily add or remove appliances or services without having to modify the building itself.

Second, by separating the building and technical systems, we could simplify the assembly and maintenance of both systems. This reduces the complexity of the overall system, making it easier to install and maintain.

Overall, our research has led us to a solution that provides flexibility and customization while being affordable and easy to maintain.

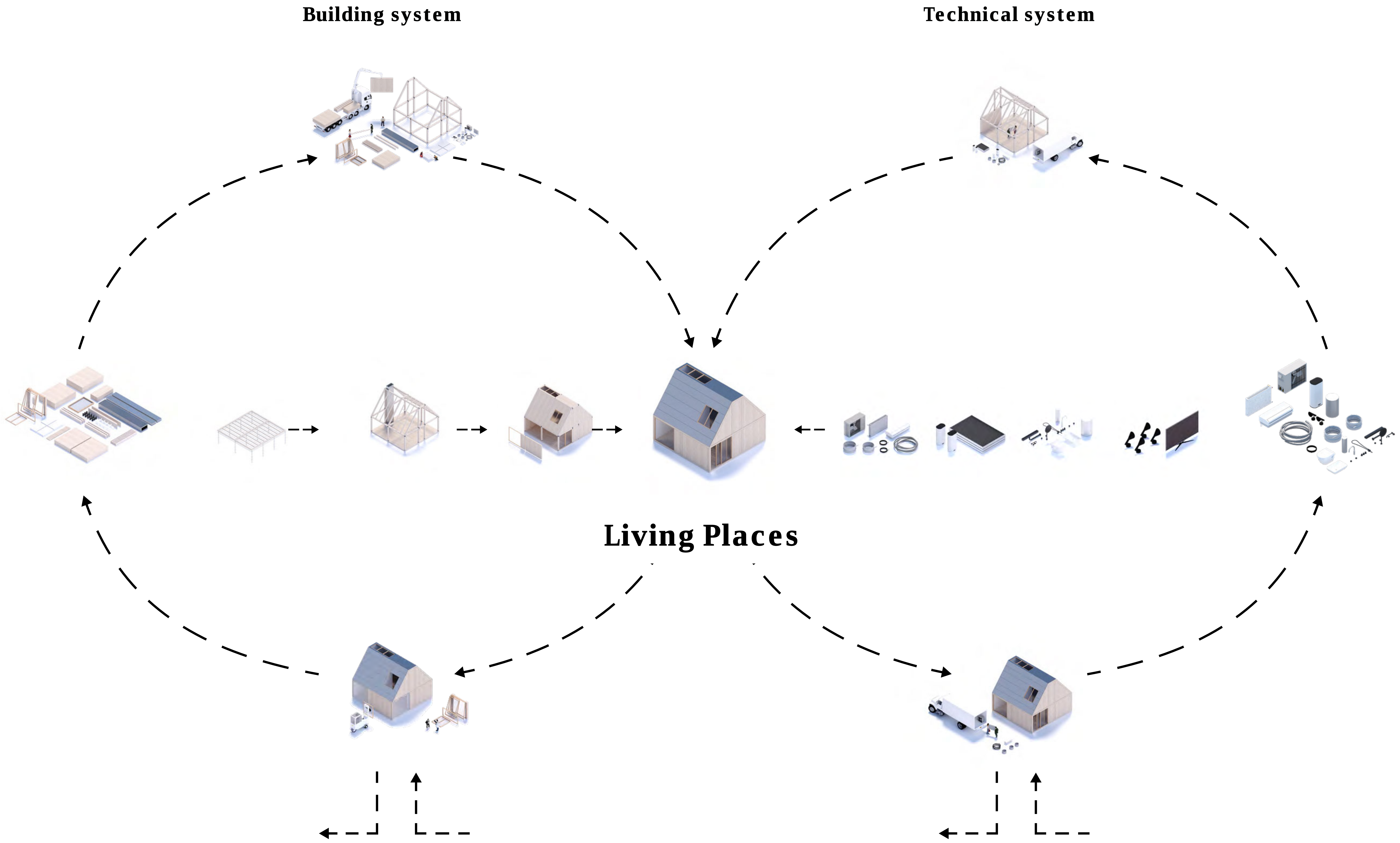
Design for disassembly
Learnings

By separating the technical systems and building systems we are able to create a system that enables a circular economy, reduced cost, labor, and waste production.

A vital part of the concept is bringing our built environment back to the basics. By carefully considering how the different components of a building come together, our homes will offer innovative, simple solutions for how the homes for the future should be built. This is achieved thanks to a modular building system that requires little to no maintenance.

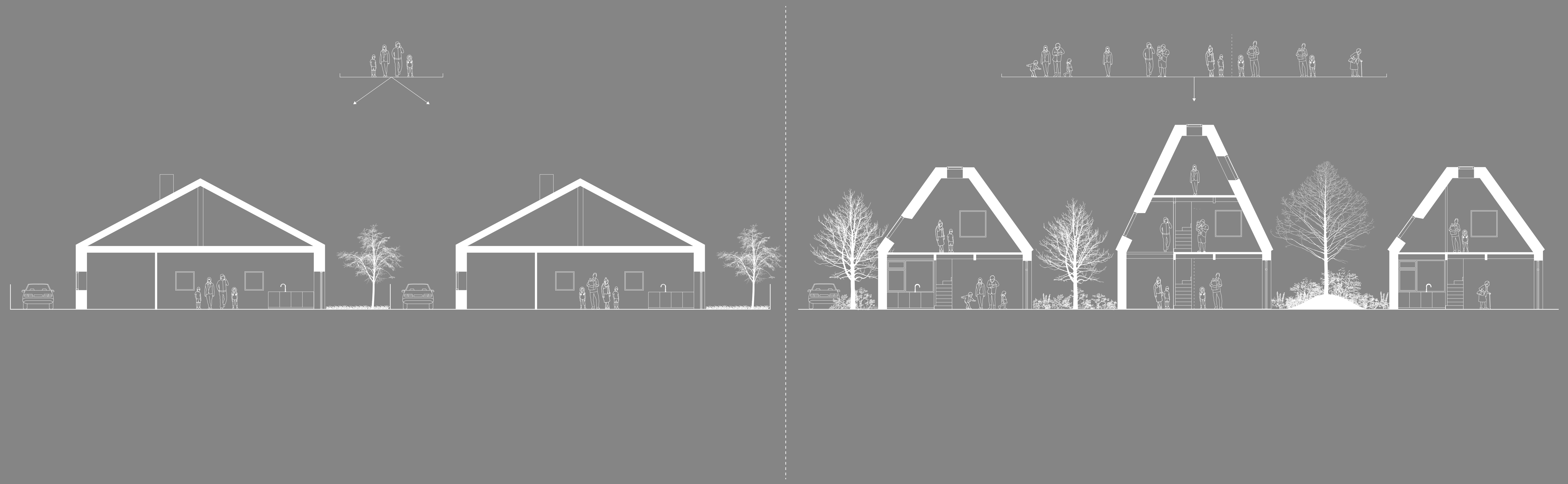
Today we merge these two by building cables into the walls, casting the pipes in the foundation. This makes it hard to repair and maintain our technical systems, and this makes the way we build expensive and inefficient.

By separating the building systems from the technical system and designing the homes so that these are easy to access and maintain, repair, and replace we create homes that can accommodate new technical systems efficiently and at a reduced cost.



Adaptive Principle

Can we create homes that respond to more ways of living?



#03. PREFABRICATION
Scalable and cost-effective solution for positive impact

One of the key advantages of prefabrication is scalability. With prefabrication, components can be manufactured at a much larger scale than traditional on-site construction. In addition, as the process is more automated, there is less variability in the quality of the components produced. This makes it possible to construct quickly and efficiently, with high consistency and quality.

Another significant advantage of prefabrication is cost reduction. Off-site construction can reduce labour costs, material waste, and construction time, leading to significant cost savings for developers and builders. Additionally, because prefabrication takes place in a controlled environment, the risk of weather-related delays and damage to building components is significantly reduced, which means that construction projects can be completed on time and within budget, with a high degree of predictability and reliability.

As the project aims to significantly impact and positively change the building sector, prefabrication was chosen as a strategy to achieve these goals. In addition, the scalability and cost-effectiveness of prefabrication align with the project's focus on creating sustainable and affordable buildings.

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Prefabrication Learnings

Lower environmental impact

- Reduction of material use and material waste, as elements are cut to precise measurements.
- Reduction of emissions related to material use and transportation.
- It can improve the preservation of the site's natural areas and minimize disturbances in the local flora and fauna.
- Reduction of water usage.
- Reduction of water usage.
- Increase in reuse or recycle of materials.

Cost and time effectiveness

- Greater degree of predictability in cost and time.
- Increased efficiency as elements are manufactured in a controlled environment and assembled on-site. This reduces construction time and personnel-related costs.
- Reduced need of form-work or scaffolding time.
- Reduced cost of transportation of partially assembled elements compared to pre-production resources.
- Less dependency of weather and site conditions leads to faster assembly time and higher workers productivity.

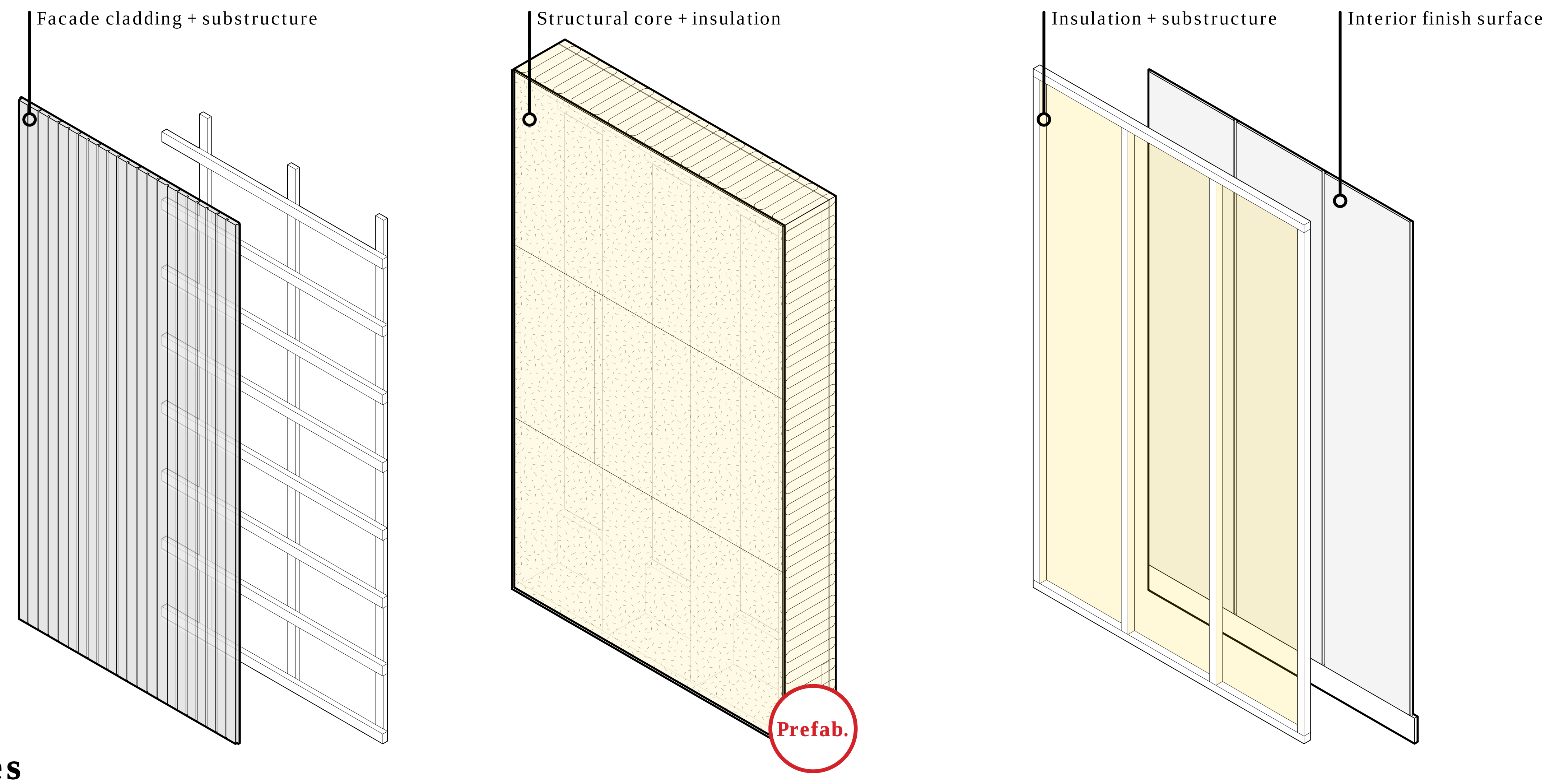
Quality control

- Reduced human errors and quality variations result in a more consistent and reliable product.
- Weather effect on manufacture is reduced thanks to the consistent indoor environment.
- Improvement of job site safety for workers.

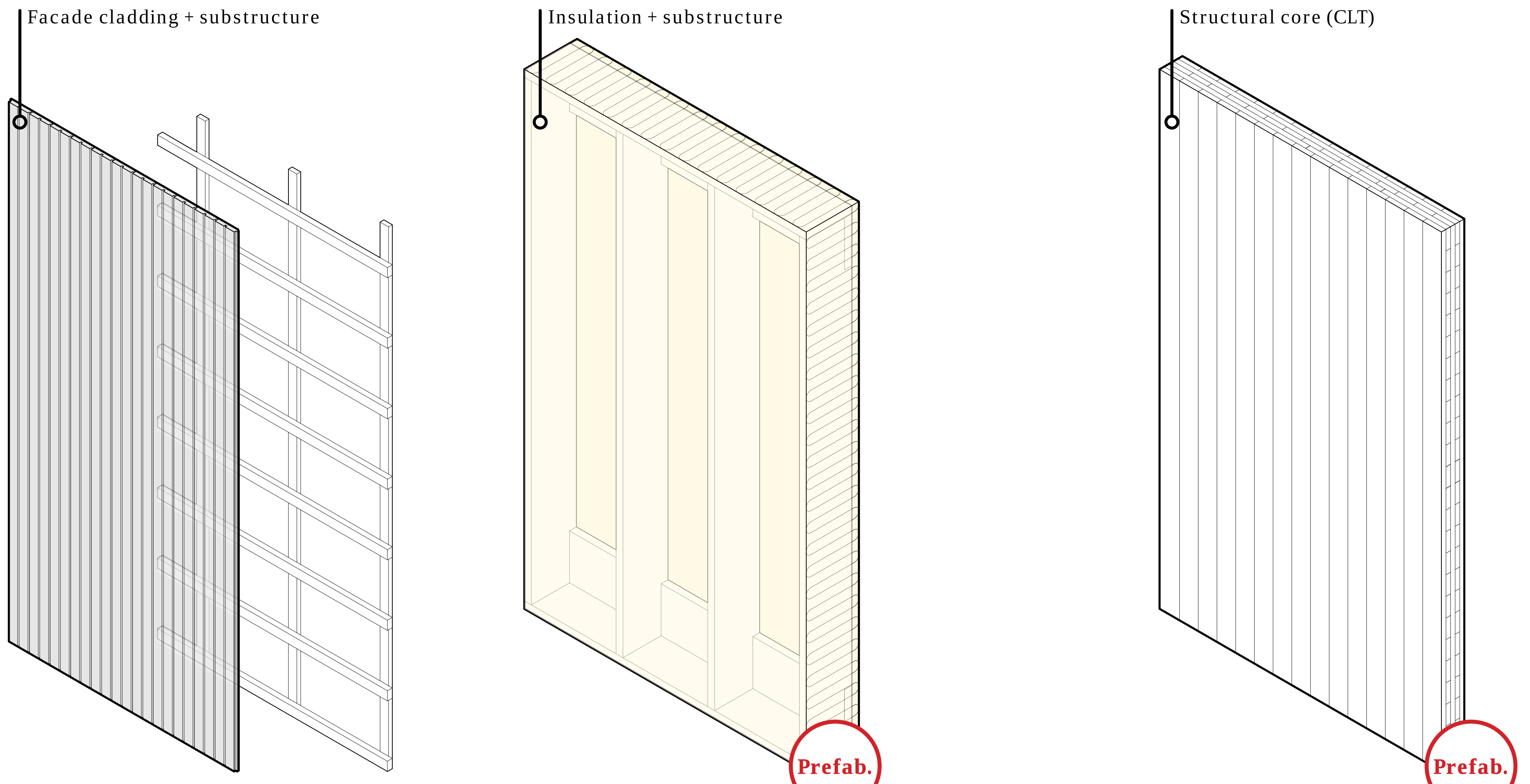
Flexibility and Scalability

- Easier disassemble and move of elements between sites.
- Increased capacity of larger projects to be executed quickly and efficiently.

Tmber frame Prefabricated modules



CLT Prefabricated modules



Scalable Principle

What if by rethinking the way we design, plan, and finance homes we could unlock housing for the many?

#04. AFFORDABLE

A new way to design, plan, and finance to unlock housing for the many

All the principles applied to Living Places help to ensure we can enable a way of building that is affordable for the many. By rethinking everything from construction to maintenance, we remove risk and many barriers affecting square meter prices.

It is economically feasible for the average European citizen to live in a healthy, sustainable, safe, and cost-effective home without negatively impacting life on this planet.

The problem is that we think the cost is a barrier, and rightly so: rapid urbanization, outdated homeownership models, and precarious working conditions have continuously decreased our possibilities of living in a quality home, let alone buying one.

How can we flip this dynamic upside down and reverse the affordable housing crisis? By creating affordable homes that challenge the one-size-fits-all logic and by creating adaptable and healthy homes that enable diverse ways of living at an affordable price.

@Adam Mork

Affordable Learnings

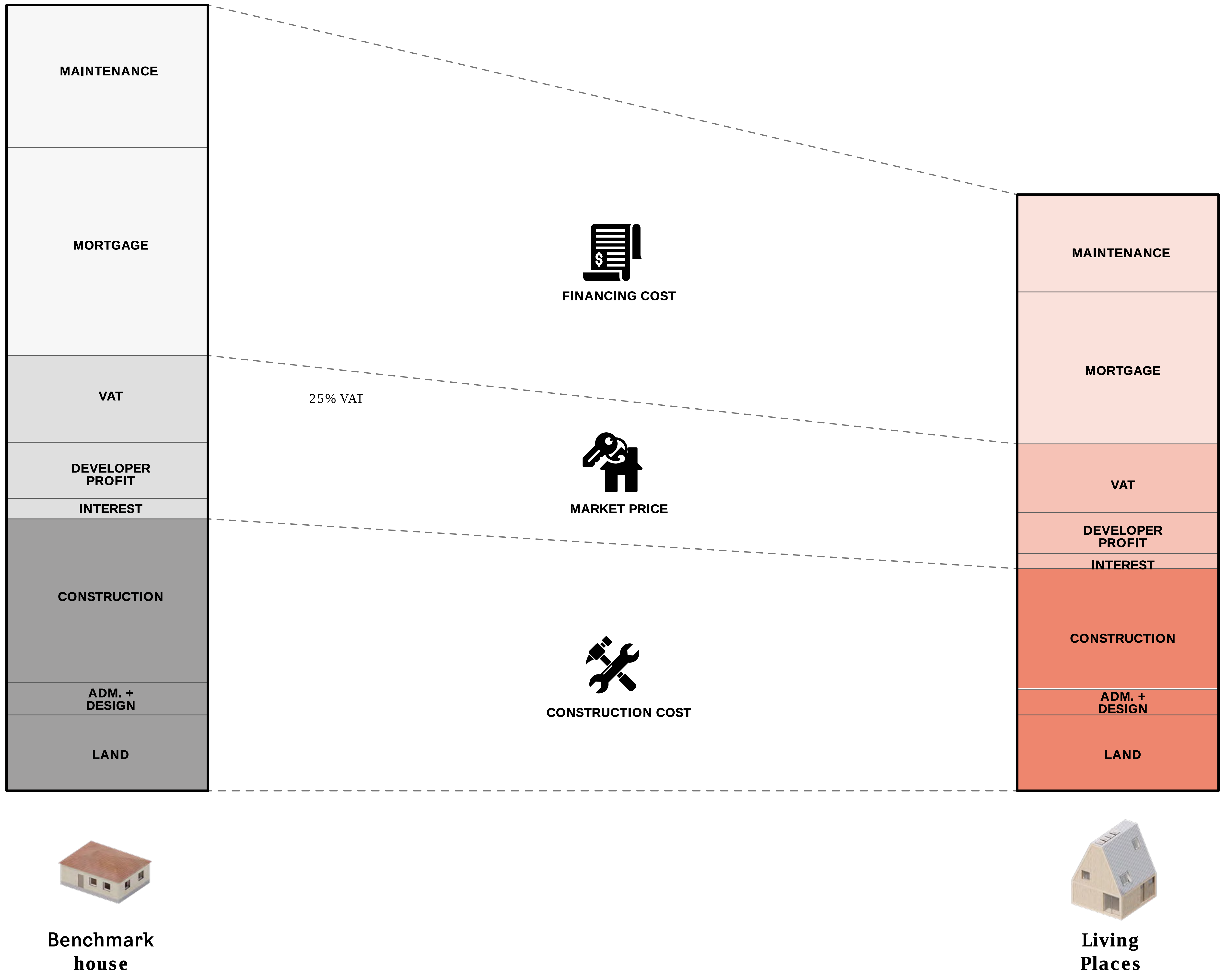
It is economically feasible for the average European citizen to live in a home that is healthy, sustainable, safe, and cost-effective without negatively impacting life on this planet.

The problem is that we think the cost is a barrier, and rightly so: rapid urbanization, outdated home ownership models, and precarious working conditions have continuously decreased our possibilities of living in a quality home, let alone buying one.

How can we flip this dynamic upside down and begin to reverse the affordable housing crisis? By creating affordable homes that challenge the one-size-fits-all logic, and by creating an adaptable and healthy home which enables diverse ways of living at an affordable price.

By combing affordability by design, circular resource loops, and new financial models for homeowners, we can lower people's entry points into the housing market.

Note: Speculative developer model calculations are based on m² prices for Copenhagen, Denmark over a 30 year period



Shared Principle

Can we strengthen
the sense of community
by rethinking how
we live?

#05. SENSE OF COMMUNITY
A new way of living that strengthen the sense of community

As humans, we crave community and fundamentally seek a sense of belonging. So, naturally, we want people with whom we can share our responsibilities and also the experiences we enjoy that form the glue in our relationships. So, when designing Living Places, we must redefine our home aspirations to serve our human needs better.

Combining principles of access over ownership with dense living allows people to meet their neighbours and proactively shape their community, transforming our disconnected homes into active communities. By creating homes and communities centred around the idea of sharing, we seek to create a new paradigm, a means to a more democratic society that understands that sharing is not a new fad but an age-old practice that creates better living environments for both people and the planet.

Shared living showcases how we can live closer while enhancing our way of life by creating active communities that significantly reduce our environmental impact and create better living environments for the many. Shared living enables us to significantly reduce environmental impact per person and reduce land use while at the same time creating healthy homes for the many.

@Adam Mork

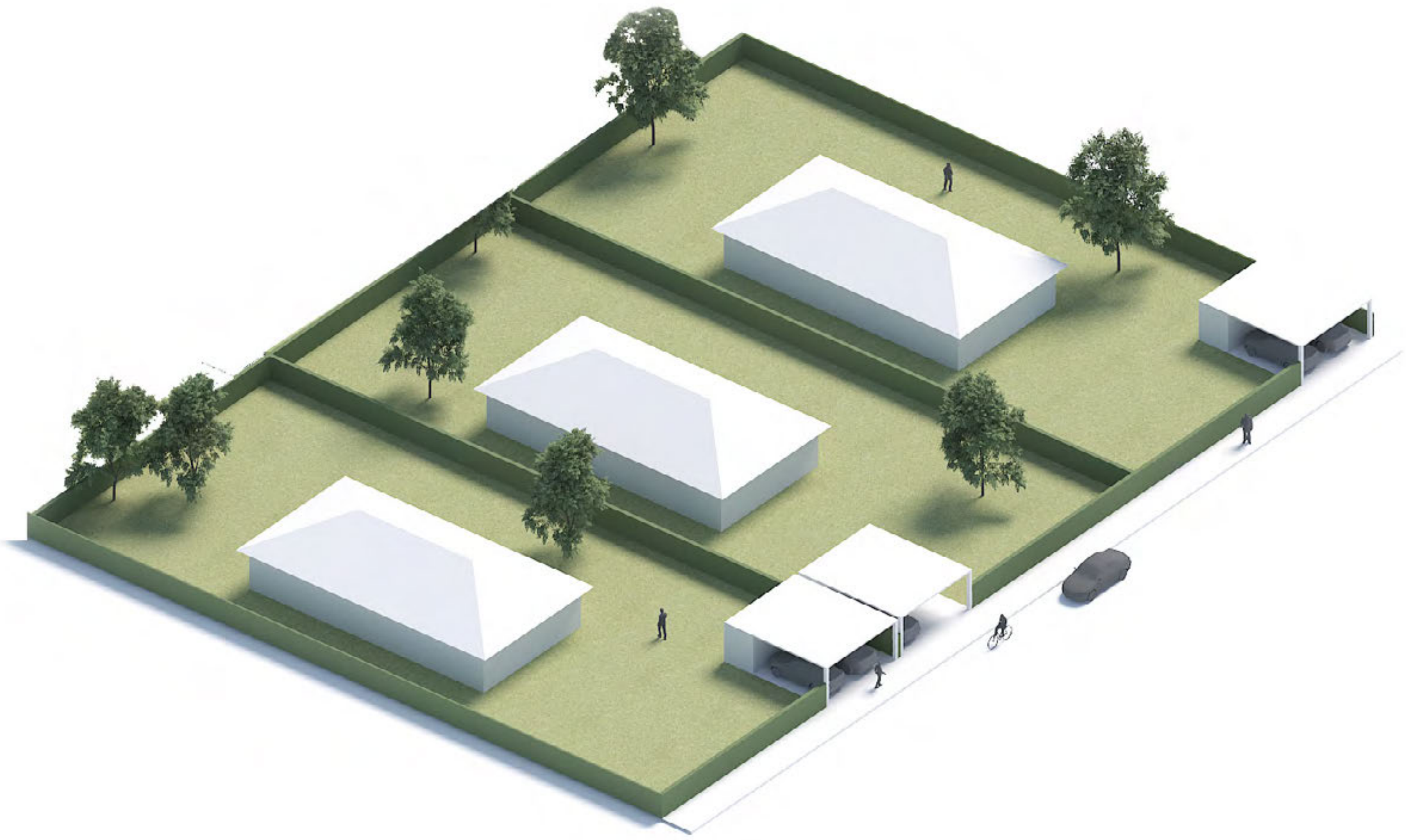
Sense of community
Learnings

What if we could move past the idea that “bigger is better” and free ourselves of the notion that more material goods will make us happier?

In fact, what if we could be happier living in smaller spaces, as long as we could access more shared services? With the above in mind, each home will combine private dwellings with shared spaces, resources, outdoor areas, and amenities.

On the one hand, the shared spaces will allow people to meet their neighbors and proactively engage in shaping their community. These spaces will also reduce the costs associated with unused square meters by pooling resources into common facilities, goods, and services that promote access over ownership.

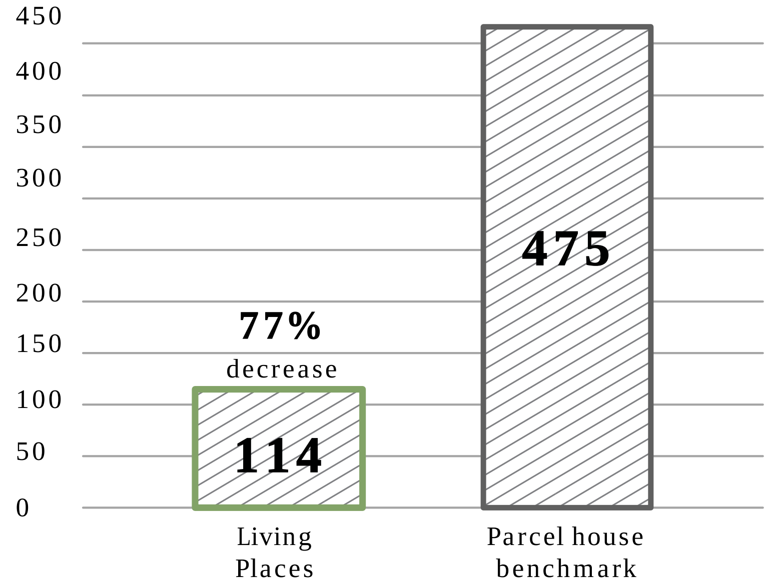
From separated private homes…



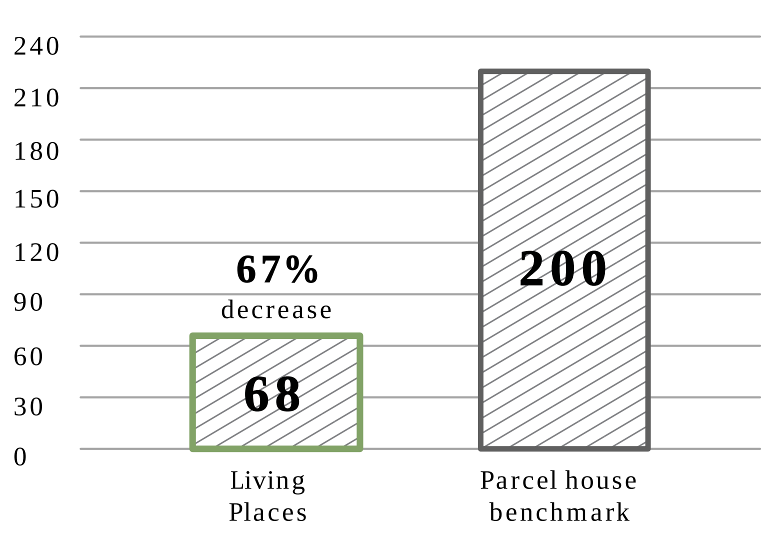
…to active communities

Impact of the design

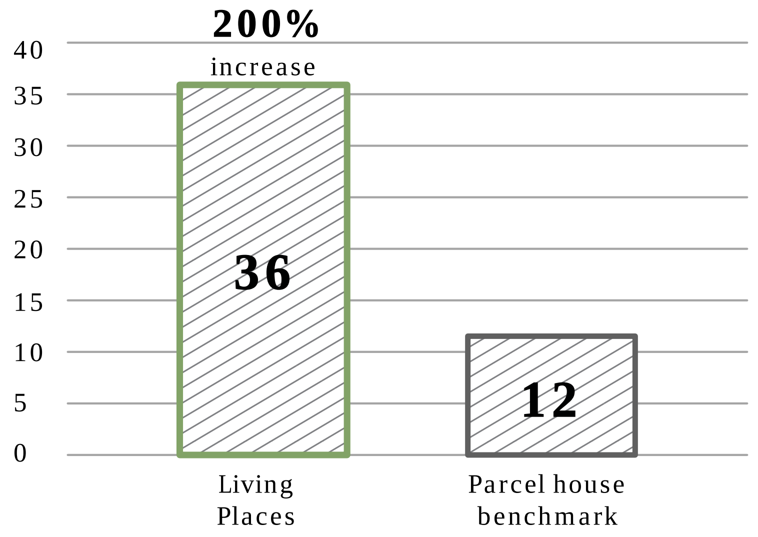
Environmental impact:
kg CO_2 / person a year



Land-use:
m^2 / person



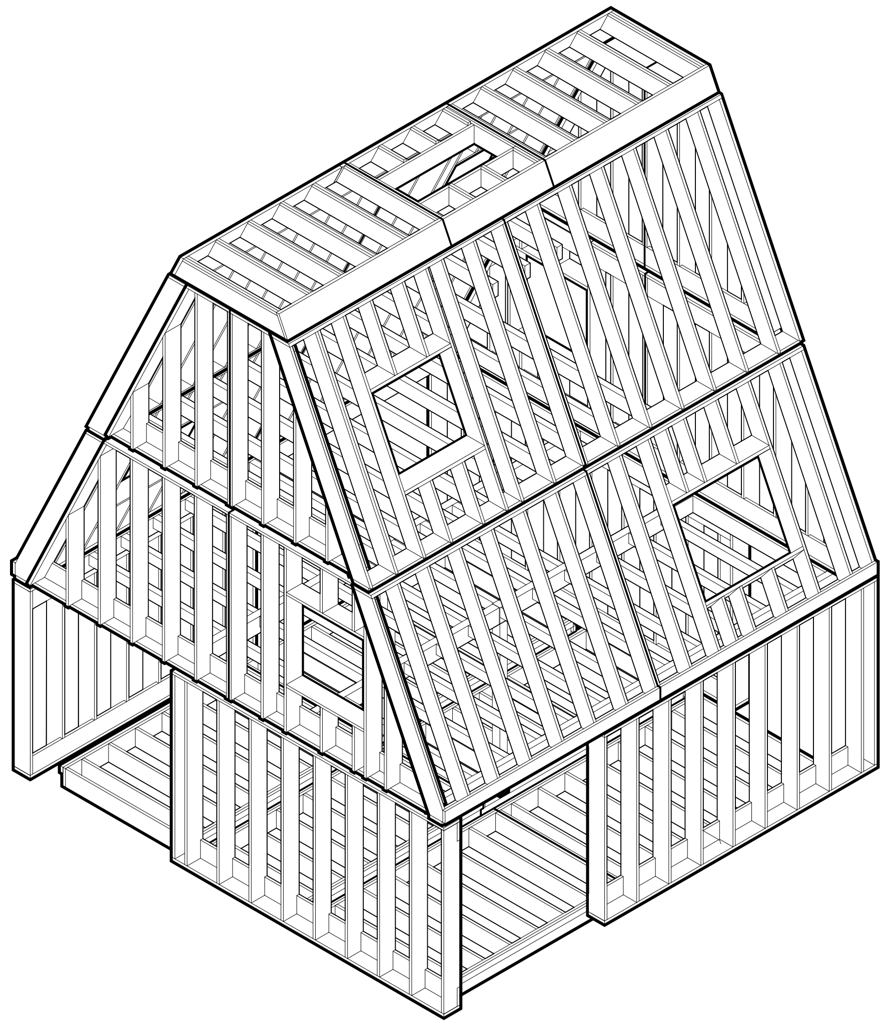
Density:
People / 2400 m^2 (site)

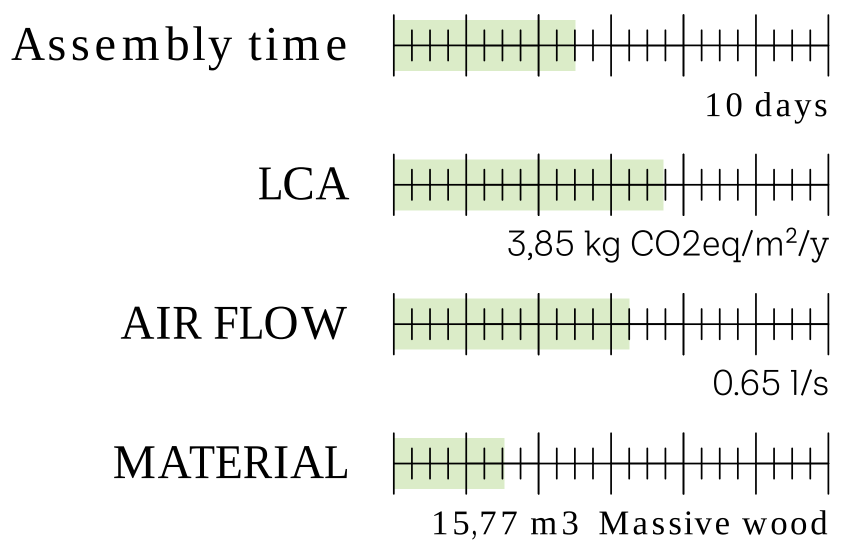


Estimation for 7 Living Places with 5 persons per unit

Case study
Solution comparison

Timber frame house Comparison



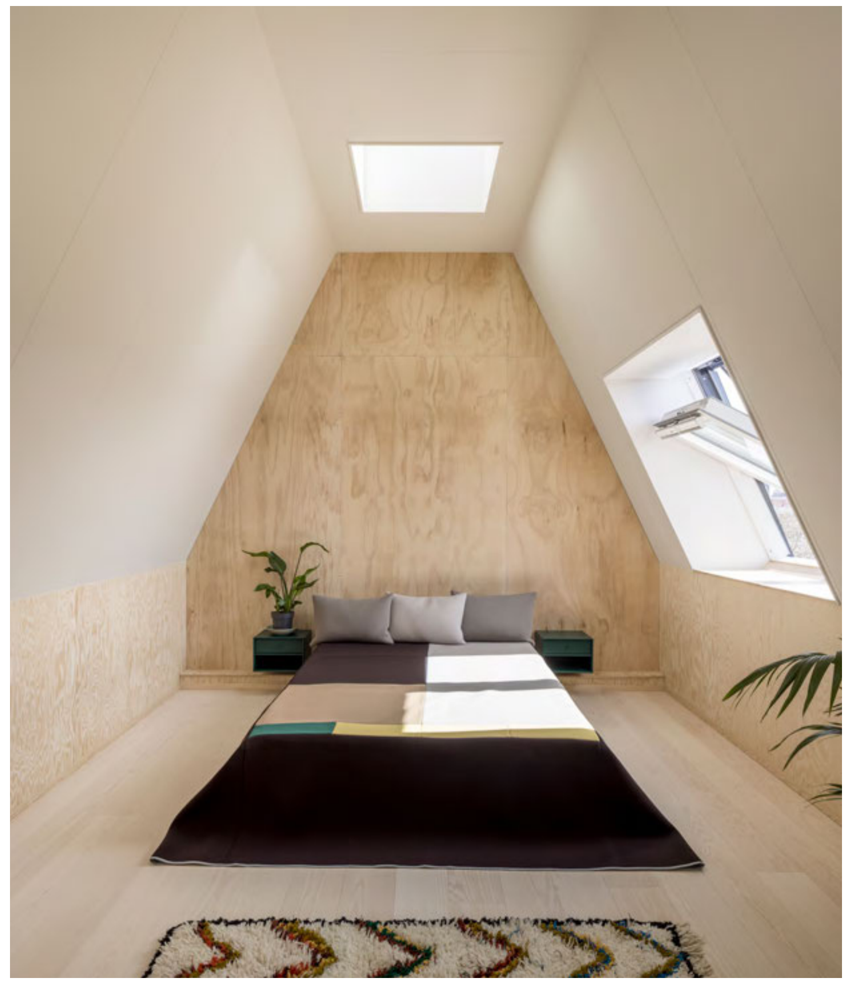


Kitchen

Ground floor

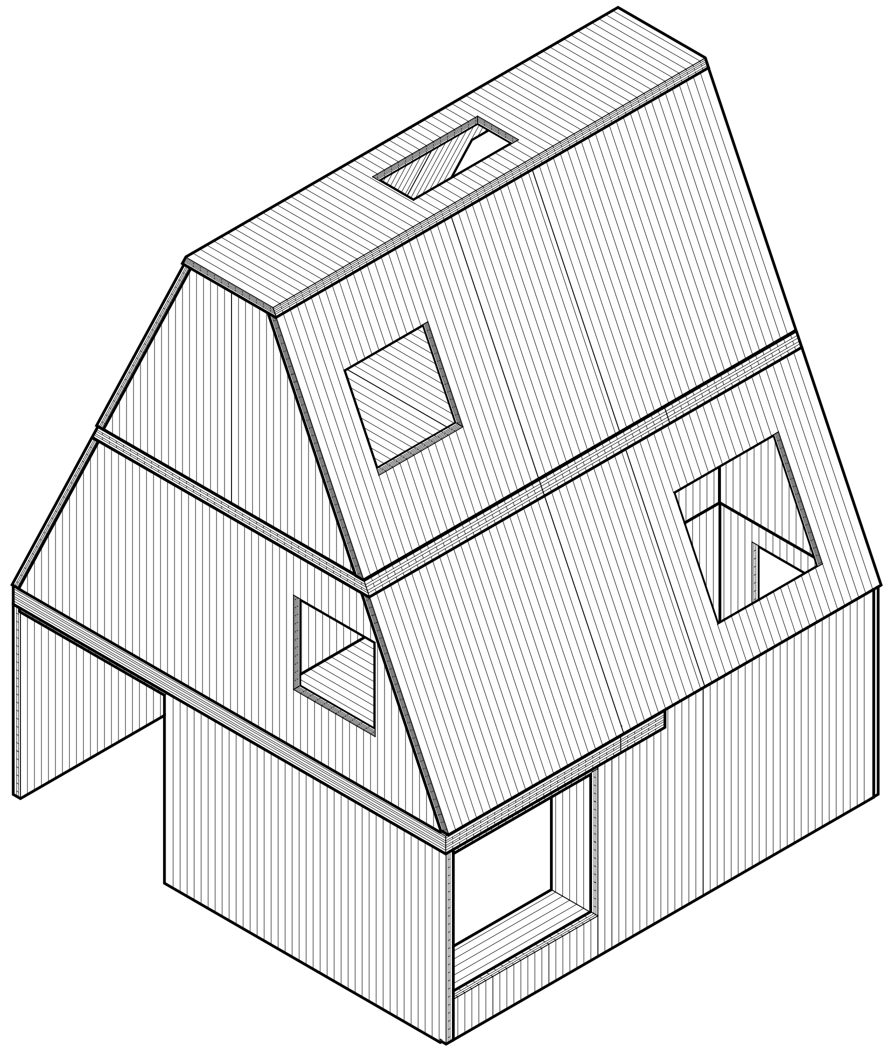
First floor

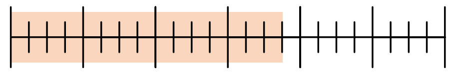
Second floor

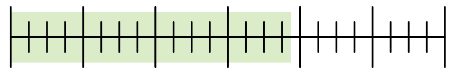


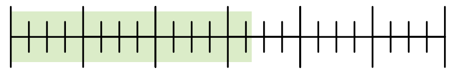
Images by @Adam Mork

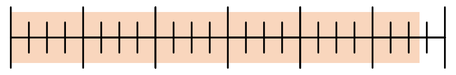
CLT house Comparison



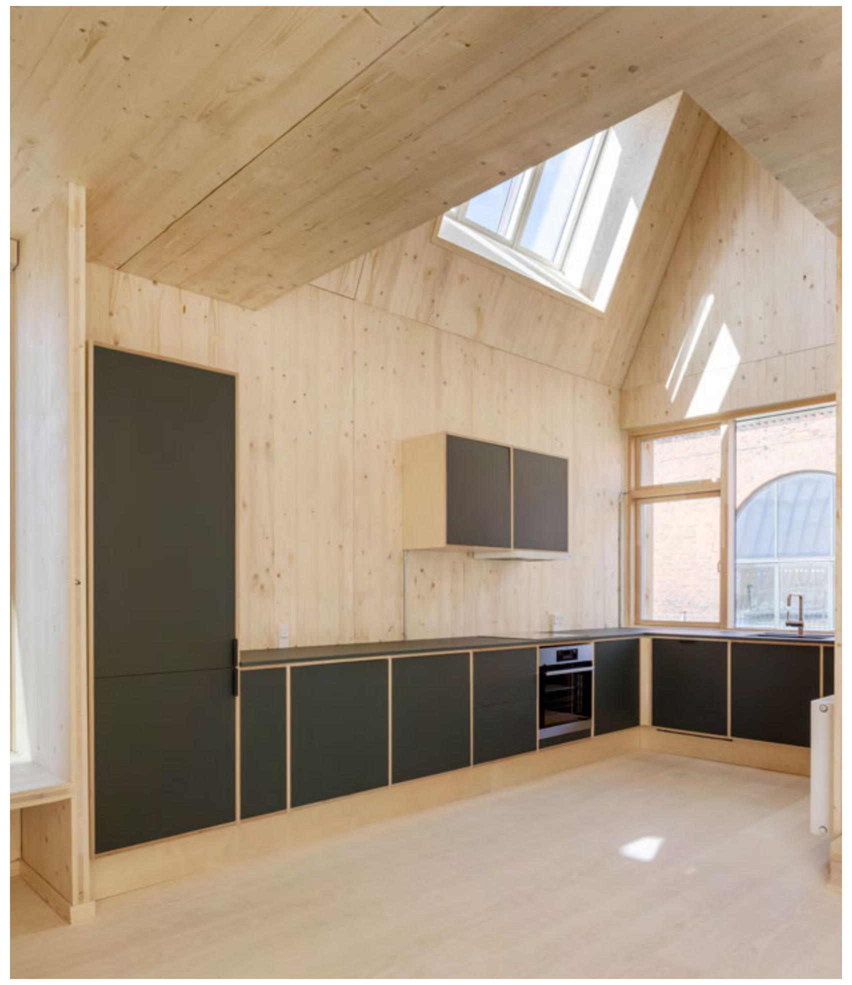
Assembly time

15 days

LCA

3,95 kg CO2eq/m²/y

AIR FLOW

0.66 l/s

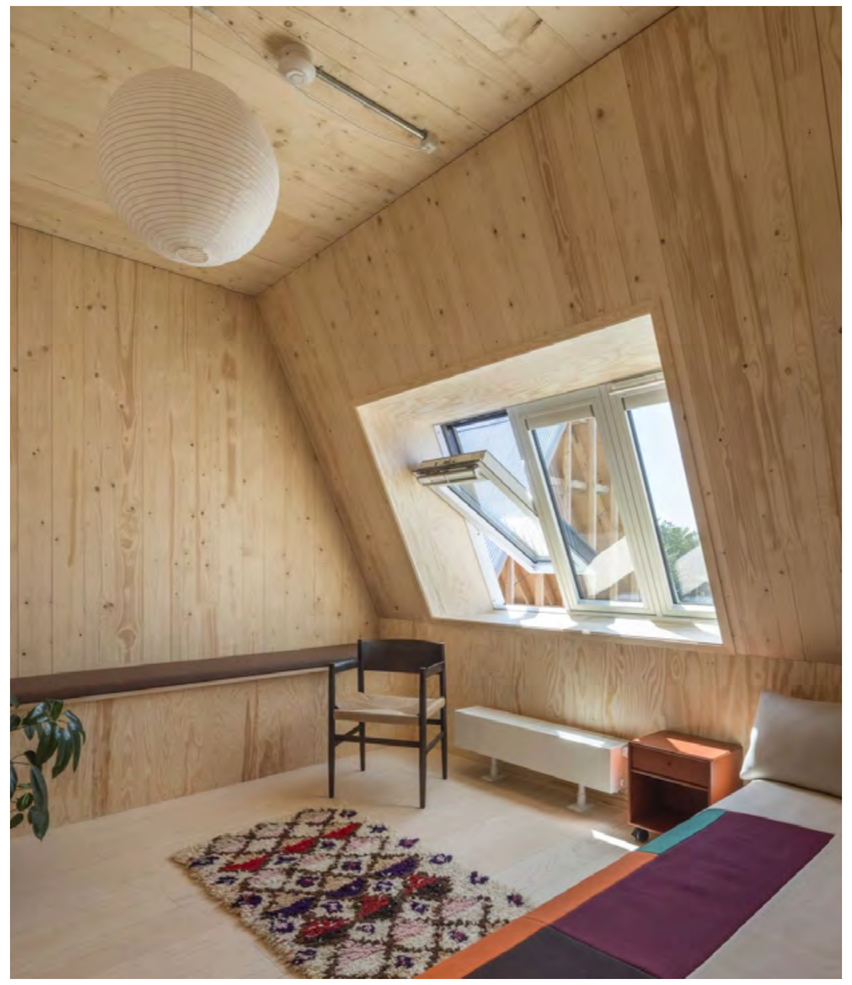
MATERIAL

13,23 m3 Massive wood
43,70 m3 CLT elements
TOTAL: 56,93 m3

Kitchen

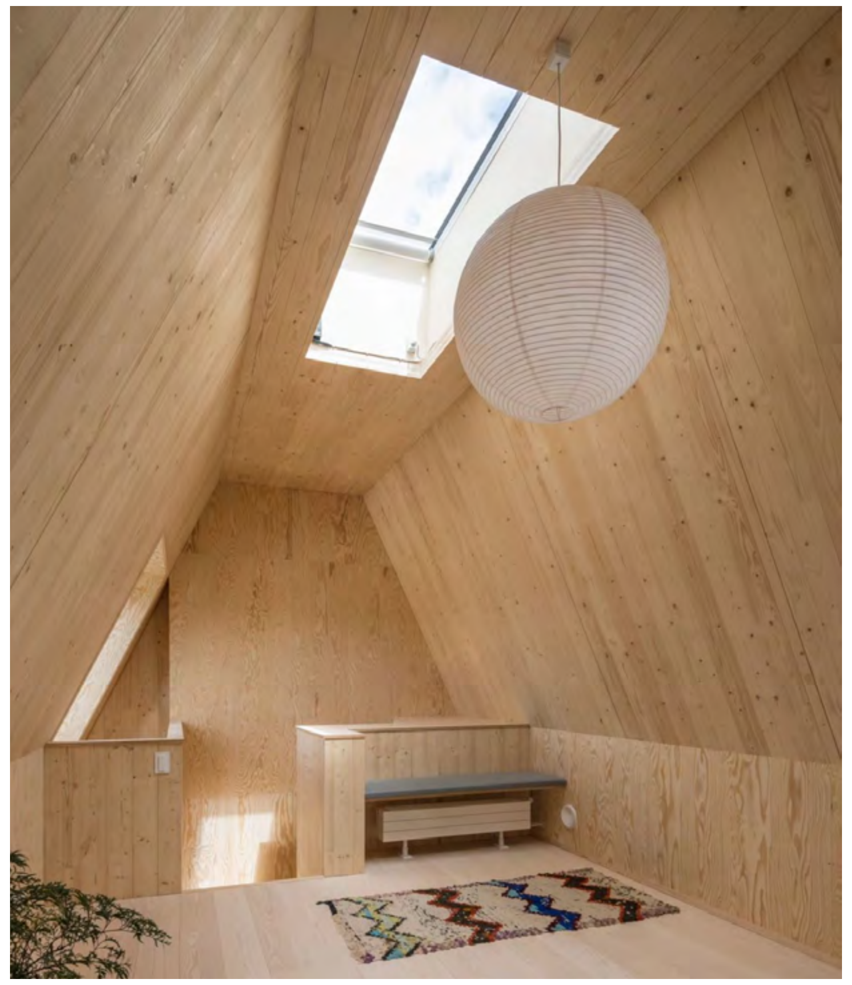


Ground floor

First floor



Second floor



Images by @Adam Mork

How we achieve
3,85 kg $CO_2eq/m^2/y$

@Adam Mork

Timber frame house
Building system

1. Foundation / Ground slab
   - Floor treatment with Indoor climate certified oil
   - Ask plank floor with click system, 15x185 mm
   - Spruce battens, 50x70 mm
   - Vapor barrier, 0,20 mm
   - Pine structural timber C18, 45x295 mm
   - Cellulose insulation, 375mm. Fire class: B-s2, d0
   - Hard wind barrier, 8 mm
2. Facade
   - Spruce facade cladding boards, 21x124 mm. Vertical
   - Spruce roofing battens, 38x73 mm. Horizontal
   - Spruce roofing battens, 25x50mm. Vertical
   - Wind panel with open diffusion, 8mm
   - Pine structural timber C18, 45x295 mm
   - Cellulose insulation, 295 mm. Fire class: B-s2, d0
   - OSB plate G3, 18 mm
   - Pine wood framing, 45x70 mm
   - Wood fiber insulation, 45mm. Fire class: B-s2, d0
   - Fiber gypsum boards, 15mm. Visible connections
   - Interior linoleum paint
3. Roof construction
   - Steel sinus plate, 18 mm. Zink-Magnesium treatment
   - Spruce roofing battens, 38x73 mm. Horizontal
   - Spruce roofing battens, 25x50mm. Vertical
   - Wood fiber roofing plate, 25 mm
   - Pine structural timber C18, 45x295 mm
   - Pine interior battens, 45x45 mm
   - Cellulose insulation, 340 mm. Fire class: B-s2, d0
   - OSB plate G3, 18 mm
   - Pine wood framing, 45x70 mm
   - Wood fiber insulation, 45mm. Fire class: B-s2, d0
   - Fiber gypsum boards, 15mm. Visible connections
   - Interior linoleum paint
4. Slab
   - Floor treatment with Indoor climate certified oil
   - Ask plank floor with click system, 15x185 mm
   - Fiber gypsum floor boards, 13 mm
   - Pine floor plywood, 18mm
   - Pine roofing plywood, 25mm
   - Pine structural timber K18, 270x120 mm
5. Interior wall
   - Interior linoleum paint
   - Fiber gypsum boards, 15mm. Visible connections
   - Pine wood framing, 45x70 mm
   - Fiber gypsum boards, 15mm. Visible connections
   - Interior linoleum paint
6. Windows
   - Oiled oak frame
   - Glass. Triple layer 6+14+4+14+6
7. Roof windows
   - Remote controlled window. Solar powered
   - Indoor blinds. Solar powered
   - Outdoor black out curtains. Solar powered
8. Flat roof windows
   - Flat glass rooflight, 800x800 mm
   - Black out curtains. Solar powered

CLT house
Building system

1. Foundation / Ground slab
   - Floor treatment with Indoor climate certified oil
   - Ask plank floor with click system, 15x185 mm
   - Floor chipboard, waterproof, 22 mm
   - Spruce battens, 50x70 mm
   - Vapor break 0,20 mm
   - Pine structural timber C18, 45x295 mm
   - Cellulose insulation, 375mm. Fire class: B-s2, d0
   - Hard wind barrier, 8 mm
2. Facade
   - Spruce facade cladding boards, 21x124 mm. Vertical
   - Spruce roofing battens, 38x73 mm. Horizontal
   - Spruce roofing battens, 25x50mm. Vertical
   - Wind panel with open diffusion, 8mm
   - Pine structural timber C18, 45x295 mm
   - Cellulose insulation, 345 mm. Fire class: B-s2, d0
   - CLT C5s, 100 mm. IVQ vertical elements
   - Varnish with UV protection, Indoor climate certified
3. Roof construction
   - Steel sinus plate, 18 mm. Zink-Magnesium treatment
   - Spruce roofing battens, 38x73 mm. Horizontal
   - Spruce roofing battens, 25x50mm. Vertical
   - Wood fiber roofing plate, 25 mm
   - Pine structural timber C18, 45x295 mm
   - Cellulose insulation, 395 mm. Fire class: B-s2, d0
   - Vapor break, 0,20 mm
   - CLT C5s, 100 mm. IVQ vertical elements
   - Varnish with UV protection, Indoor climate certified
4. Slab
   - Floor treatment with Indoor climate certified oil
   - Ask plank floor with click system, 15x185 mm
   - CLT C7s, 240 mm. IVQ
   - Varnish with UV protection, Indoor climate certified
5. Interior wall
   - Varnish with UV protection, Indoor climate certified
   - CLT C3s, 90 mm. IVQ vertical elements
   - Varnish with UV protection, Indoor climate certified
6. Windows
   - Aluminum - Pine frame
   - Triple glass layer. 6+14+4+14+6
7. Roof windows
   - Remote controlled window. Solar powered
   - Indoor blinds. Solar powered
   - Outdoor black out curtains. Solar powered
8. Flat roof windows
   - Flat glass rooflight, 800x800 mm
   - Black out curtains. Solar powered

Partnerships

Arkitekturhovedstad 2023
OFFICIEL PARTNER

COPENHAGEN IN COMMON
UNESCO-UIA
COPENHAGEN 2023

WORLD CONGRESS OF ARCHITECTS · UIA 2023 · COPENHAGEN

LIVING PLACES CONCEPT

VELUX®
Owner & Ideator

LIVING PLACES PARTNERS

EFFEKT
Architects
Concept partner

ARTELIA
Engineers
Concept partner

Enemærke & Petersen a/s
Contractor

DSB
Landowner

COMPASS PARTNERS

ACT colour
Color concept
Textiles, surfaces

BOLIG LABORATORIUM EKSPERIMENT VIDEN
STATENS KUNSTFOND OG REALDANIAS BOLIGLABORATORIUM
Exhibition on
7 experimental
housing projects

BANEBY KONSORTIET
Exhibition on
Future railway district

LANDSBYGGEFONDEN
Exhibition on
'Neighborhoods for
Generations'

FÆLLES HAVEN
Nature, Biodiversity
and gardens

CXF
Architecture
programme curators

COMPASS SUPPLIERS

Stykka®
Kitchens

Montana
Furniture

mater
Furniture

kvadrat
Curtains

louis poulsen
Light

URBAN HELP
Facility support