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The technology is there: How to build more sustainably

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We create well-being for people and planet by transforming spaces using daylight and fresh air






Key Challenges

DIGITALISATION & LIFETIME

The construction industry is the second least digitised in the world[1], this is one of the primary reasons for the lifespan of our buildings being halved in the last century and is predicted to continue[2]. One of the main reasons is that we build increasingly complex structures and systems that are unable to connect with each other.[3].Therefore they are not able to adapt to changes we cannot foresee. Digitizing the construction industry whilst building more flexible and adaptable buildings could make them able to adapt to the challenges we cannot foresee while increasing the lifespan of our built environment.

1. CiC - roadmap for change (2020)
2. Reinier de Graaf - 4 walls and a roof (2018)
3. Memori - smart city report (2019)

PRODUCTIVITY & EFFICIENCY

The building industry has the lowest productivity gains of any industry. Just 31% of all projects came within 10% of the budget in the past 3 years, this is due to inefficiencies in design, planning and construction phases of the build. Lack of productivity and rising salaries mixed with a heightened complexity have resulted in a steep decrease in quality. By using prefabrication we can increase efficiency and enable more sustainable development by reducing waste, increase collaborations and enable circular material flows.[1]

1. Kpmg - climbing the curve report 2019

ENVIRONMENTAL

Buildings alone are responsible for approx. 40% of global CO2-emissions[1], and 40% of the world populations will need new homes[2]. Simultaneously we need to reach net zero emissions in this same time frame to avoid dramatic climate change[3].

By using low impact materials and focusing on the LCA of a building we could meet the demand for increased housing without depleting the earth's resources.

1. International Energy Outlook 2019 (EIA, 2019)
2. Sustainable Consumption and Production (UNEP, 2015)
3. Global Warming of 1.5°C (IPCC, 2020)

HEALTH

We spend up to 90% of our time indoors[1], but fail to build for a healthy indoor climate by applying a one-size-fits-all logic to our buildings and compromising on the quality of construction materials[2].

By designing with healthy indoor principles and healthy materials we can create buildings that don't just make you less sick but actually makes you healthier.

1. The National Human Activity Pattern Survey (EPA, 2001)
2. Living conditions in Europe (eurostat, 2018)

LONELINESS

Even though we live closer, and are more connected than ever we feel more lonely, anxious and stressed. And 1 in 5 people in Denmark long for community and a sense of belonging[1].

By designing a built environment that enables community through sharing, participation, identity and safety we could increase well-being and increase overall health and reduce anxiety, loneliness and stress.

1. Fælleskabsmålingen - trygfonden (2019)

AFFORDABILITY

2.5 billion more people are expected to live in cities by 2050[1]. At the same time most places worldwide have seen a substantial and steady increase in housing prices, making our built environment unaffordable for the people who would benefit from them the most[2].

By designing a built environment that focuses on affordability by design, shared living and new business cases we could unlock housing for the people that would benefit from it the most.

1. World Urbanization Prospects 2018 (United Nations, 2018)
2. UBS Global Real Estate Bubble Index 2019 (UBS, 2019)

POST-PANDEMIC LIVING

Whatever our experience of pandemic restrictions, their impact is prompting many of us to re- evaluate what makes a good home. The future home meeting our emotional needs will depend on health and wellbeing becoming the gold standard for a better life at home. These new and different priorities could have dramatic implications for what we mean by a 'good home', and for the way we live in the future[1].

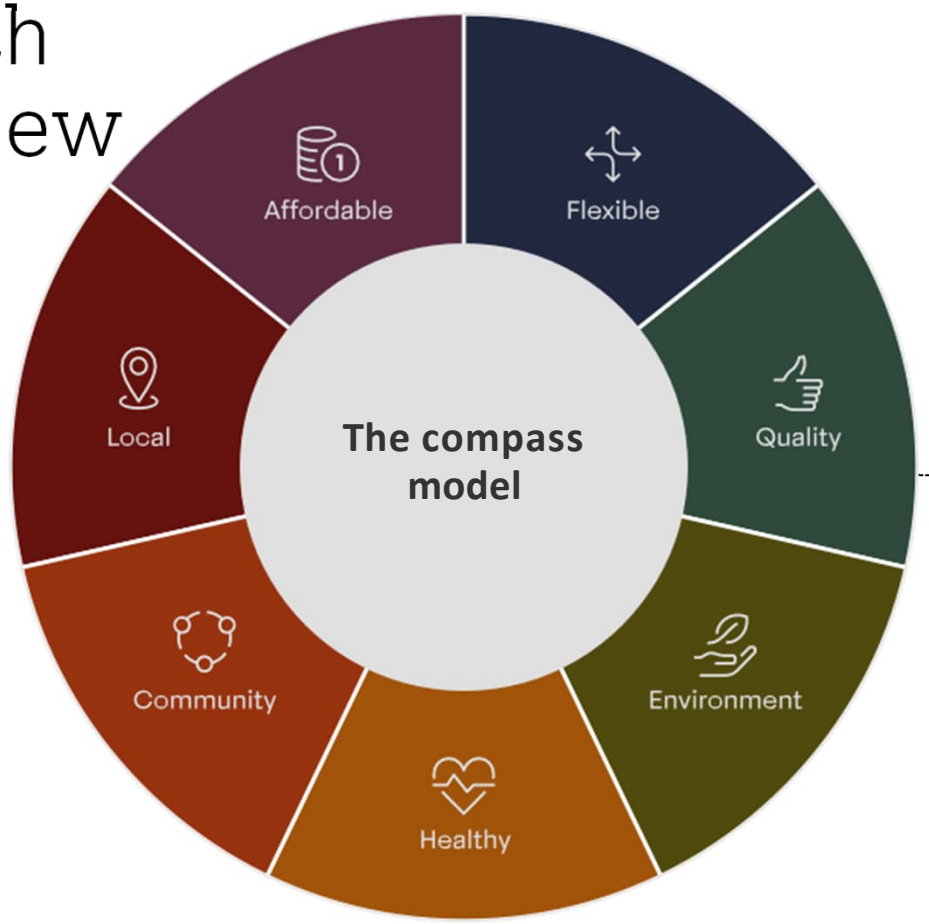
By designing a build environment focused on meeting our emotional needs and enabling a strong sense of place we could pioneer a new way of thinking home, one that isn't about location but about the local context and what life it empowers people to live.

1. Ikea - "life at home" report 2020

Compass - a strategic approach for both renovation and new build

The approach can be used for new build, transformation and renovations. It serves as a strategic way of thinking which outlines a clear framework to guide the building and development process.

Most of all, the Compass lays out a series of building principles to ensure quality and integrity throughout the entire design process.



NEW BUILD

RENOVATION

TRANSFORMATION

Extraction

Production

Construction

Use

Renovation

End of life

Beyond

How we benchmarked

How we build today

TYPICAL SINGLE FAMILY HOUSE

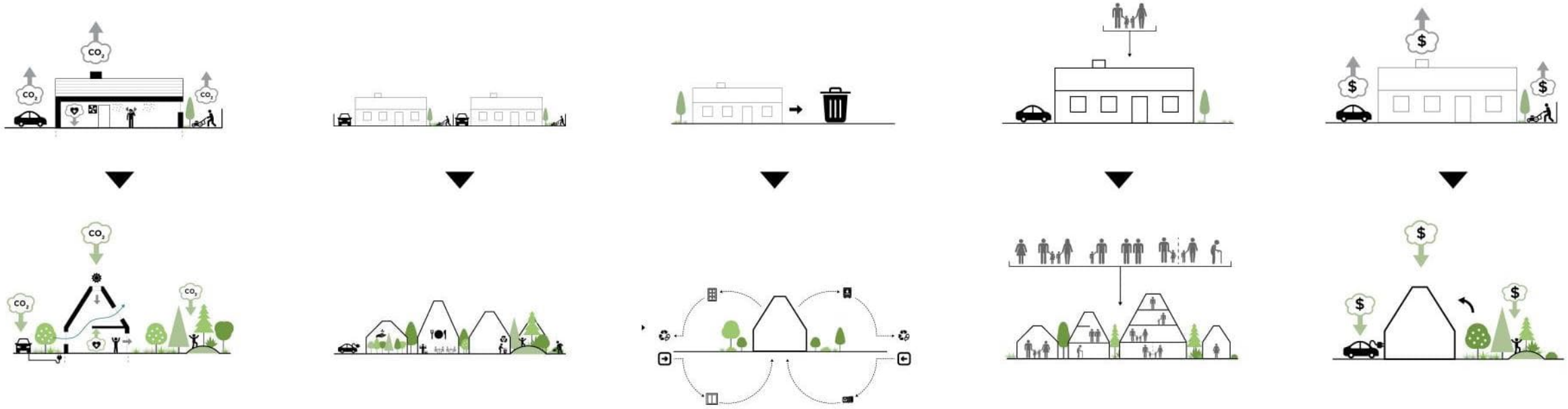
Size:	184
Floors:	1
Building principle:	Brick
Foundation:	Concrete
Floor height:	2.7 m
Room height:	2.4 m
Heating application:	District heating
Heating source:	Floor heating
Ventilation:	Mechanical
Solar panels:	7 m^2

How we might build in the future

LIVING PLACES CONCEPT

Size:	144
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 panels:	12 m^2

Rethinking how to build: Principles for Living Places



HEALTHY

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

SHARED

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

SIMPLE

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

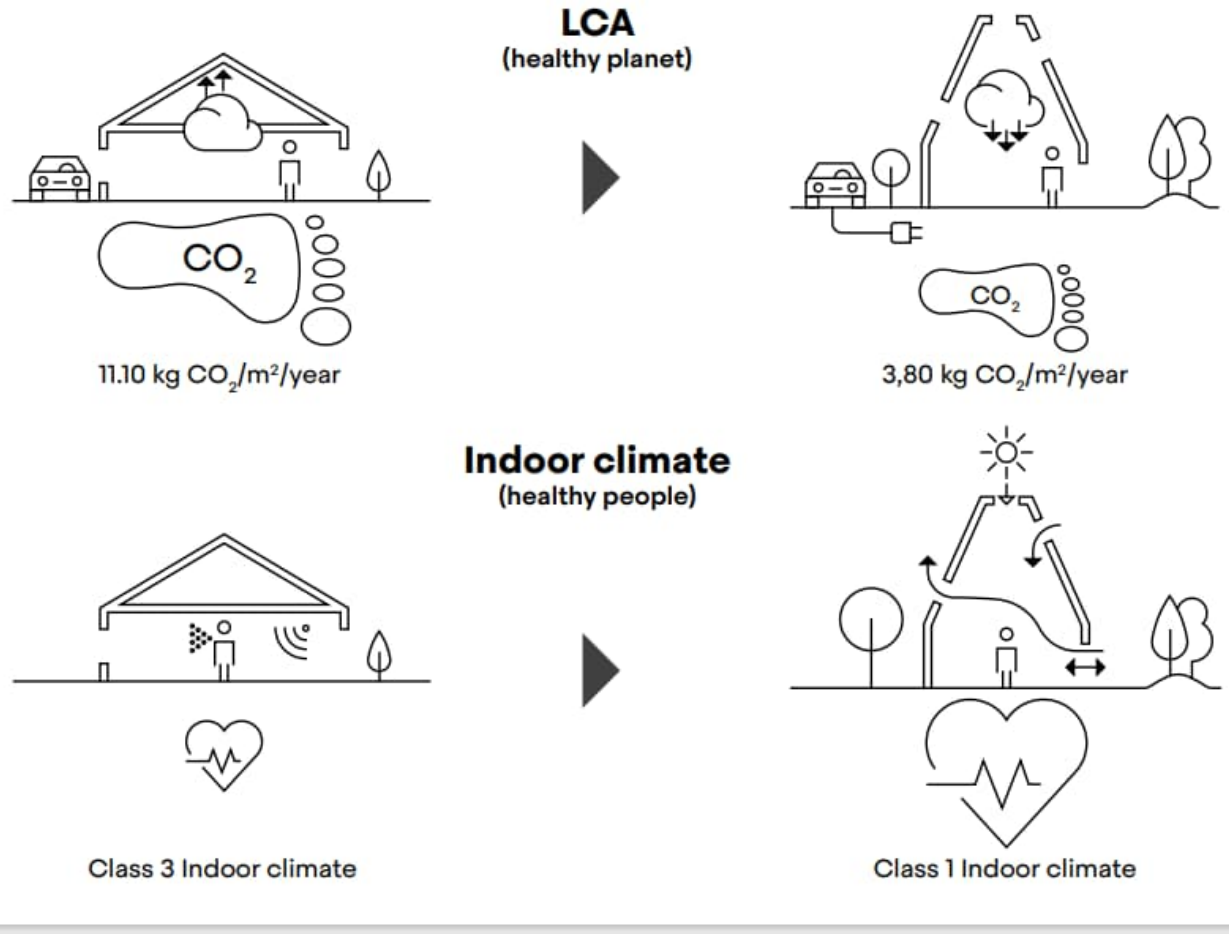
ADAPTIVE

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

SCALABLE

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

3x lower carbon footprint

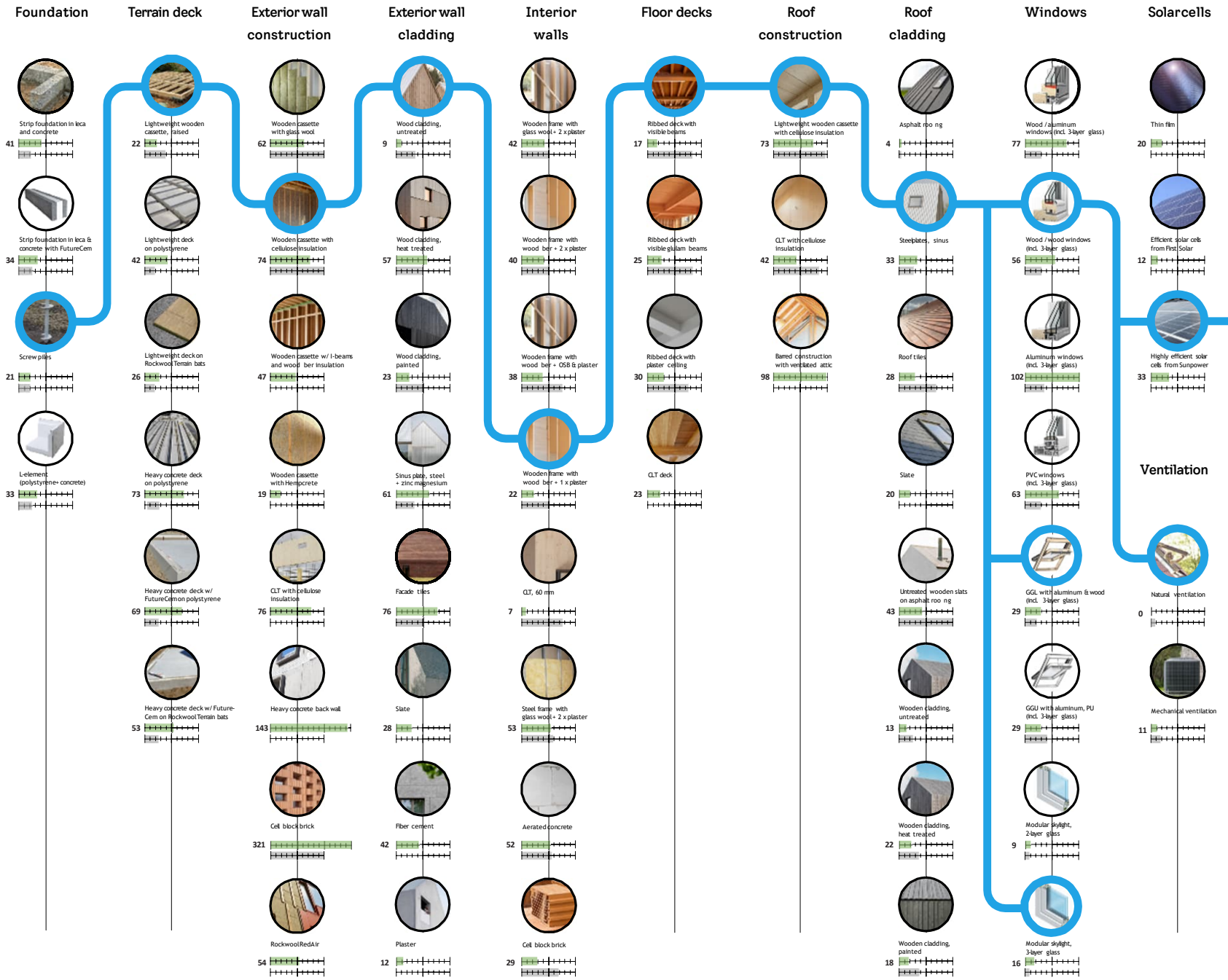


SIMPLE LCA COMPARISON TOOL TIMBER FRAME

During the investigation and development of the project, have created an LCA calculator that provides an overview of solutions and their environmental impact. The calculator simulates building performance based on material choices.

Living Places timber frame

The diagram shows the choices we have made for the timber frame building system and what the environmental impact of this home would be.



VELUX®

TIMBER FRAME STRUCTURAL SYSTEM

LCA: 3.8 kg CO_2eq/m²/y

FOUNDATION
- Screw piles

TERRAIN DECK
- Lightweight wooden cassette, raised

EXTERIOR WALL CONSTRUCTION
- Wooden cassette with cellulose insulation
- Wood cladding, untreated

INTERIOR WALLS
-Wooden frame with wood fiber + 1 x fiber gypsum or plywood per. side

FLOOR DECKS
- Ribbed deck with visible beams

ROOF
-Lightweight wooden cassette with cellulose insulation
- Steelplates, sinus

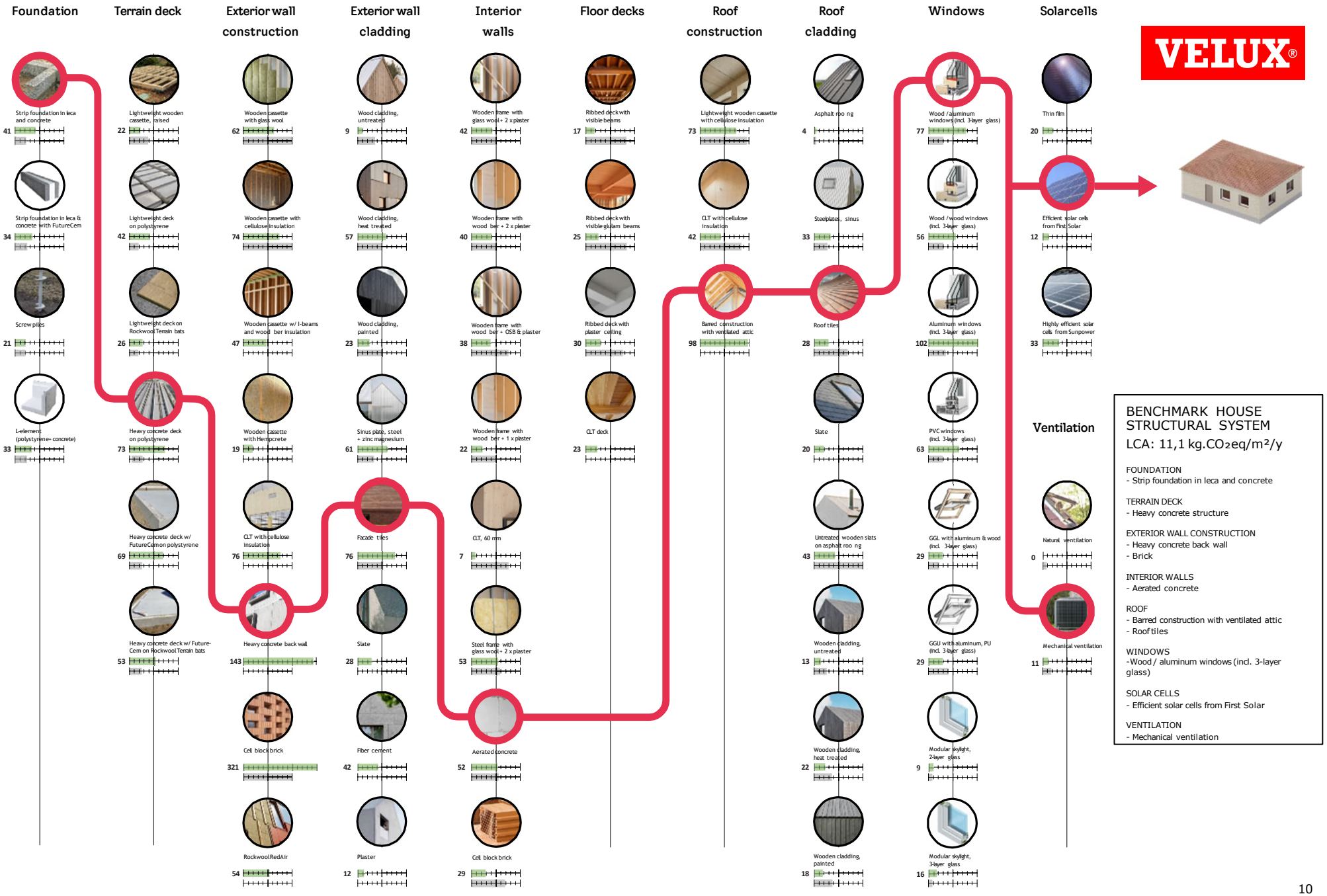
WINDOWS
- Wood / wood windows (incl. 3-layer glass)
-GGL with aluminum & wood (incl. 3-layer glass)
- Modular skylight, 3-layer pane

SOLAR CELLS
- Highly efficient solar cells from Sunpower

VENTILATION
- Natural ventilation

SIMPLE LCA COMPARISON TOOL BENCHMARK HOUSE

The diagram shows the materials used in a traditional benchmark house and what the environmental impact of this home is.



BENCHMARK HOUSE
STRUCTURAL SYSTEM
LCA: 11,1 kg.CO_2eq/m²/y

FOUNDATION
- Strip foundation in leca and concrete

TERRAIN DECK
- Heavy concrete structure

EXTERIOR WALL CONSTRUCTION
- Heavy concrete back wall
- Brick

INTERIOR WALLS
- Aerated concrete

ROOF
- Barred construction with ventilated attic
- Roof tiles

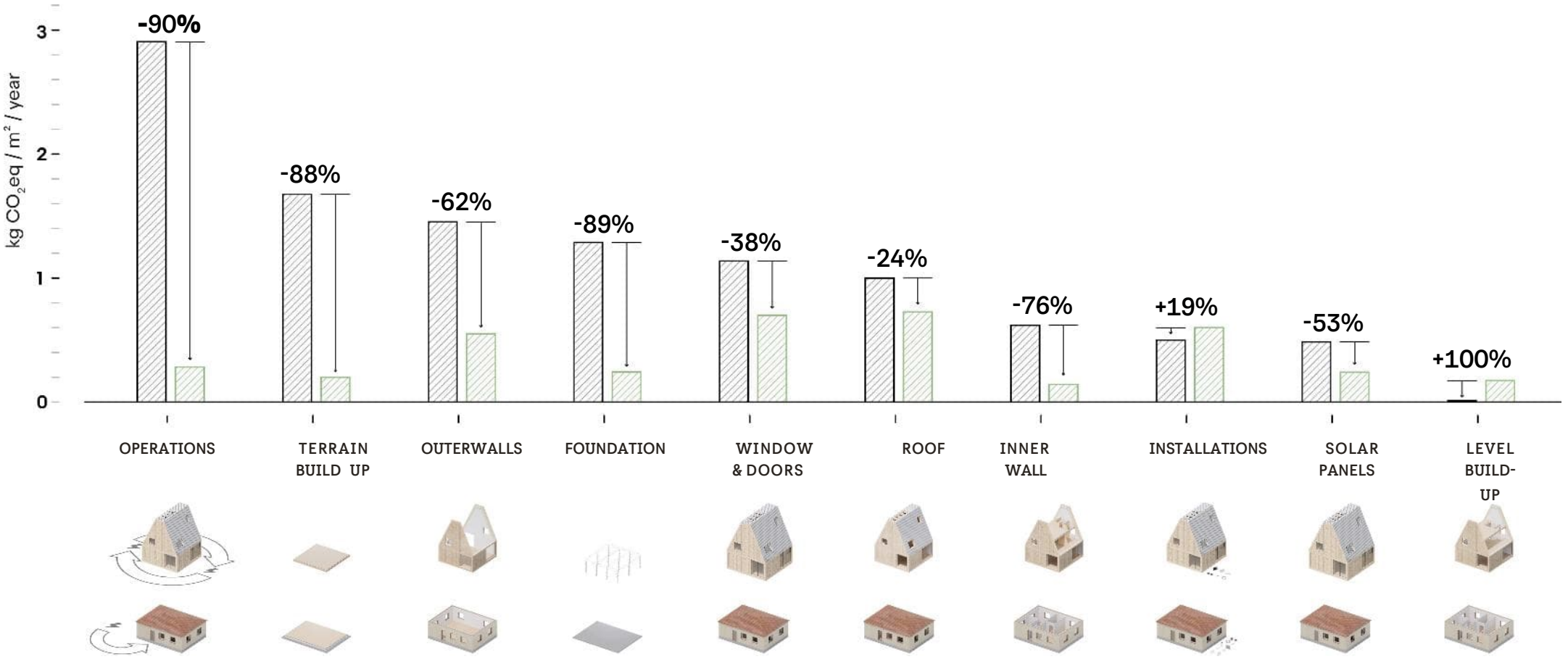
WINDOWS
-Wood / aluminum windows (incl. 3-layer glass)

SOLAR CELLS
- Efficient solar cells from First Solar

VENTILATION
- Mechanical ventilation

Optimization on each component

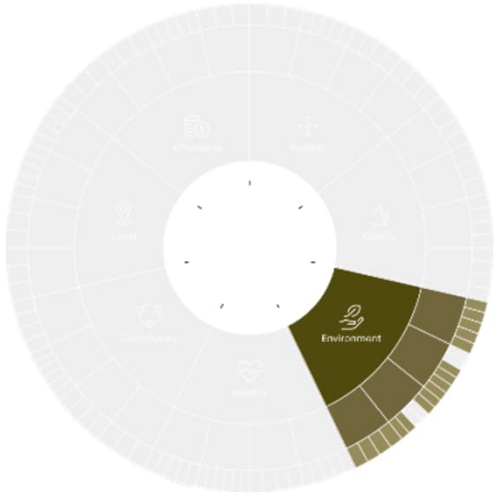
Diagram showing the comparison between each element. This shows where we get the biggest savings.



Compass model - Living Places Copenhagen designcard - Environment

VELUX®

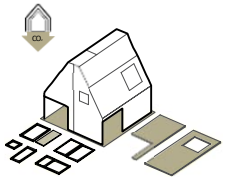
STRATEGIC DRIVERS
Define



ENVIRONMENT

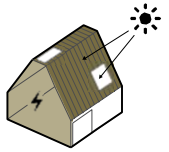
Our homes, and the way they frame our lifestyles, are designed, delivered, and maintained in respect for planetary boundaries. The footprint of a home ad- heres to best practice targets in all aspects, and must account for total service life of a building including emissions and consumption impact.

DESIGN DRIVERS
Ideate



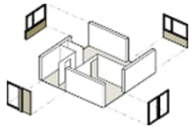
EMBODIED ENERGY

Homes are designed and built with a high level of material efficiency to minimize carbon footprint.



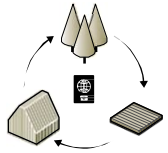
OPERATIONAL ENERGY

Best practice building principles in- crease the home's energy efficiency and resilience in the use phase.



LIFECYCLE

Homes are built for responsible dis- assembly to increase possibilities for future recycling of materials and com- ponents.



MATERIAL SOURCING

Ethical and environmental profile is improved by using components where sustainable raw materials are sourced responsibly through proper documen- tation.

PERFORMANCE DRIVERS
Implement

LOW IMPACT MATERIALS
Accounting of all the embodied carbon emissions (tCO2e) from the construction process (including energy consumed during construction).

MATERIAL EFFICIENCY
Select constructive solutions that reduce the amount of material needed.

OPTIMIZE FLOOR AREA
Multifunctional spaces and optimized floorplans with fewer "dead areas" greatly reduce the amount of materials used.

BIOBASED MATERIALS
Select natural materials wherever possible to offset the carbon footprint of the building, to increase well-being for occupants.

PREFAB CONSTRUCTION
By using prefab elements waste is reduced during construction significantly. This reduces embodied emissions and ensures re- source efficiency.

MOTION SENSORS
Motion sensors in selected indoor and outdoor areas can auto- matically turn off the light when there is no activity, thereby sav ing on electricity.

WATER-SAVING FAUCETS
Use of water-saving faucets and showers. The lower water con- sumption also results in a smaller heating consumption, as less water has to be heated.

RENEWABLE ENERGY SOURCES
Installed on the roof or in the community to provide free and renewable energy for use in the household or to operate a elec- trical appliances.

ENERGY EFFECIENT SYSTEMS
Use energy effective system like a heat pump to efficiently utilize the energy in the outdoor air to heat water for heating and domestic hot water.

ENERGY-SAVING DESIGN
Optimized orientation of windows and shading systems. Shape and location of the building. Constructive solutions.

ENERGY-SAVING APPLIANCES
Installation of efficient services (Lighting, heat pumps, extrac- tors...).

FOCUS ON REDUCING THE LCA EMISSIONS
Understanding a building's LCA allows to focus on how to reduce the emissions, and benchmark materials and systems in order to select the best option. Perform LCA including all the phases of the building.

END OF LIFE STRATEGIES
Define what strategies will be implemented at the end of use of the building for the different components and materials and take back schemes.

UTILIZE/OPTIMIZE RECYCLING POTENTIAL
Investigate the possibility of reusing or upcycling materials con- sidered "waste" that would otherwise be demolished, incinerated or sent to landfill.

MATERIALS WITH A LONG LIFESPAN
Use materials with a long lifespan to ensure an extended lifetime for the building.

IMPROVED LIFETIME OF SYSTEMS
Use technology to extend the lifetime of utilities and services if possible to reduce waste. Examples: Controlled systems, filters for soft water.

DIGITAL TWIN
Digital twin of the building to have an overview of all components and facilitate maintenance and management.

CERTIFIED MATERIALS
Prioritize the selection of materials with documented environ- mental product declaration (EPD).

LOCAL SOURCING
Set a target for the distance that material can travel until the con- struction site.

HEALTHY MATERIALS
Select materials that do not have any known adverse effects on the health of users and the natural environment.

MATERIAL PASSPORT
Securely stored, digital record of information on the material source and processes until installed in the construction site.

BUILDING PASSPORT
Securely stored, digital & up-to-date record of information on a building throughout its lifecycle.

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