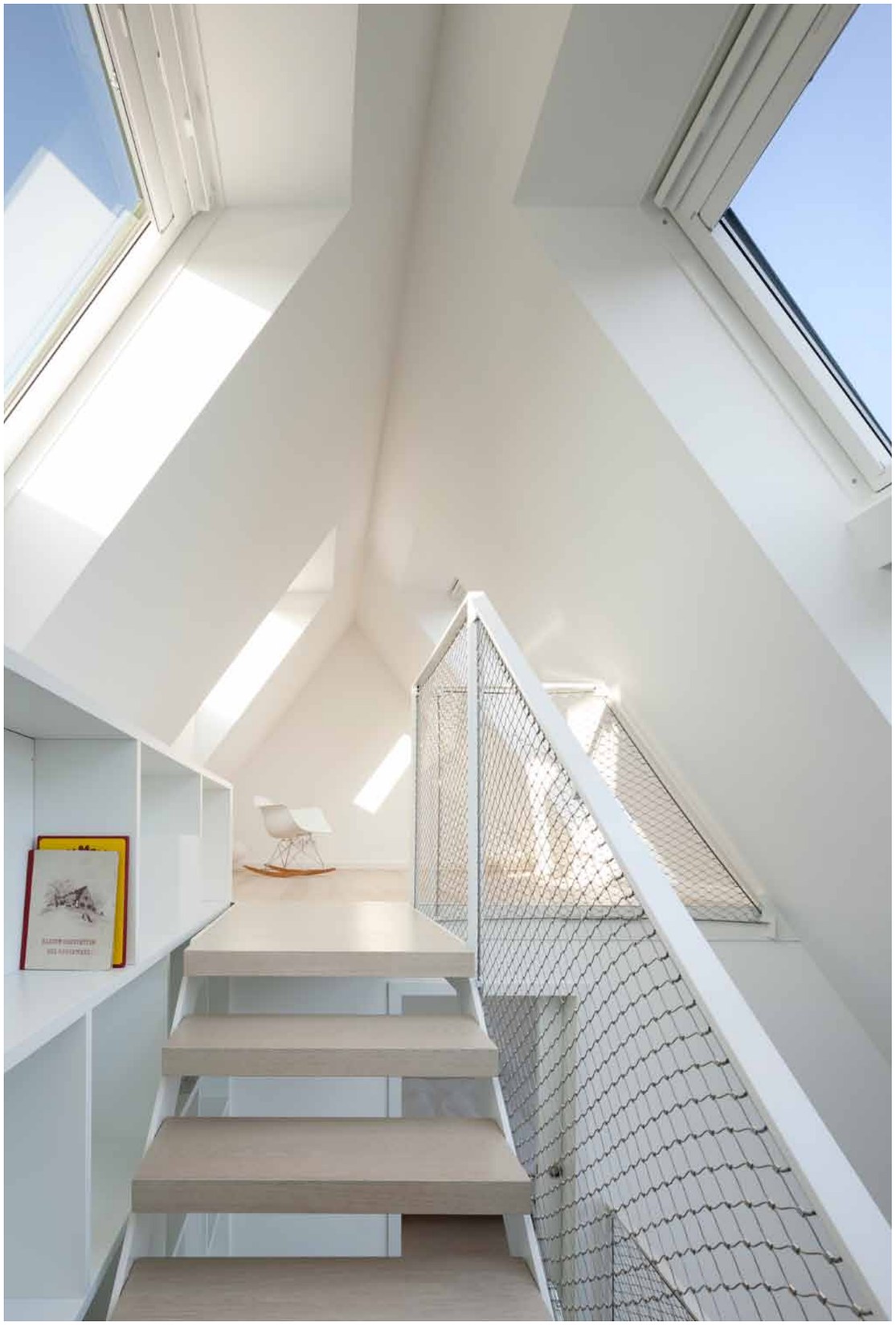
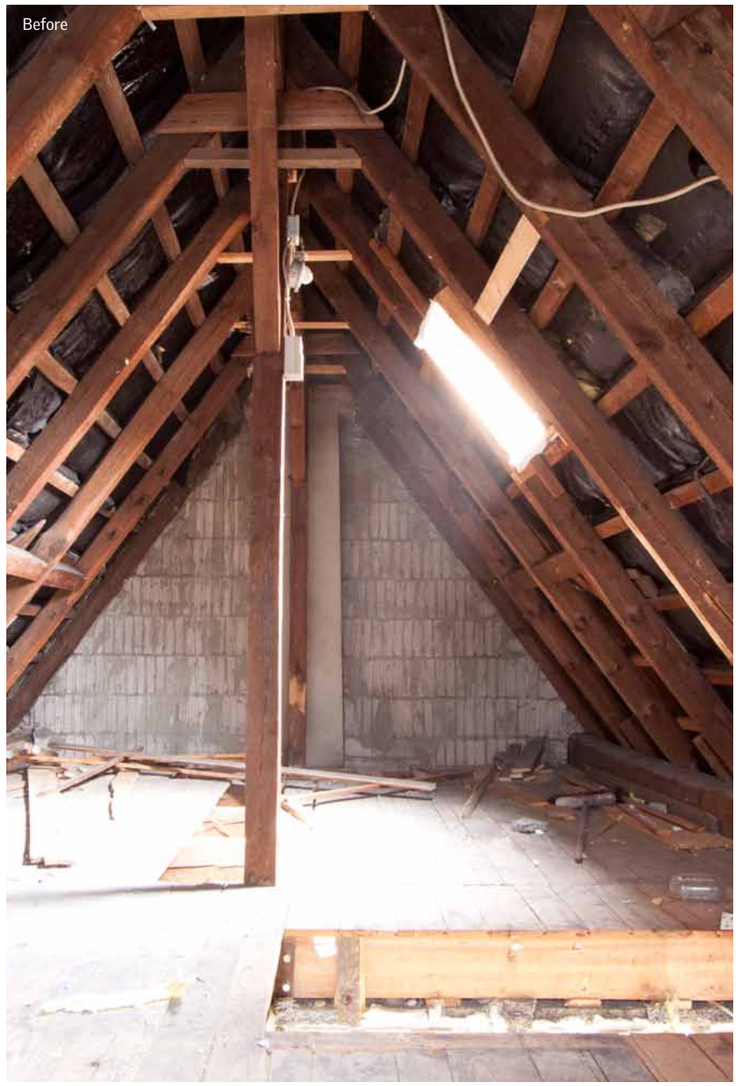
LichtAktiv Haus

VELUX®
MODEL HOME 2020





How can energy-efficient architecture and high liveability ideally be combined in modernising old houses?

LichtAktiv Haus involves the modernisation of a 1950s so-called settler house situated in the Wilhelmsburg district of Hamburg. The experiment shows how the vision of abundant natural light, fresh air and open views can be realised even in the most challenging modernisation project. The aim is to combine optimum energy efficiency and the highest standards of liveability in a home that operates on a carbon-neutral basis.

Address
Katenweg 41
21109 Hamburg
Germany

Photos of LichtAktiv Haus
Adam Mørk

Illustrations of LichtAktiv Haus
Cenario

Other photos and illustrations
The VELUX Group

IBA_HAMBURG

The LichtAktiv Haus is part of the *Internationalen Bauausstellung* IBA (International Building Exhibition) Hamburg,which deals with the challenges of the future quality of living as an urban development process.

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Modular modernisation strategy

The LichtAktiv Haus can be realised in different variants. A basic modernisation and in modules according to financial ability, energetic ambition and need for extra square metres in the extension.

Unrenovated
- Unrenovated house
- Oil heating
- Unconverted attic space
- 102 m²

Basic modernisation

- Unaltered basic structure
- Energy renovation of the exterior
- New boiler
- Thermal solar collectors
- 122 m²

The approach used for this project is a basic way to modernise an existing building without having to make major changes to the building structure, as only the facade is renovated to make the building more energy efficient. The building stock is left in its original state, receiving only a new roof with roof windows which offer adequate daylight in the upper floor. Furthermore, solar collectors are being installed on the roof. The interior of the building is organised more efficiently and provides generous space. The old extension is transformed into a kitchen and living space, creating a new entrance area as well as generous views onto the large garden.

Extended modernisation

- Altered basic structure
- New extension
- Air-water-heat pump connected to thermal solar collectors
- 148 m²

The extended modernisation goes one step further to create living space for a three- to four-person household. An extension is added, offering space for the kitchen and the dining room and a bathroom. A porch connects this part of the LichtAktiv Haus with the existing building and also serves as the main entrance. The extension consists of a timber frame construction, that allows a flexible modernisation in terms of length and its configuration depending on individual needs. The building is efficient in terms of the use of energy and space, and it opens the living area onto the garden.

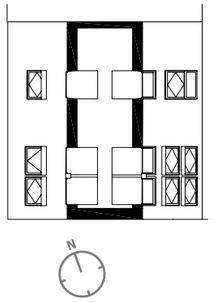
Premium modernisation

- Altered basic structure
- New extension
- Air-water-heat pump connected to thermal solar collectors
- PV solar cells
- 189 m²

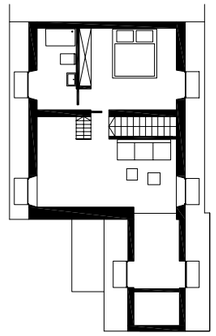
In this variant, the basic structure of the existing building is similar to that of the extended modernisation. The extension is larger with more room for the family and an utility room is incorporated. The main differences between the two variants are in the technologies incorporated and the materials used.

Basic modernisation

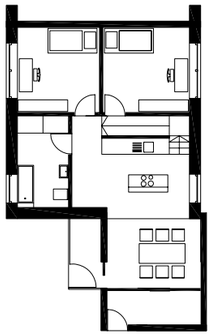
Second floor



First floor

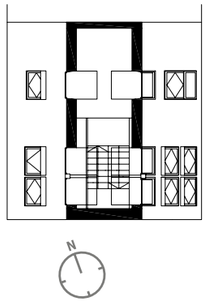


Ground floor

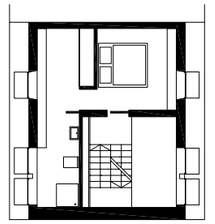


Extended modernisation

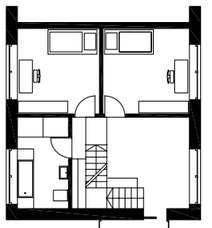
Second floor

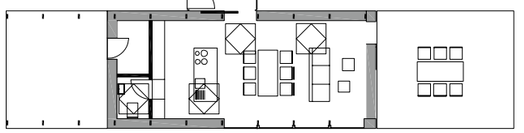


First floor



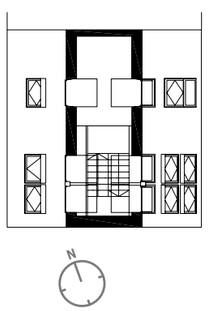
Ground floor



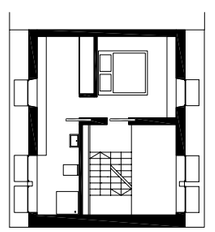


Premium modernisation

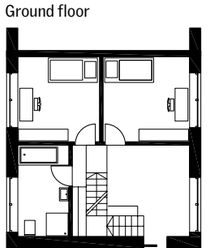
Second floor

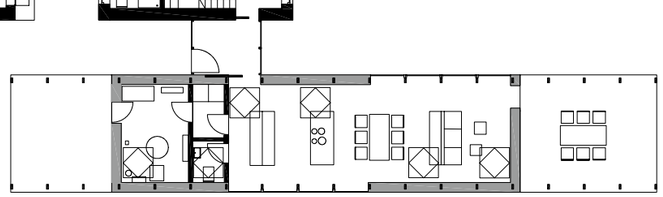


First floor



Ground floor





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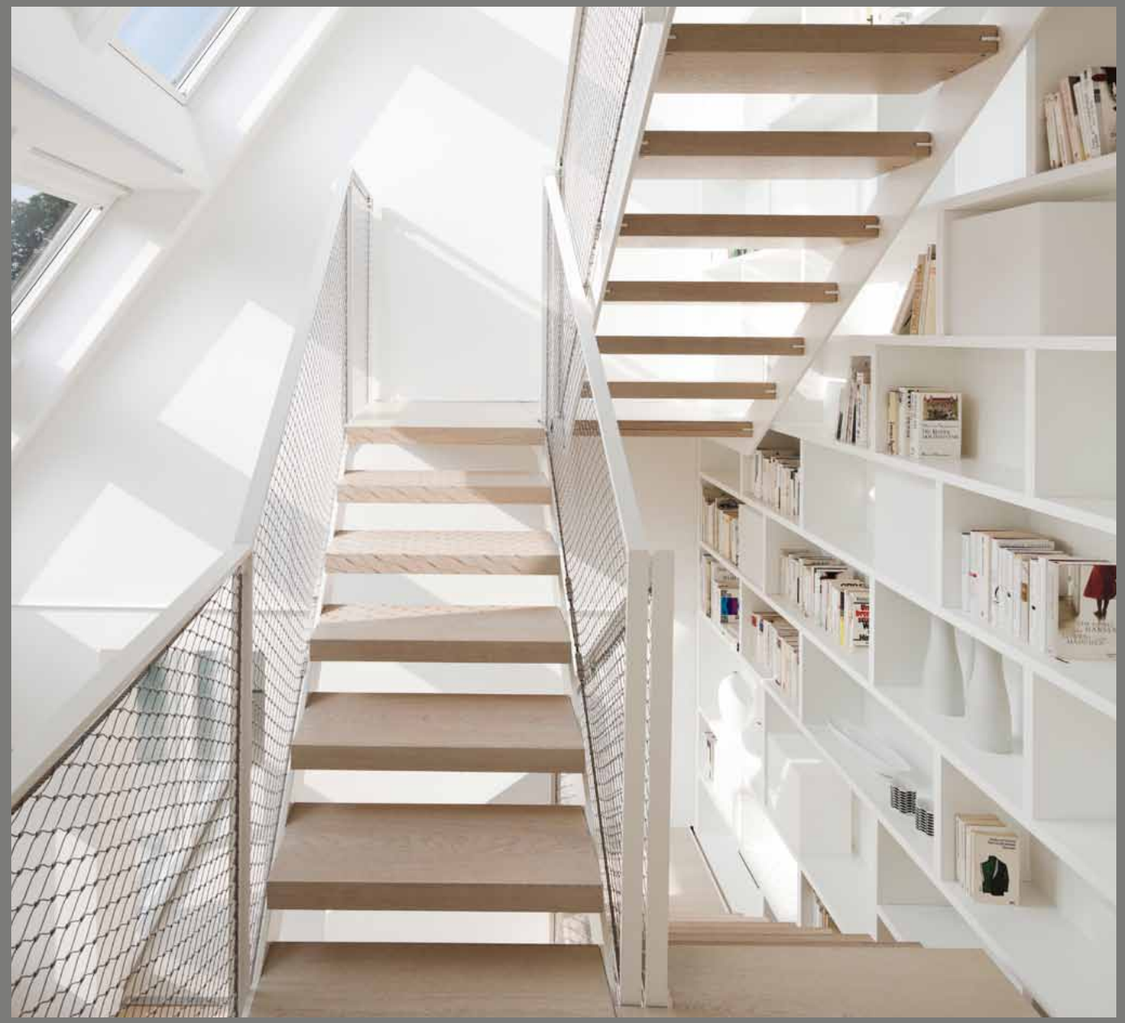
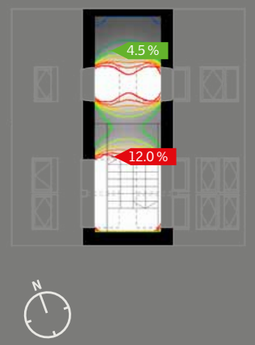


Daylight
Daylight is vital for our biological rhythm and has a positive impact on our well-being and performance. In addition, an optimised and controlled use of daylight reduces the need for artificial lighting and provides useful solar gains during the winter period. In this respect, intelligent use of daylight can significantly help to reduce a building's energy consumption.

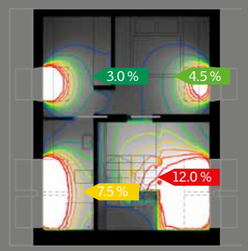
Daylighting design played a central role in the architectural concept of LichtAktiv Haus. It is based on extensive studies conducted by lighting designer and professor, Peter Andres. Daylight analyses were used in the early design phase of the project and integrated in the dynamic process of building planning. By focussing on the optimal use of daylight, living environments of high quality as well as good energy efficiency could be achieved. High amounts of daylight and generous views permit the occupants to fully experience the daily rhythms and seasonal changes of the surrounding nature.

Ventilation
Together with shutters and sun screening products the ventilation concept works as 'natural air conditioning' and ensures a pleasant indoor climate. At midday, the south-facing shutters remain closed during the warmer times of the year. On the western side, the external awnings are lowered automatically in the afternoon. As the day gets cooler, the shutters and awnings are raised again and windows open to let in the fresh evening air to cool down the living space. During the cooler times of the year, raised shutters allow additional solar energy to enter the building during the daytime. At dusk the shutters close and improve insulation.

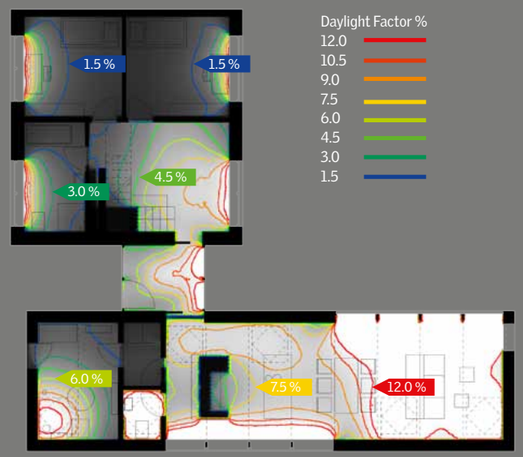
Second floor



First floor



Ground floor



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Architectural concept

What makes the conceptual design of LichtAktiv Haus so unique is an innovative modernisation strategy that combines maximum liveability with optimum energy efficiency. The once closed structure of the existing building is transformed into spacious rooms flooded with light, providing occupants with the best liveability.

In the premium version, the two children's rooms, the two bathrooms and the bedroom are located in the old house. With a so-called 'daylight lamp', the space under the roof is extended, creating a central living area and reading room which receives an optimum influx of natural light. The living environment also opens up horizontally thanks to a glass facade extending almost five metres in length and facing the garden. The window area has been increased overall from 18 m^2 in the old building to 60 m^2.

An extension is added, offering space for the living and dining room, kitchen and utility room.

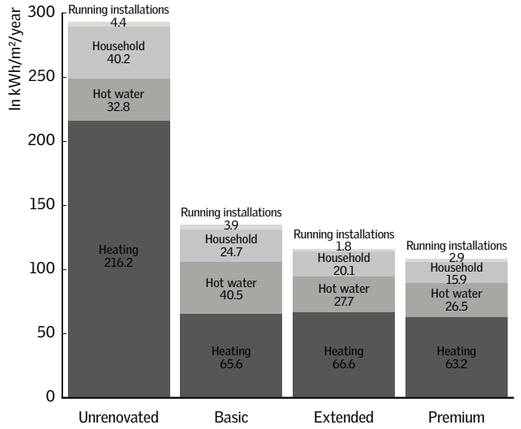
Energy concept

Future buildings should create healthier and more comfortable lives for their occupants without having a negative impact on the climate. Therefore, LichtAktiv Haus aims to cover its entire energy demand, including household electricity, by using renewable energy – without losing any of its high living value such as daylight and fresh air. This is a particular challenge, since the precondition for achieving this goal is a low total energy demand – which is usually considerably higher in old building stock. The conceptual design picks up on the 'settler spirit'. The original idea of the settlement was to achieve self-sufficiency for the occupants in terms of food. The new goal is now self-sufficiency in terms of energy.

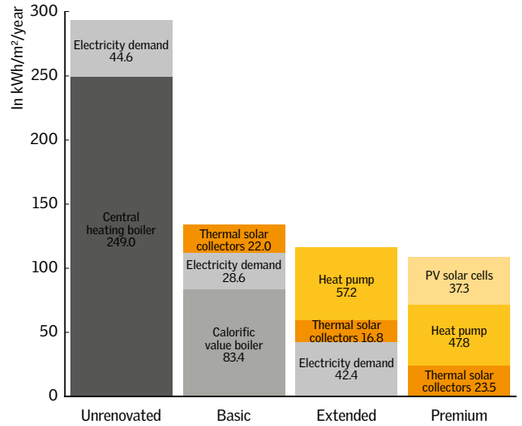
In the premium version, LichtAktiv Haus can achieve carbon neutrality when it is in operation. Yet this is a more striking fact, considering it does not have access to heat recovery systems or a mechanical air conditioner since a post installation during modernisation would be too complex in most cases. Automatic roof windows guarantee a minimum air change required for air tight buildings due to energy efficiency reasons. This automatically controlled natural ventilation is a very good alternative in a modernisation project, since no ventilation shafts need to be installed.

The residual energy needed for household electricity, the compressor of the heat pump and the electricity for the auxiliary power is only one-third of the total energy demand. The amount of energy gains achieved by photovoltaic elements and the energy demands for residual energy are equal, so that carbon emissions are compensated by renewable resources. Polycrystalline photovoltaic modules are coloured grey for aesthetic purposes since grey blends in fine with the overall architectonic concept.

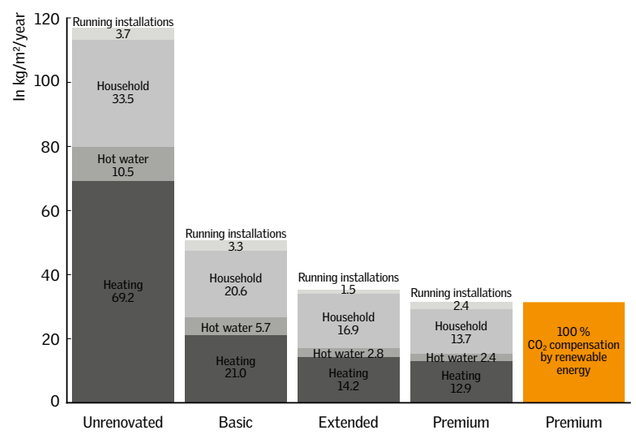
Overall energy requirement



Distribution of energy sources



CO_2 emissions



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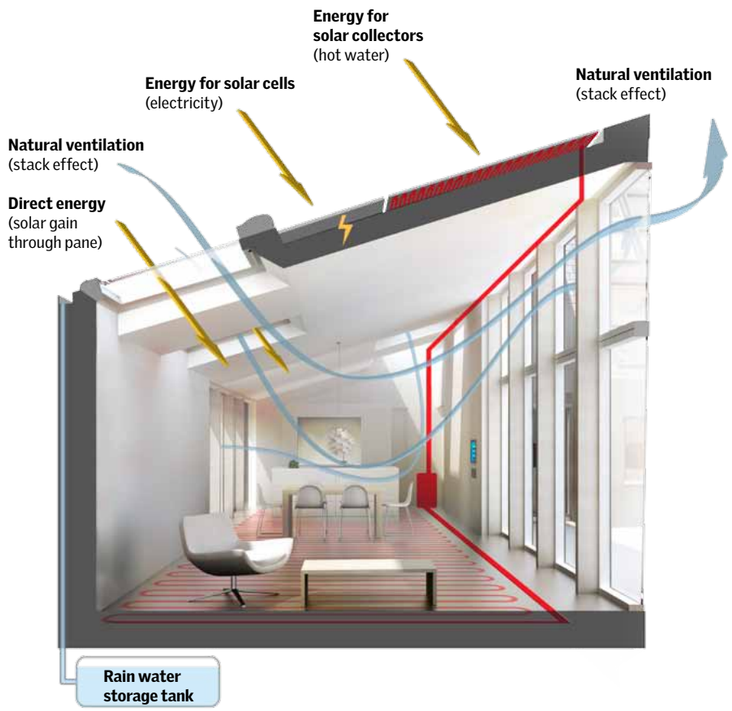
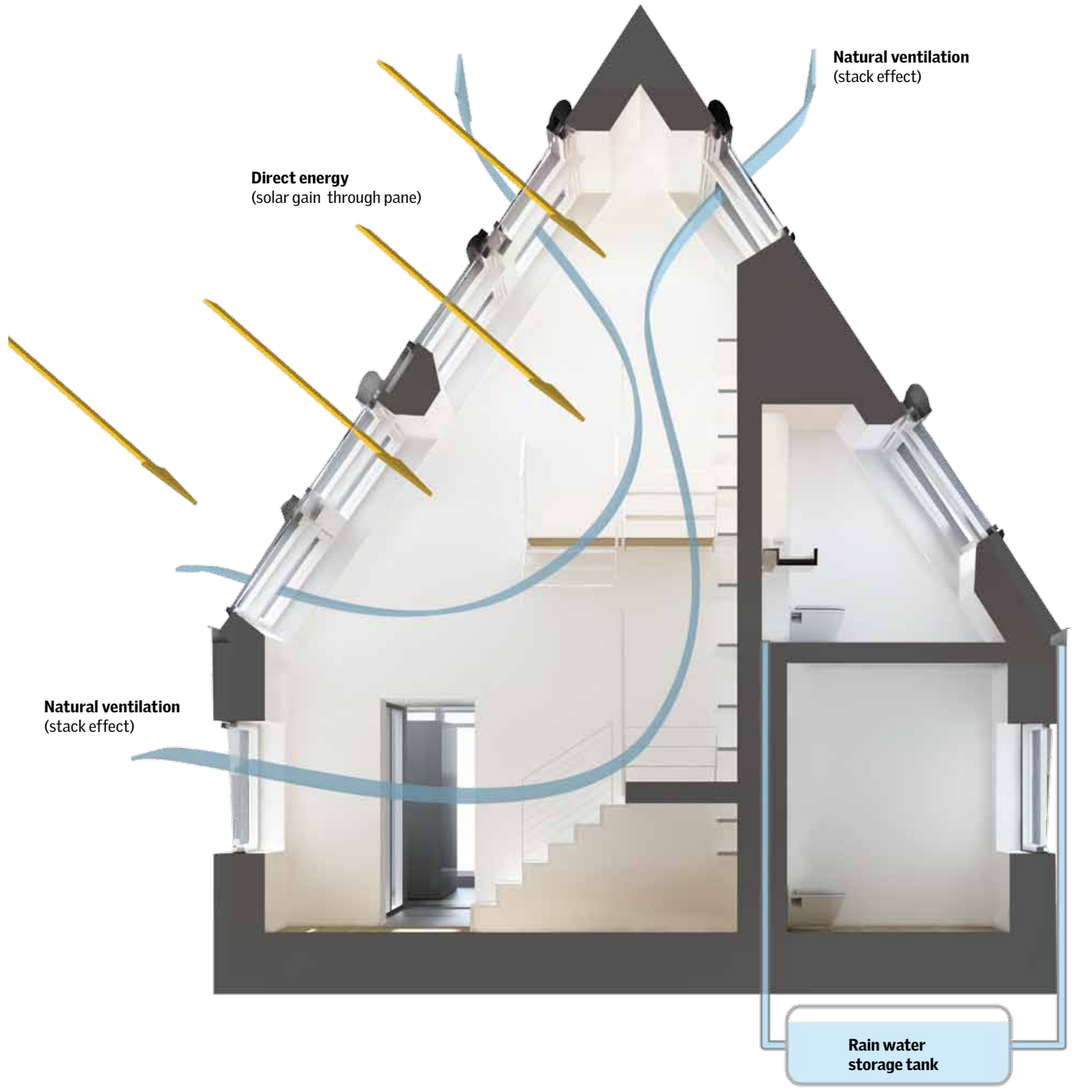
Energy concept

In the case of the VELUX experiment, a control system automatically opens and closes the windows, depending on temperature, CO_2 concentration and humidity – thus creating a comfortable and healthy indoor climate. To change air, the forces of nature are being used. The wind pressure on the building and the difference in temperature between inside and outside ensure ventilation when the windows are open. The supply of fresh air is most effective when several facade and roof windows are opened at the same time. The varying installation heights of the windows increase the effect of the temperature difference and the so-called chimney effect comes into play. It utilises the fact that warm, stale air rises.

The used air escapes through the roof window, while cooler, fresher air is automatically taken in at the bottom.

An air-water-heat pump and a solar thermal system create an innovative complete solution. The heat pump covers the larger part of the energy demand for heating and warm water. The unique feature of this system is that the solar thermal collectors are an integral part of the heat pump and provide heat all year round – not only for hot water but also for heating the building. The highly efficient technology minimises the need for conventional energy. Therefore, the system contributes to reducing greenhouse gas emissions.





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Products

Attic

1 light band with double-glazed, top-hung, polyurethane roof window 114 × 140 cm (GPU S08 0059) and vertical window element 114 × 92 cm (GIU S34 0073) + installation set and flashing EDW/ETW
1 electrically operated roller shutter (SMG S08)
2 manually operated pleated blinds (FHL S04 + FHL S08)
1 double-glazed, centre-pivot, polyurethane roof window 114 × 118 cm with solar window operator (GGU S06 006030) + installation set and flashing EDW
1 solar awning blind (MSL S06 5060)
1 manually operated pleated blind (FHC)

Daylight lamp

10 double-glazed, centre-pivot, polyurethane roof windows 114 × 118 cm (GGU S06 005930) with solar window operator + installation set, combi flashing EKW and support rafter EKY
10 solar awning blinds (MSL S06 5060)
10 solar roller blinds (RSL S06)

Thermal solar energy

9 solar collectors 134 × 180 cm (CLI U12) with flextubes

Dining/living room

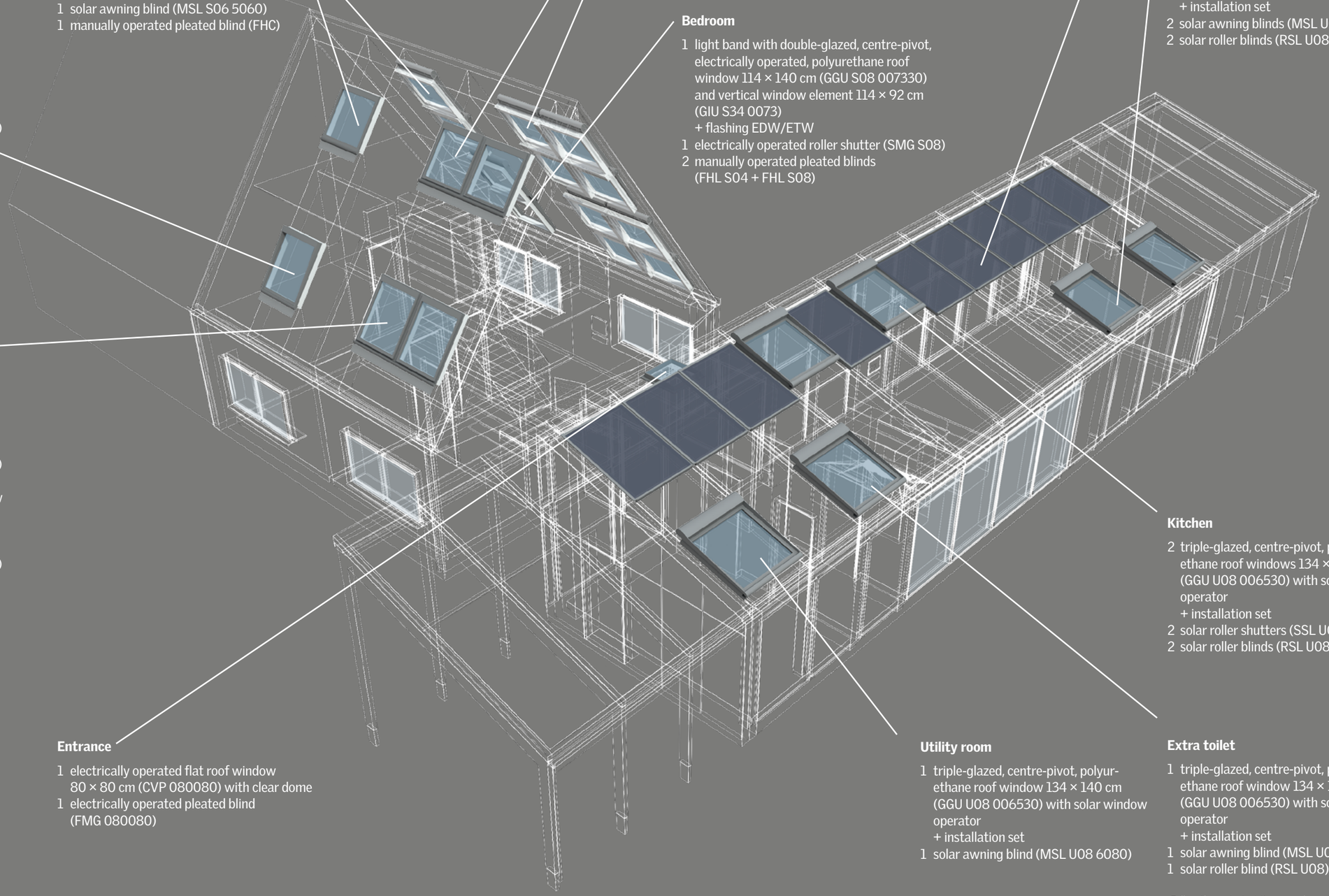
2 triple-glazed, centre-pivot, polyurethane roof windows 134 × 140 cm (GGU U08 006530) with solar window operator + installation set
2 solar awning blinds (MSL U08 6080)
2 solar roller blinds (RSL U08)

Dressing room

1 double-glazed, centre-pivot, polyurethane roof window 114 × 140 cm with solar window operator (GGU S08 006030) + installation set and flashing EDW
1 solar awning blind (MSL S08 5060)
1 electrically operated Venetian blind (PML S08)

Bedroom

1 light band with double-glazed, centre-pivot, electrically operated, polyurethane roof window 114 × 140 cm (GGU S08 007330) and vertical window element 114 × 92 cm (GIU S34 0073) + flashing EDW/ETW
1 electrically operated roller shutter (SMG S08)
2 manually operated pleated blinds (FHL S04 + FHL S08)



Bathroom

1 double-glazed, top-hung, polyurethane finish roof window (rescue opening) 114 × 140 cm (GTU S08 0060) + installation set and combi flashing EKW
1 solar awning blind (MSL S08 5060)
1 electrically operated Venetian blind (PML S08)
1 double-glazed, centre-pivot, polyurethane roof window 114 × 140 cm with solar window operator (GGU S08 006030) + installation set and flashing EDW
1 solar awning blind (MSL S08 5060)
1 electrically operated Venetian blind (PML S08)

Kitchen

2 triple-glazed, centre-pivot, polyurethane roof windows 134 × 140 cm (GGU U08 006530) with solar window operator + installation set
2 solar roller shutters (SSL U08)
2 solar roller blinds (RSL U08)

Entrance

1 electrically operated flat roof window 80 × 80 cm (CVP 080080) with clear dome
1 electrically operated pleated blind (FMG 080080)

Utility room

1 triple-glazed, centre-pivot, polyurethane roof window 134 × 140 cm (GGU U08 006530) with solar window operator + installation set
1 solar awning blind (MSL U08 6080)

Extra toilet

1 triple-glazed, centre-pivot, polyurethane roof window 134 × 140 cm (GGU U08 006530) with solar window operator + installation set
1 solar awning blind (MSL U08 6080)
1 solar roller blind (RSL U08)

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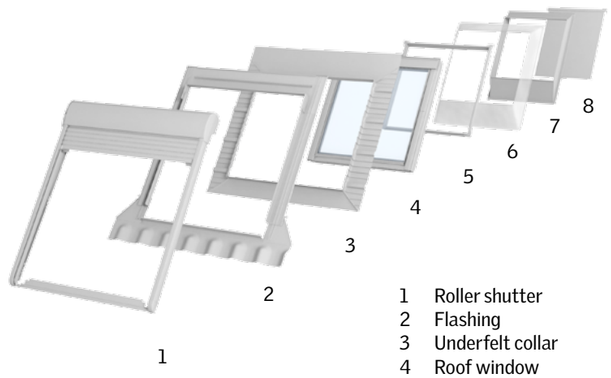

1 Roller shutter
2 Flashing
3 Underfelt collar
4 Roof window
5 Insulation collar
6 Vapour barrier
7 Lining
8 Interior sunscreening

Figures
The chart shows the technical characteristics of the VELUX roof windows in relation to heat loss, passive heat gain and daylight. The heat loss (U_w) of the roof windows is influenced by the roof pitch. The heat gain (g-value) and light transmittance (Tau) are not affected by the orientation or roof pitch.

Roof windows with pane --65

Roof pitch	90°	30° (South)	45° (North)
U_w (Heat loss U-value window)	1.0 W/m²K	1.1 W/m²K	1.1 W/m²K
U_g (Heat loss U-value pane)	0.5 W/m²K	0.7 W/m²K	0.6 W/m²K
g (Heat gain g-value)	0.46	0.46	0.46
Tau (Light transmittance)	0.67	0.67	0.67

Outer walls	**Renovated house**	**Unrenovated house**
U (Heat loss U-value)	0.14 W/m²K (310 mm insulation)	0.48 W/m²K (80 mm insulation)
Roof		
U (Heat loss U-value)	0.14 W/m²K (300 mm insulation)	0.55 W/m²K (100 mm insulation)
Floor slab		
U (Heat loss U-value)	0.21 W/m²K (280 mm insulation)	0.9 W/m²K (30 mm insulation)

Fenestration	
Glass area	107 m²
Floor area	185 m²

The glass area is equivalent to 58 % of the floor area.

Project partners

TECHNISCHE UNIVERSITÄT DARMSTADT

IBA_HAMBURG
Projekte für die Zukunft der Metropole

VERBAND WOHNEIGENTUM

Group partners

VELFAC

Window Master

forever clever SONNENKRAFT

Product partners

KERAMAG

KNAUF INSULATION

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Eternit

KNAUF

GROHE ENJOY WATER

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