

VELUX®
MODEL HOME 2020



Buildings of the future
from 2009 to 2011



Today's challenges in buildings:
In the EU today, we spend **90%** of our time indoors,
in buildings that consume over **40%** of the total energy
consumption. Up to **30%** of the building stock does not
contribute to nor provide a healthy indoor climate.

Looking into a future perspective of how we construct
and renovate buildings, it is necessary to consider climate
changes, resource supply and human health.

Renderings of Home for Life:

aart

Photos of Home for Life:

Adam Mørk and Martin Dyrlov

Renderings of Green Lighthouse:

Christensen & Co Architects

Photos of Green Lighthouse:

Adam Mørk

Renderings of Sunlighthouse:

HEIN-TROY Architekten

Photos of Sunlighthouse:

Adam Mørk

Renderings of LichtAktiv Haus:

Cenario

Photos of LichtAktiv Haus:

Adam Mørk

Renderings of CarbonLight Homes:

HTA Architects

Renderings of Maison Air et Lumière:

Cenario

Other photos:

The VELUX Group

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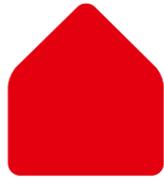
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Atika
Completed in 2006



Model Home 2020
Six projects under development
2009-11



VELUX House
Completed in 2009
for COP15 in Copenhagen



Future experiments



SOLTAG
Completed in 2005

Background

Since 1941, the VELUX Group has been working to improve living conditions and manmade environments. With the invention of the VELUX roof window, it became possible to convert otherwise uninhabitable attics into comfortable and attractive living space in millions of homes around the world. Today, VELUX roof windows are part of an entire system that provides people with daylight, fresh air and outlook. The underlying principle of the VELUX range of products is to transform homes into self-sufficient organisms that let daylight, sun and natural air flow inside, harnessing and controlling them to create the indoor comfort and energy conditions necessary for better living.

Situation today

The future of construction is facing serious challenges – resource supply, energy efficiency and unhealthy buildings to name but three. The real challenge facing us is essentially a dual challenge – energy and liveability.

The EU has adopted a comprehensive package for European energy policy up to 2020. It entails that EU member states are to reduce their total energy consumption and CO₂ emissions by 20 %. Moreover, all EU member states must document that 20 % of their total energy consumption comes from renewable energy sources.

The solution

In order to find solutions to the challenges of climate change and liveability, we need to examine a future model that addresses them as a holistic solution.

The ultimate objective of future construction is three-fold. It should ensure that the energy consumed in the construction and subsequent use of a building is taken into account in the design phase; it should employ modern technology and visionary

design to create an efficient building envelope without compromising the highest standards of comfort and health; and it should have the lowest possible impact on the climate by using renewable energy sources and adopting the concept of climate payback.

The VELUX Group is working hard today on the solutions of tomorrow by promoting architecture that enhances our quality of life and the sustainable development of society. The VELUX Group has already developed CO₂-neutral solutions – the SOLTAG demo house for markets in Northern Europe and the Atika concept house for the Mediterranean countries.

We wish to contribute to setting the agenda for a new generation of energy-efficient housing that does not compromise people's living comfort, but ensures a healthy indoor climate with plenty of fresh air and daylight while also ensuring architectural quality.

Part of this strategy is the project Model Home 2020 – our vision for how we should construct future buildings.

Sustainable Living

We relate sustainability to buildings and we have defined our conceptual thinking in this large and globally relevant issue as Sustainable Living. It is based on:

- Maximised energy efficiency and minimised CO₂ emissions
- Visionary architecture combined with improved health, well-being and comfort for people
- Renewable energy sources, with focus on thermal solar energy

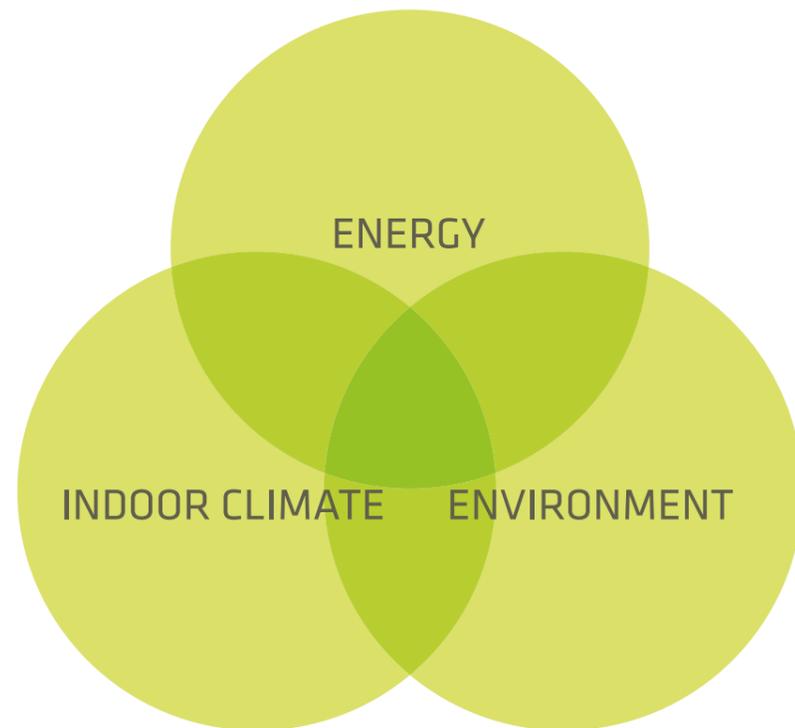
Vision

Active House is a vision of buildings that create healthier and more comfortable lives for their occupants without impacting negatively on the climate – moving us towards a cleaner, healthier and safer world.

The Active House vision defines highly ambitious long term goals for the future building stock. The purpose of the vision is to unite interested parties based on a balanced and holistic approach to building design and performance, and to facilitate cooperation on e.g. building projects,

product development, research initiatives and performance targets that can move us further towards the vision.

Active House proposes a target framework for how to design and renovate buildings that contribute positively to human health and wellbeing by focusing on the indoor and outdoor environment and the use of renewable energy. An Active House is evaluated on the basis of the interaction between energy consumption, indoor climate conditions and impact on the external environment.



Energy – Contributes positively to the energy balance of the building

An Active House is energy efficient and all energy needed is supplied by renewable energy sources integrated in the building or from the nearby collective energy system and electricity grid.

Indoor Climate – Creates a healthier and more comfortable life

An Active House creates healthier and more comfortable indoor conditions for the occupants and the building ensures generous supply of daylight and fresh air. Materials used have a positive impact on comfort and indoor climate.

Environment – Has a positive impact on the environment

An Active House interacts positively with the environment by means of an optimised relationship with the local context, focused use of resources, and on its overall environmental impact throughout its life cycle.

Key principles of Active House

An important aspect of the Active House concept is that of 'integration'. Although Energy, Indoor climate and Environment are essential components of the vision, it is the way their integration promotes architectural quality, human health, comfort and well-being which represents the value of the building.



Energy

- A building which is energy efficient and easy to operate
- A building which substantially exceeds the statutory minimum in terms of energy efficiency
- A building which exploits a variety of energy sources integrated in the overall design



Indoor climate

- An indoor climate that promotes health, comfort and sense of well-being
- A building which ensures good indoor air quality, adequate thermal climate and appropriate visual and acoustical comfort
- An indoor climate which is easy for occupants to control and at the same time encourages responsible environmental behavior



Environment

- A building which exerts the minimum impact on environmental and cultural resources
- A building which avoids ecological damage and seeks to add to local biodiversity
- A building which is constructed of materials which have high recycled content and which provides the ability for its own recycling or re-use

Integration of the three main principles of energy, indoor climate and environment

- A building which integrates the demands of comfort, climate, energy, environment and ecology into an attractive whole
- A building where such integration adds to architectural quality and human wellbeing
- A building whose interactive systems and spaces add to human enjoyment and support environmentally responsive family life

Active House is an initiative supported by the VELUX Group

MODEL HOME 2020

The VELUX Group has launched the project Model Home 2020. It is our vision for climate-neutral buildings with a high level of liveability. This is part of a VELUX strategy to take an active part in developing sustainable buildings – the buildings of the future. The vision and principles behind Model Home 2020 need to be developed and tested; so from 2009 to 2011, we will build six full-scale experimental demo-houses which will be placed at six different locations in five countries.

The houses in Denmark (Copenhagen and Aarhus) were built in 2009, the ones in Germany and Austria opened in 2010 and those in the UK and France will follow in 2011. The two experiments in Denmark were built as a partnership between the VELUX Group and VELFAC. Each of the six houses will also involve a number of local and regional partners, suppliers, architects, engineers and researchers.

They will all reflect and respond to three main principles – efficient energy design, high degree of liveability and minimum climate impact – as well as the different climatic, cultural and architectural conditions of the countries in which they are built.

Our philosophy is that one experiment is better than a thousand expert views.

Testing and monitoring

The testing and monitoring of the Model Home 2020 experiments will be part of an overall initiative where each of the experiments around Europe will provide data to be collated, reviewed and reported.

The houses will be open to the public for 6-12 months after completion, after which there will follow a 12 month period with test families in residence. After that the houses will be sold below the market price.

In return, we will continue to monitor the experiments with the new residents in order to learn how the buildings perform in real life conditions.



“You never change things by fighting the existing reality. To change something, build a new model that makes the existing model obsolete.”

Buckminster Fuller

“We take responsibility in accordance with our goal to be a model of good behaviour and to be useful to society – and because our business depends on our products being used when the low-energy buildings of the future are built.”

Jørgen Tang-Jensen, CEO, The VELUX Group

Daylight, energy and indoor climate

The benefits of VELUX products today are more important than ever before. Daylight and fresh air have been at the core of our business since the company started in 1942. By bringing daylight and fresh air into people’s homes, the VELUX Group has contributed to improving the well-being of the people living in them. Buildings should be designed to ensure thermal and visual comfort as well as the quality of the breathable air inside them. Building design must be a balance between good energy performance and good indoor climate conditions. For a number of years, we have dedicated considerable resources to building unique skills and acquiring documentation of the effects of our products in the fields of energy efficiency, indoor climate and the benefits of daylight.

Climate change

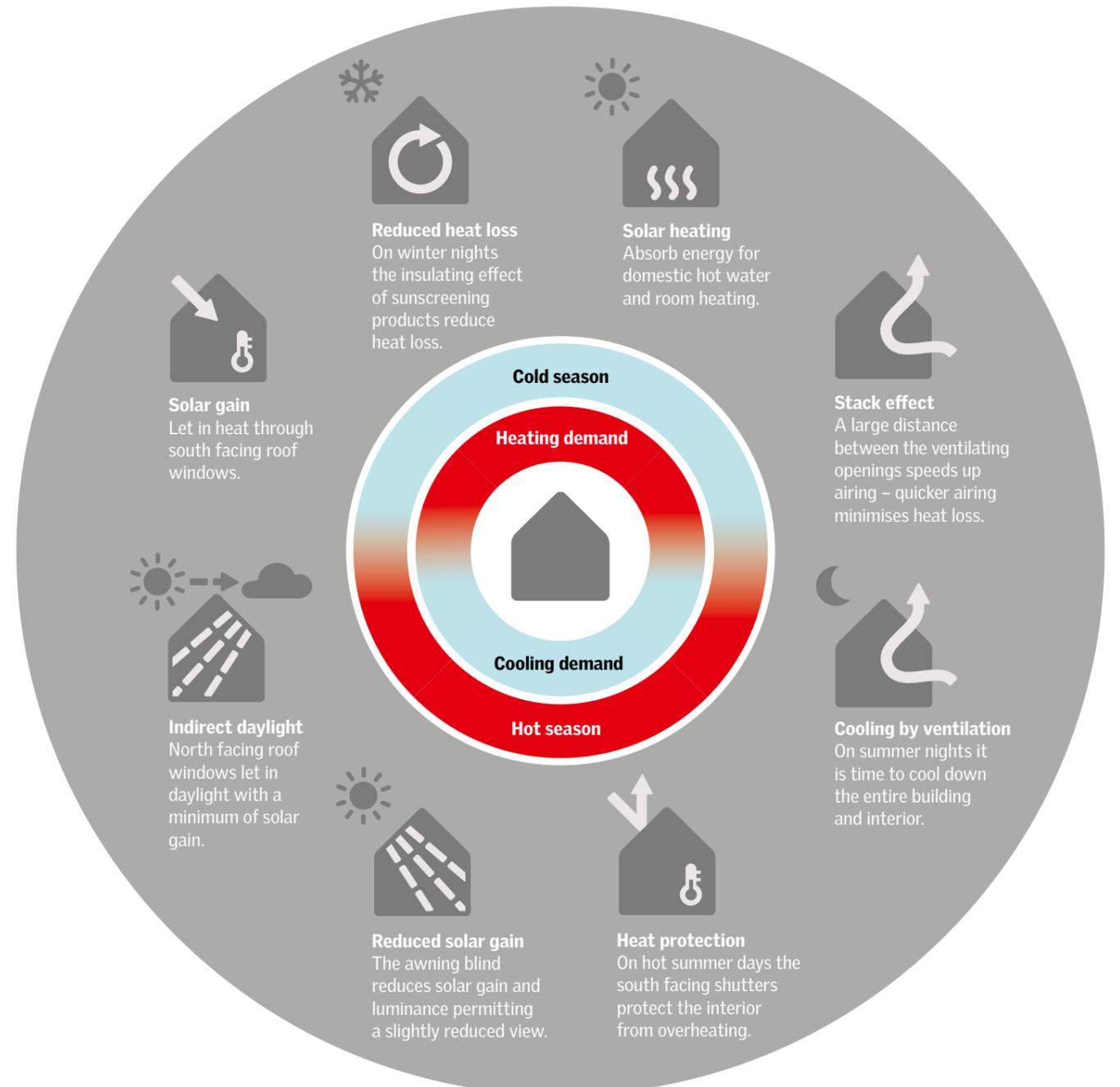
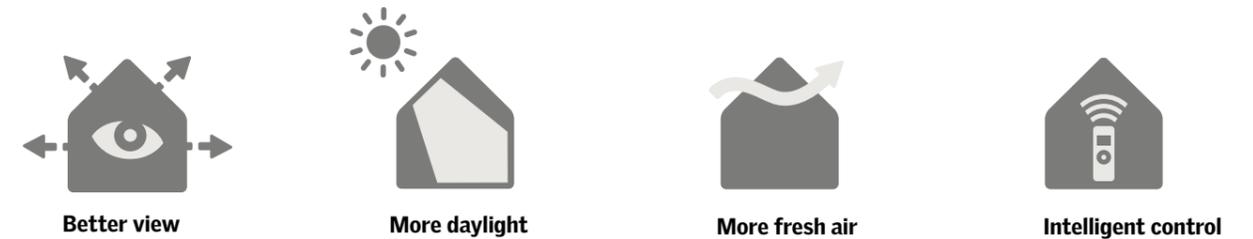
Climate change is an equally important item on the agenda. The VELUX Group works to supply products that help reduce CO₂ emissions from buildings without compromising on the highest standards of daylight and indoor comfort. With our products and the way they are used, we wish to contribute to more sustainable buildings. We are intensifying our own efforts to reduce global CO₂ by making considerable investments and setting ambitious goals. The strategy is two-fold: reduction of our own environmental impact and environmentally beneficial improvements in the use of the company’s products. We go to great lengths to reduce the environmental impact of the production, use and disposal of our products. We have a responsibility to contribute to alleviating global climate problems, and reducing the climate impact of our operations and our products is an important part of that responsibility.

Product categories

In the Model Home 2020 experiments, five main product categories will be incorporated. They can stand alone or be combined in many different ways, as in Model Home 2020. The five categories have a decisive influence on the energy balance of the house:

- **Roof windows** – a wide range of various roof windows to match any need
- **Blinds and shutters** – that control daylight and heat with functional, decorative and easy-to-install window accessories that allow for individual needs and preferences
- **Solar energy systems** – that supply hot water and room heating and have been designed to optimise effectiveness, aesthetics and convenience
- **Installation products** – that ensure a tight seal between window and roof construction
- **Home automation** – electrically operated windows, blinds and shutters bring intelligent technology (io-homecontrol®) that optimise comfort.

Energy demands in synergy with liveability



VELUX roof windows



VELUX roof windows are well-known for bringing fresh air and daylight indoors. They have minimum environmental impact and harness the unlimited supply of free natural energy. Depending on their size, they provide larger amounts of daylight and passive solar gains than facade windows, thus reducing the need for electrical light and heating. Because of their strategic location in the sloping roof, VELUX roof windows are highly energy-efficient light sources.

We offer three categories of roof windows: solar powered, electrical (wired) and manual.

VELUX solar products comprise a range of windows, sunscreening accessories and internal blinds that are supplied with energy from the sun by integrated photovoltaic arrays. So they take no electricity from the grid whether in standby mode or in operation.

All VELUX roof windows have highly efficient, gas-filled, coated glazing units that minimise heat loss.

VELUX roof windows have a long life span – up to forty years. Most of the timber used in making them comes from sustainable PEFC- or FSC-certified forestry. The glass and aluminium used in the windows can be recycled.

VELUX roof windows improve the indoor climate by supplying generous amounts of daylight. As they are located at the top of the building, they also provide efficient ventilation and fresh air to the occupiers. They help regulate the temperature and ensure efficient cooling of the building at night. The electrically operated models maximise all the advantages of the manual models.

The electrical product line allows all roof windows and suncreening products in people's homes to be controlled with a single remote control. Windows, blinds and roller shutters can even be programmed to 'think' for themselves, making sure that the home is filled with clean, fresh air whenever wanted.

The intelligent control will even open and close windows at pre-set times and dates, and at programmed intervals. The exact settings of all windows, blinds and roller shutters in the home are monitored and controlled to create the ambience the user wants. A built-in rain sensor ensures that windows are closed immediately at the first drop of rain. Converting existing manually-operated roof windows to fully-functional electrically operated windows is a simple procedure for professionals as well as house owners.

The programming of the electrically operated windows or sunscreening products can even be performed by the house owner, depending on practical needs and seasonal considerations.

All VELUX electrical products are compatible with io-homecontrol® technology, a wireless communication protocol that enables interaction between products from different manufacturers. io-homecontrol is noted for its high level of security, equivalent to that of secured Internet payments. A fundamental part of io-homecontrol technology has been adopted as a standard in the EU, meaning that VELUX electrical products are already in accordance with future EU requirements governing radio frequency and security.

All in all, VELUX electrical products bring new solutions for improved home comfort, energy savings, security and indoor climate control.



Real time energy balance

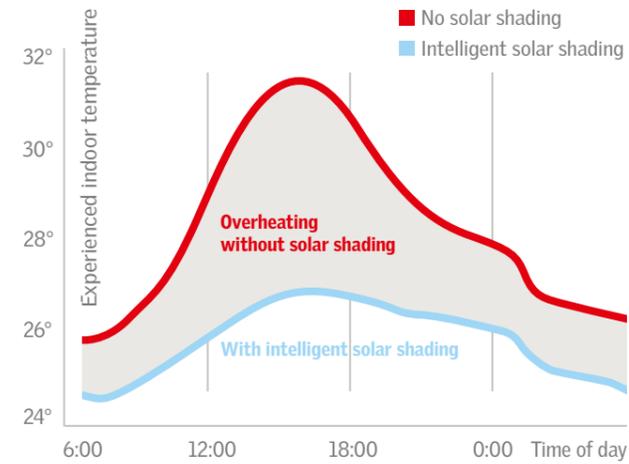
The real time energy balance webpage shows the current energy balance and daylight provision of VELUX roof windows installed in the following Model Home 2020 experiments: Home for Life, Sunlighthouse, LichtAktiv Haus. The current energy balance is calculated based on the sun position, time of day, window orientation and location of the house together with measured weather data. For specific roof windows the user can adjust the solar shading and see the effect on the energy balance and daylight provision. Predicted weather situations are also available making it possible to illustrate winter or summer situations all year round.

To experience the real time energy balance, visit www.velux.com/modelhome2020



The roof window energy balance

The term energy balance is used to describe the energy characteristics of a window – the balance between solar gain and heat loss. Energy balance is calculated as the sum of usable solar gain through the window during the heating season minus any heat loss. Energy balance is a more accurate way of describing the energy characteristics of a window than just the U_w -value, as energy balance includes both U_w -value and g-value to provide a more complete picture.



Blinds and shutters

Optimised indoor comfort and energy savings

VELUX blinds and roller shutters contribute to improving the indoor climate and help home owners save energy. VELUX blinds and roller shutters enable them to control daylight and heat intake and heat loss – all factors that have an influence on indoor climate.

VELUX blinds and roller shutters reduce heat loss through the window by up to 34 %, depending on the type of window pane, blind or roller shutter, ensuring improved insulation during cold winter nights.

Roller shutters

For the best protection against heat, sunlight must be stopped before it reaches the window pane. That is why VELUX heat protection products are positioned outside. If maximum heat protection and total blackout is needed, the best solution is the VELUX roller shutter. It stops the sun's rays before they strike the window, blocking out up to 95 % of the heat from outside and ensuring a pleasant indoor climate, even on hot days with direct sunlight. The VELUX roller shutter offers several key benefits:

- Optimal heat protection
- Optimal blackout (100 %)
- Security – helps to prevent break-ins
- Energy-saving – provides insulation in the winter
- Protection from the elements.

VELUX roller shutters are available in manual, electrical (wired) and solar-powered versions.

Solar-powered versions

If energy saving has the highest priority, we recommend VELUX solar-powered decoration and sunscreening products in combination with VELUX solar-powered roof windows. These products are powered by solar cells and are therefore self-sufficient in energy and need no external power supply. The solar cells generate electricity even with indirect sunlight, so they are reliable all year round. And as no external wiring is needed, installation is a quick and simple job.

Awning blind



Roller shutter





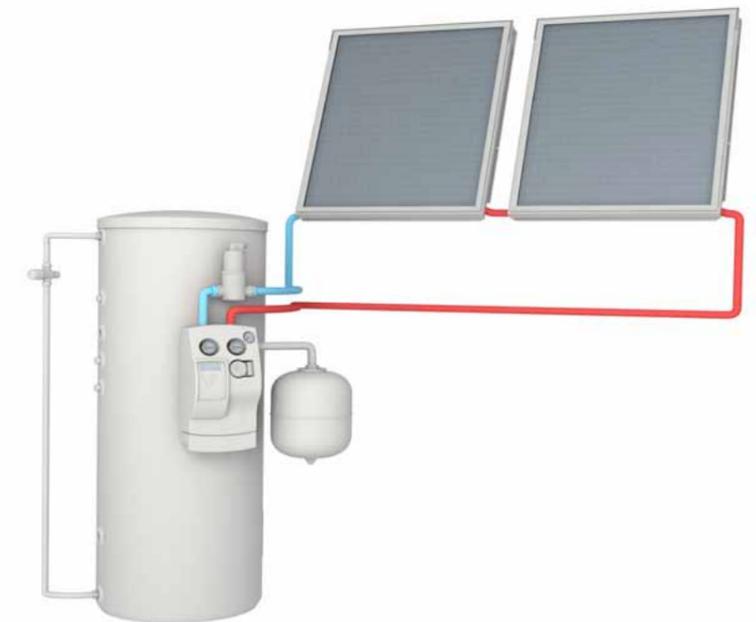
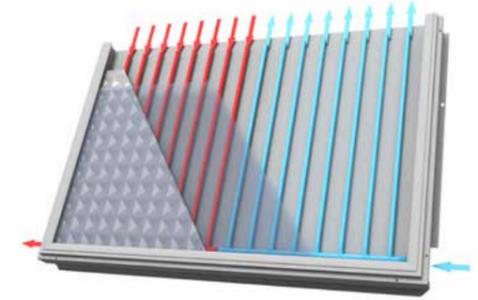
Thermal solar energy

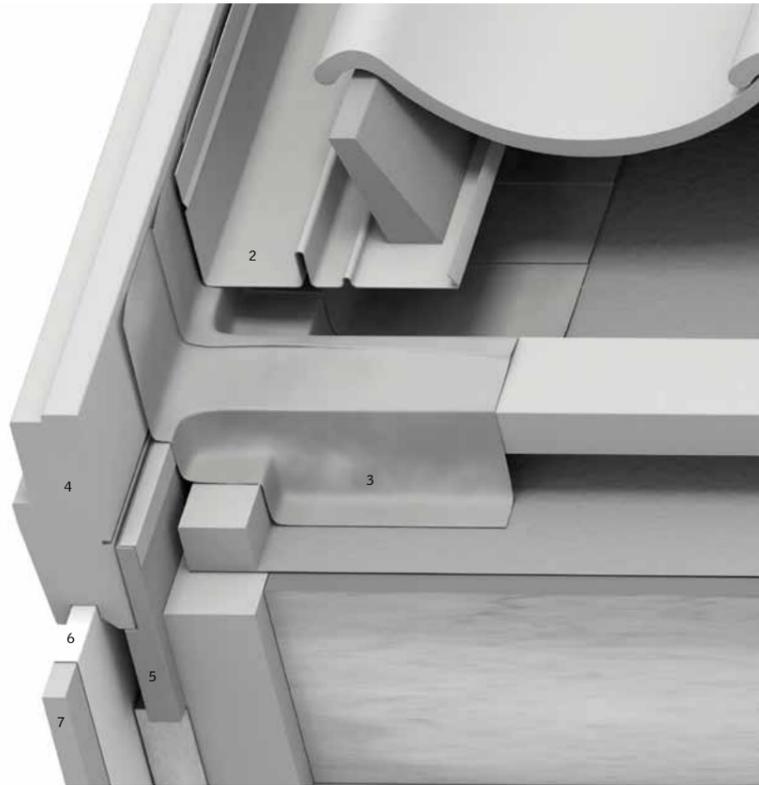
The sun provides incredible amounts of energy. As hard as we try, we will never be able to consume it all.

The VELUX thermal solar energy systems for domestic hot water and room heating are designed to maximise efficiency, aesthetics and convenience.

They use the sun's energy to provide the hot water used in the building, meeting up to 70 % of occupier requirements. Their installation is of the same renowned high quality of all VELUX installations. They result in an aesthetically pleasing placement and are easily mixed with VELUX roof windows.

VELUX solar collectors are a safe, secure and elegant solution, using the sun's heat to provide hot water for heating and hot water for households.





System solutions

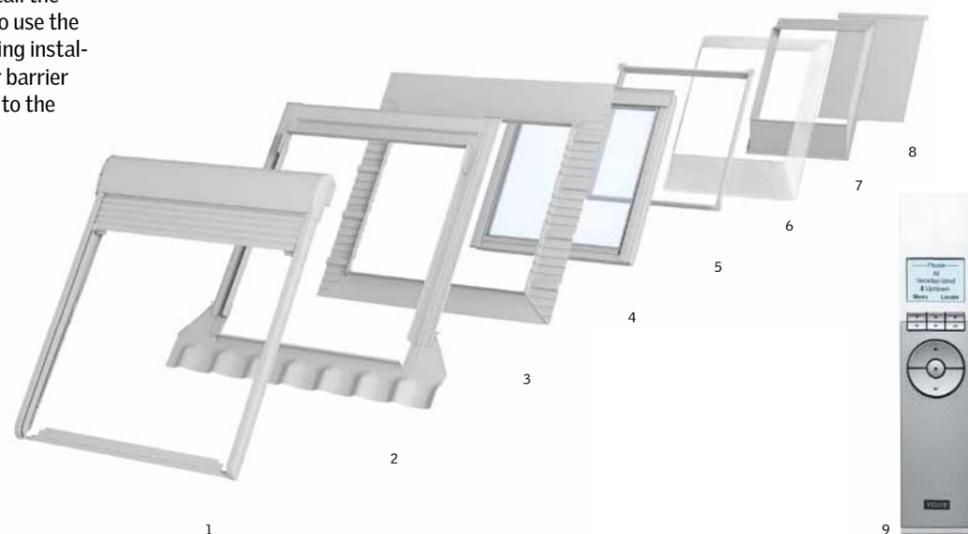
VELUX installation products ensure that the VELUX roof window is connected to the roof in the most energy-efficient way. No matter how energy-efficient an individual building component is, it is never better than its fitting to the rest of the building. Over 60 years, the VELUX Group has developed a unique installation procedure that is well known throughout the industry. It ensures the best possible connection to the roof and eliminates unnecessary energy loss between roof and window.

The underlying principle is to install the window deep into the roof, and to use the correct flashing, the BDX insulating installation frame and the BBX vapour barrier collar to ensure tight connection to the

rest of the construction. The insulation frame also ensures the highest installation quality and minimises unnecessary heat loss in the space between window and roof material.

To meet today's stringent demands for energy-efficient buildings, homes must be airtight. Any penetration of a building's climate shell could compromise those demands. The VELUX installation procedure prevents that and ensures the most secure installation in the roof.

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



Home automation

VELUX home automation systems give added performance through intelligent technology, such as io-homecontrol that optimises comfort and convenience.

All electrical products in the system are based on io-homecontrol and share a common platform for interchange of information, allowing them to work together intelligently. We offer automation solutions for existing as well as new installations.

The VELUX Group has more than 30 years' experience in electrical operation of windows, blinds and shutters – and our solutions work quietly and effectively at the press of a button.

VELUX ACTIVE Climate Control adds a whole new dimension of home climate control by opening and closing windows and sunscreening products automatically as sunlight and temperature change.



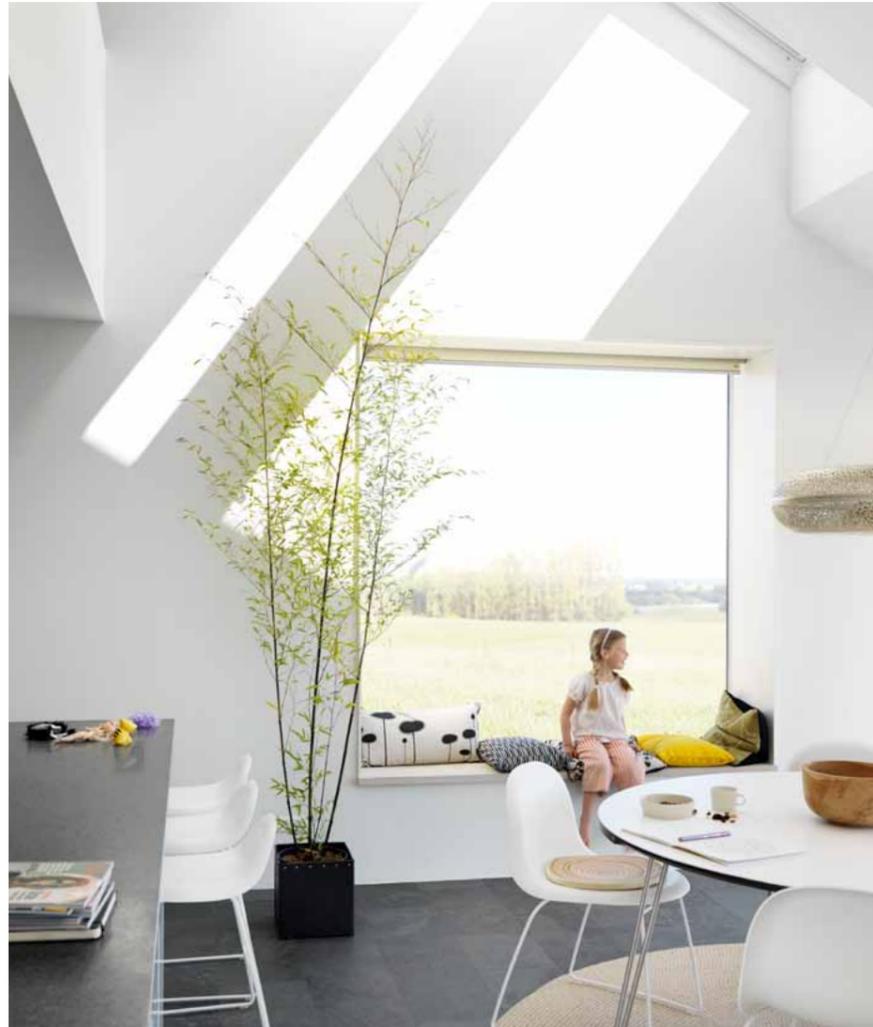
io-homecontrol® provides advanced and secure radio technology that is easy to install. io-homecontrol® labelled products communicate with each other, improving comfort, security and energy savings.

www.io-homecontrol.com

Home for Life



Elmehaven 1, 8520 Lystrup, Denmark



Home for Life is the result of an interdisciplinary project to synthesise the parameters of energy, comfort and visual appeal into a holistic entity, where the parameters are mutually complementary and maximise the quality of life in the home and the world around it.

Life, light and air reflected in the architecture

The house has 190 m² of floor space, distributed over 1½ storeys. The window area (facade windows and roof windows) is equivalent to 40 % of the floor area.

The principal architectural idea in Home for Life is to unite single-family house requirements to experience, functionality and energy consumption in an integrated design. It is the light incidence, the active facade, the relationship between indoors and out and the flexibility of the house that gives it its high architectural quality.

The look and feel of this model home is an interpretation of the archetypical residence as a futuristic 'energy machine' that interacts with nature and the life lived inside the home.

Project partners: VELFAC and the VELUX Group
 Architects: aart
 Energy concept: Esbensen Rådgivende Ingeniører
 Turn-key contractor: KFS Boligbyg



The active facade

The choice of slate covering on the facade and roof reflects both the wish for durability, low CO₂ impact and minimal maintenance, and the wish to integrate the dark surfaces of the solar cells, the solar panels and the windows in a sculptural composition. The wood covering and wood flooring, with their feeling of natural warmth, provide a contrast to the hardness and cold expression of the slate.

The active facade changes according to the seasons and needs. It can either be open to let in light and heat, or it can be closed to screen against the sun and retain heat during the night.



Daylight

The use of daylight has been optimised to ensure the health and well-being of the residents as well as to minimise consumption of electric light during daytime. The window area amounts to 40 % of the floor area (as opposed to the usual 20-25 %), with the windows placed in all four facades as well as the roof to ensure plenty of natural light, distributed deep into all rooms. Daylight levels are evaluated and finally defined via simulations in VELUX Daylight Visualizer 2 and model studies in a light lab.

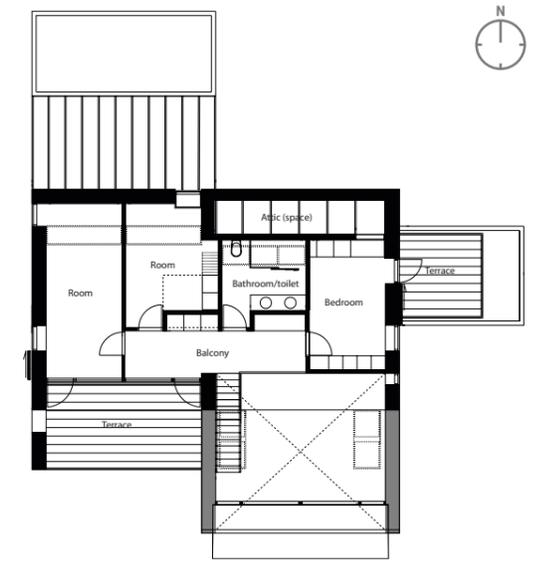
Home for Life uses the energy-optimised windows of the future, with linings that transmit light deep into the rooms. The house's active facades regulate light and solar gain. The south-facing roof overhang creates shade from a high summer sun and admits light from a low winter sun. Shutters and blinds regulate solar heat and ensure privacy when needed. The size and placement of the windows have been determined by the position of the sun in the sky, seasons, energy optimisation and the needs of the residents. Furthermore, the risk of glare is avoided with screening both inside and outside.

Ventilation

There is generous provision of fresh air in Home for Life. In the winter, the air enters via the mechanical ventilation system with heat recovery. The equipment is programmed to adapt to the ventilation needs of the rooms. The air is circulated into the 'clean' rooms (bedrooms and living rooms) and exhausted from the utility rooms (kitchen, bathroom, laundry room). In the summer, fresh air enters through natural ventilation controlled by a sensor in the house; this ensures that the home is not ventilated more than necessary at the same time as maintaining a good indoor climate. The natural ventilation replaces the mechanical system during summer and reduces energy consumption.



Ground floor



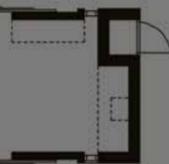
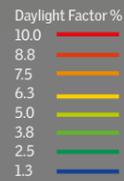
First floor

Experiment # 1

Daylight levels



First floor



Ground floor

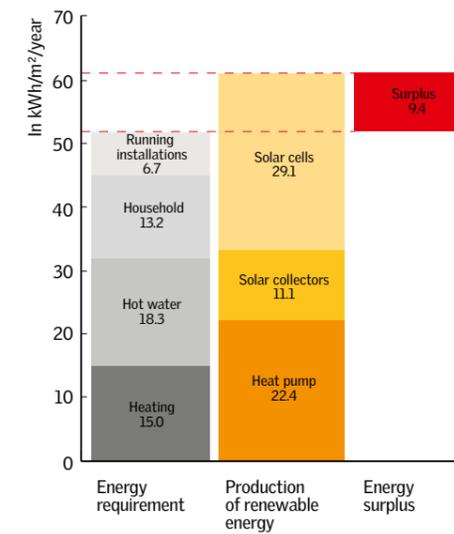
Energy

The total energy consumption is minimised and met by renewable CO₂-neutral energy generated by the building itself. After around 30 years, the surplus energy is equivalent to the amount of energy represented by the materials from which the house is built. A primary parameter in the energy design is the fenestration; positioned to cater for energy technology and visual appeal, the windows optimise light, air and solar gain.

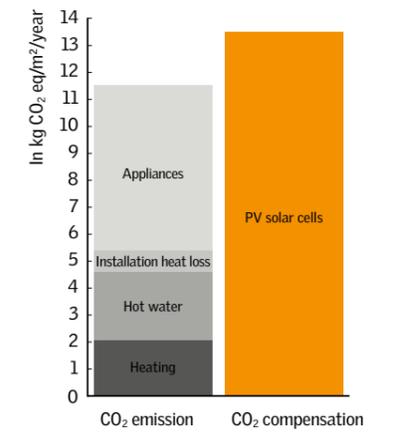
The house is managed in such a way that electricity and heat are used to a minimum. In the summer, the automatically controlled natural ventilation is used to air the rooms. During the heating season, mechanical ventilation with heat recovery is used, so the cold air can be heated without the use of additional energy. Intelligent control regulates the outdoor and indoor sun screening for optimising heat and light intake as well as switching off the light when the room is not in use.

- Solar cells, solar heating and a heat pump produce electricity, hot water and room heating.
- About 50 % of heating requirements are met by passive solar heat from the energy-optimised windows.
- Natural and mechanical ventilation, as well as internal and external sun screens ensure fresh air and a comfortable room temperature.
- The control system of the house reduces energy consumption and ensures a healthy indoor climate.

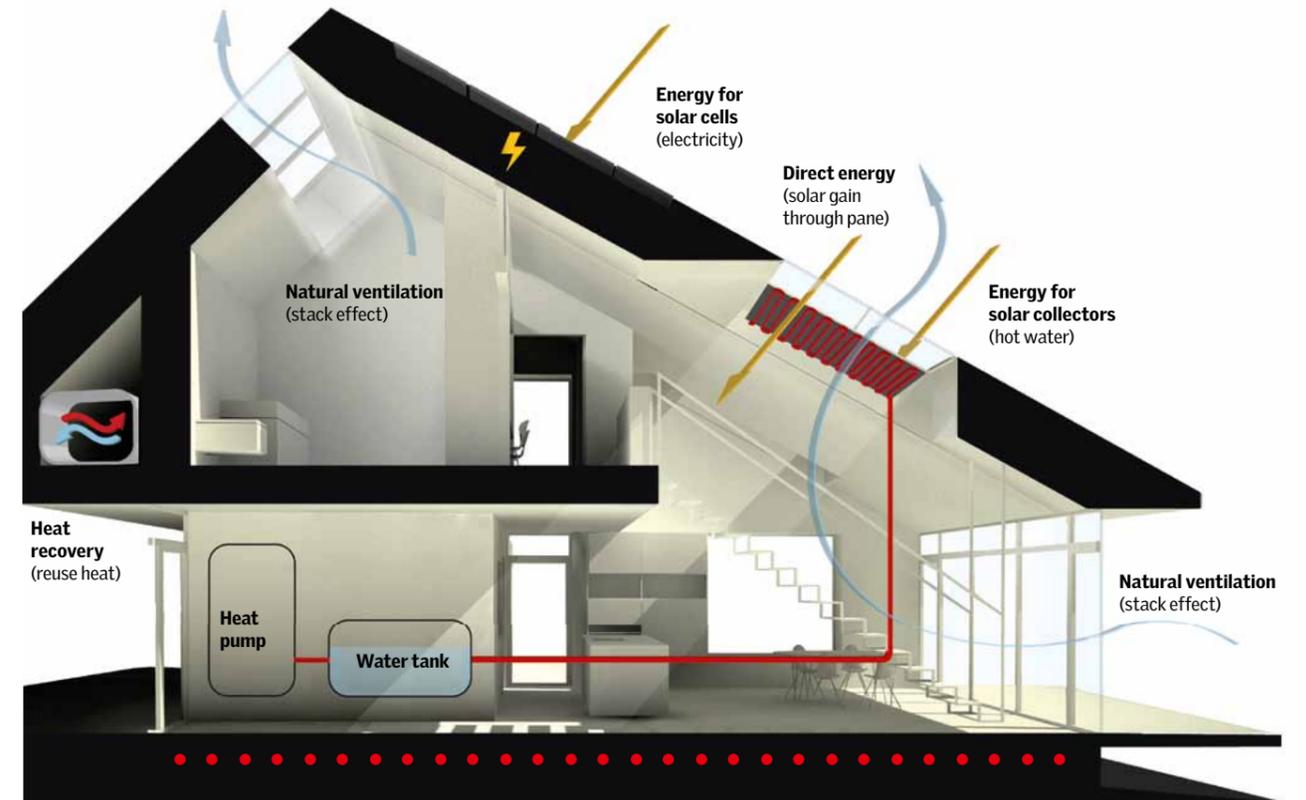
Net energy balance



CO₂ balance



Home for Life produces an annual energy surplus calculated at 9.4 kWh/m²/year. The calculation of the energy performance and production has been made according to national standards.



Experiment # 1

Bedroom 2

- 2 triple-glazed centre-pivot roof windows with white polyurethane finish and solar window operators (GGU U04 006530)
- 2 solar window operators (KSX 100)
- 2 frame extensions (LGI U04 2000)
- 1 installation set (BDX U04 2010)
- 2 vapour barrier collars (BBX U04 0000)
- 1 special flashing set for 2x2 roof windows in both bedrooms (EBLX99 U04)
- 2 solar blackout blinds (DSL U04 1025)
- 2 solar awning blinds (MSL U04 6080)

Bedroom 1

- 2 triple-glazed centre-pivot windows with white polyurethane finish and solar window operators (GGU U04 006530)
- 2 solar window operators (KSX 100)
- 2 frame extensions (LGI U04 2000)
- 1 installation set (BDX U04 2010)
- 2 vapour barrier collars (BBX U04 0000)
- 2 solar blackout blinds (DSL U04 1025)
- 2 solar awning blinds (MSL U04 6080)
- 1 triple-glazed facade window with white painted finish (VFAX P38 2065G)
- 1 triple-glazed centre-pivot roof window with white painted finish (GGL P06 206)
- 1 installation set (BDX P06 2000)
- 2 vapour barrier collars (BBX P06 0000)
- 1 flashing (EFL P06 0000)
- 1 frame extension (LGI P06 2000)
- 1 frame extension (LGI P10 2000)
- 1 manually operated blackout blind (DKL P06 1025WL)
- 1 manually operated blackout blind (DKL P38 1025WL)

Bathroom

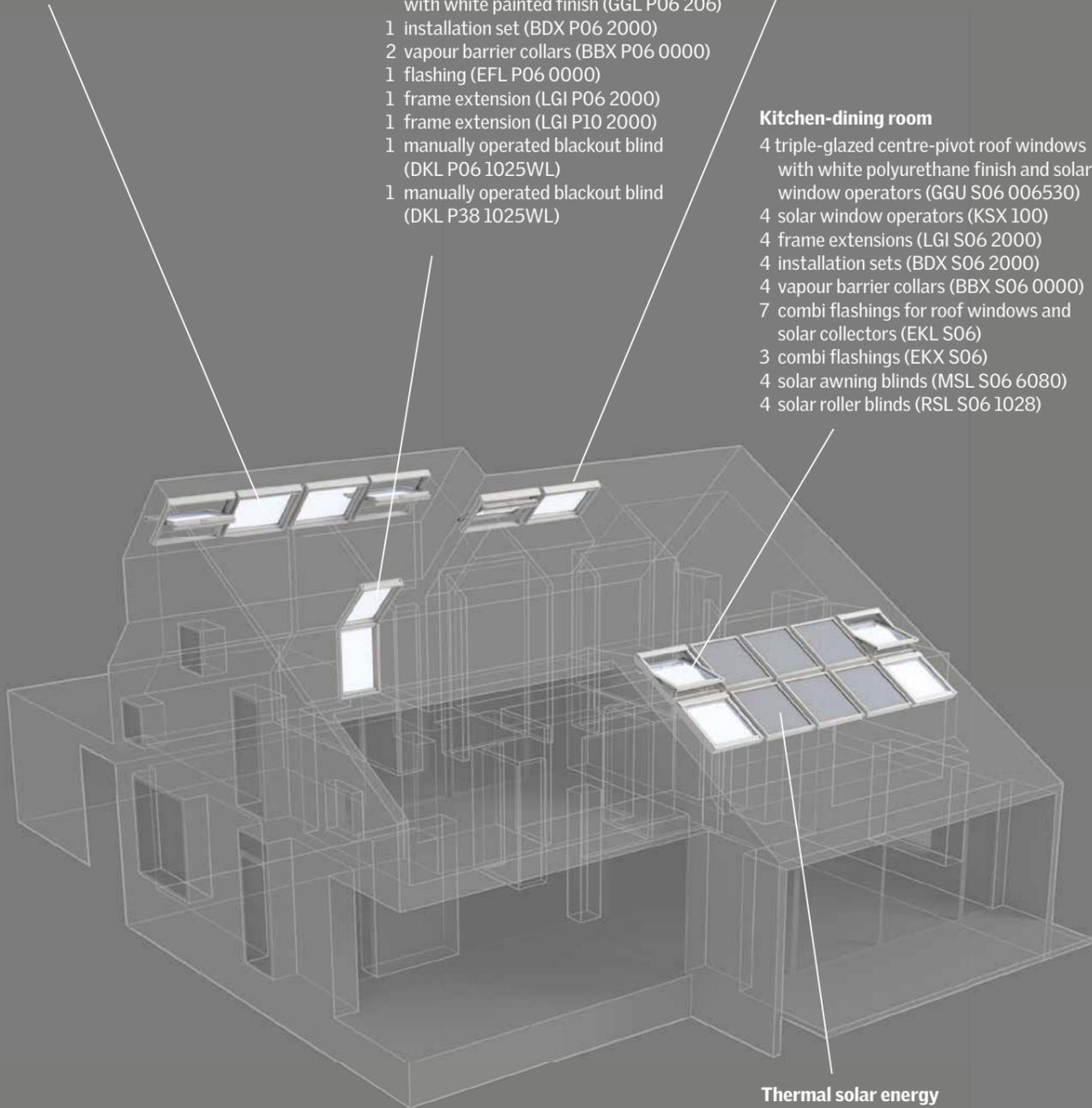
- 2 triple-glazed centre-pivot roof windows with white polyurethane finish (GGU U04 0065)
- 1 solar window operator (KSX 100)
- 2 frame extensions (LGI U04 2000)
- 1 installation set (BDX U04 2010)
- 2 vapour barrier collars (BBX U04 0000)
- 2 solar roller blinds (RSL U04 4070)

Kitchen-dining room

- 4 triple-glazed centre-pivot roof windows with white polyurethane finish and solar window operators (GGU S06 006530)
- 4 solar window operators (KSX 100)
- 4 frame extensions (LGI S06 2000)
- 4 installation sets (BDX S06 2000)
- 4 vapour barrier collars (BBX S06 0000)
- 7 combi flashings for roof windows and solar collectors (EKL S06)
- 3 combi flashings (EKX S06)
- 4 solar awning blinds (MSL S06 6080)
- 4 solar roller blinds (RSL S06 1028)

Thermal solar energy

- 6 solar collectors (CLI S06 4000) and flex-tubes for solar collectors (ZFR + ZFM 020)



Prizes and mentions

Green Good Design Award 2010

Home for Life won the Green Good Design Award 2010, selected from thousands of submissions from over 46 countries.

Bo Grøn Award

In September 2010, Home for Life won the prestigious Bo Grøn award (Live Green). It is presented annually for an idea, invention or design that can help make a greener home.

Selected entrant

At the Architects Council of Europe (ACE) 20th anniversary exhibition in 2010 at the European Parliament in Brussels. Home for Life was selected as an entrant for the exhibition from numerous submissions from all over Europe.

Technical Data

The chart shows the technical characteristics of the VELUX roof windows in relation to heat loss, passive solar gain and daylight. The heat loss (U_w) of the roof windows is influenced by the roof pitch. The solar gain (g-value) and light transmittance (τ) 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/m ² K	1.1 W/m ² K	1.1 W/m ² K
U_g (Heat loss U-value pane)	0.5 W/m ² K	0.7 W/m ² K	0.6 W/m ² K
g (Solar gain g-value)	0.45	0.45	0.45
τ (Light transmittance)	0.67	0.67	0.67

Outer walls

U (Heat loss U-value)	0.1 W/m ² K	(395 mm insulation)
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Roof

U (Heat loss U-value)	0.07 W/m ² K	(540 mm insulation)
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Floor slab

U (Heat loss U-value)	0.07 W/m ² K	(500 mm insulation)
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Fenestration

Window area	75 m ²
Floor area	190 m ²

The window area is equivalent to 40 % of the floor area.

Experiment # 1



"Right from the start we noticed that the air in the house was good. The rooms are comfortable all the time because the warm air is exhausted and the indoor climate adjusted," says Sverre Simonsen, father of the test-family who lived in Home for Life for a year. "We will miss the light, to say nothing of the view." The Simonsen family left Home for Life in the summer of 2010. The experience gained from the experiment is being put to use in the development and operation of the next buildings in the Model Home 2020 series.

Tested in real life

The results from Home for Life show that the house really is zero-carbon, meaning that the building-integrated production of energy will be greater than the use of energy, after planned adjustments have been made. Home for Life was designed to be zero-carbon but also to have great daylight conditions and an excellent indoor climate. Both the quantitative daylight measurements and the qualitative interviews show that the daylight conditions are very good, with high levels of well-balanced daylight and access to direct light in all main rooms. The occupants also express satisfaction with the daylight conditions.

Measurements and registrations were made in connection with the research project Minimum Configuration & Home Automation. Measurements, observations and interviews were carried out by The School of Engineering in Aarhus, the Alexandra Institute, VELFAC and WindowMaster. The project was financed by The Danish Enterprise and Construction Authority.

Conclusions and lessons learned from year 1

Indoor climate

Ample daylight, from all facades and roof, and fresh air are great assets. Good indoor climate requires optimised sunshading and natural ventilation.

The south-facing window area can be reduced in size and compensated with a larger area to the north to minimise the risk of overheating and to balance daylight even further.

A faster-reacting and individual form of heating and heavy, heat-accumulating building materials will contribute to a more stable indoor temperature all year round.

The balance between automatic control and the opportunity for resident control can be optimised, particularly in terms of hybrid ventilation systems and the use of external sunshading and user interaction, so that the house creates the greatest possible degree of comfort with the lowest possible use of energy. Control in the spring and autumn in particular can be optimised.

Automatic control systems for heating, mechanical ventilation, natural ventilation and solar shading are necessary for optimal performance in low-energy buildings. The system's communication can be something of a challenge in terms of user friendliness, and the intuitive interaction and communication between technicians and occupants can be optimised.

The transition periods (spring and autumn) are particularly challenging. The indoor air quality is evaluated based on CO₂ levels.

CO₂ measurements generally indicate a good indoor air quality, but with elevated levels in the sleeping rooms.

The family expressed satisfaction with the access to fresh air and the air quality, which indicates that CO₂ levels above 1,200 ppm may be acceptable in residential buildings. Demand-controlled ventilation based on CO₂ and humidity can provide good air quality but should be designed at room-level to account for the large differences between loads in living and sleeping rooms from day to night.

Daylight should be given a high priority, so the strategy for control of overheating when occupants are home should use natural ventilation first and shading as the second measure.

In low-energy buildings, occupant behaviour has a greater influence on energy demand than in standard buildings.

The qualitative interviews showed that the occupants in many cases deactivated the solar shading in favour of daylight, views and contact to the surroundings. Some problems with overheating have been recorded which to some extent were caused by the occupant overriding the solar shading and natural ventilation controls.

Energy

The house meets 2020 requirements and is classified by building regulations as a surplus-energy house.

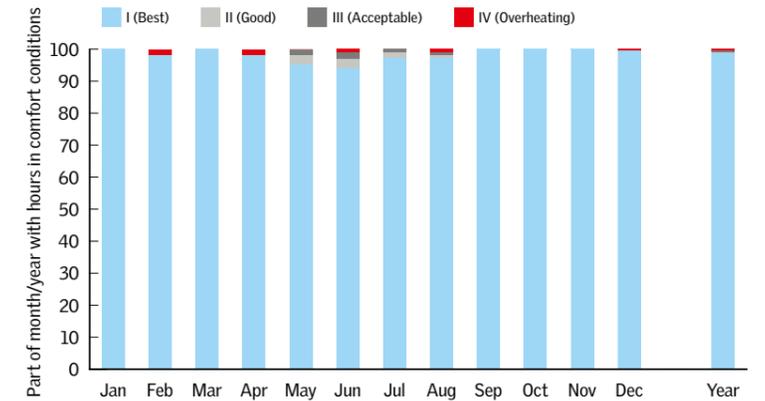
The overall operation of the house is expected to produce a surplus of energy of 1,700 kWh/year. Total energy consumption, including domestic electricity, is expected to be 2,000 kWh/year.

Energy consumption for heating is higher than expected as the average room temperature was 2-3 degrees higher than calculated by the Danish Building Research Institute's approval tool Be06. The residents have a major influence on deviations in the building's energy consumption, exacerbated when they have the possibility of interacting with the control and regulation of the house.

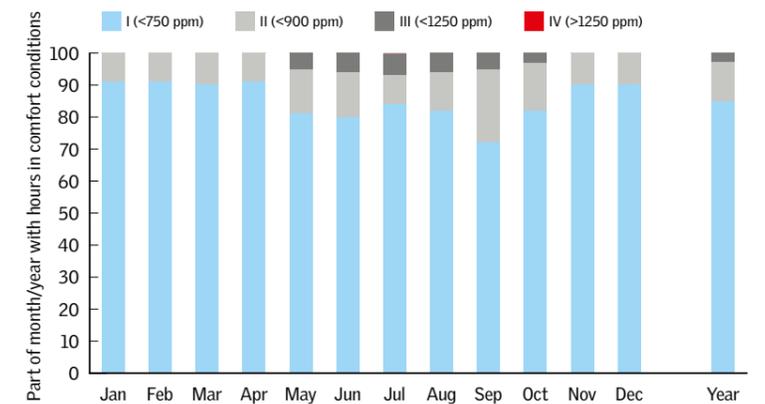
The heating system should be dimensioned in accordance with the individual building's preconditions and not to calculations from approval tools such as Be06.

Experience points

- Home for Life leads the way to the next generation of climate-neutral buildings. Built according to the active house principles, Home for Life not only saves on energy and electricity but also has a comfortable indoor climate and has the best possible interaction with its surroundings.
- Home for Life is an experiment – the house was built with the best intentions – and the purpose of the experiment is to learn from it.
- Energy consumption during the first test year was higher than expected, mainly due to family habits, the control system and the construction of the house. Lessons learned from each category will be taken onwards.
- Comfortable living for the family has been the most important issue. They have enjoyed the large amounts of daylight, also in the winter season.



The indoor temperature is evaluated according to the European standard EN 15251, which defines four comfort categories from I (best) to IV (unacceptable). The figure shows the distribution of categories for each month and for the entire year. More than 95% of the hours of the year are in category I, which means that the family room is categorised as I as far as indoor temperature according to EN 15251 is concerned.



The CO₂ level is an indicator of indoor air quality and is evaluated according to the European standard EN 15251, which defines four comfort categories from I (best) to IV (unacceptable). The figure shows the distribution of categories for each month and for the entire year. More than 95% of the hours of the year are in category II, which means that the family room is categorised as II as far as regards to indoor air quality according to EN 15251 is concerned.

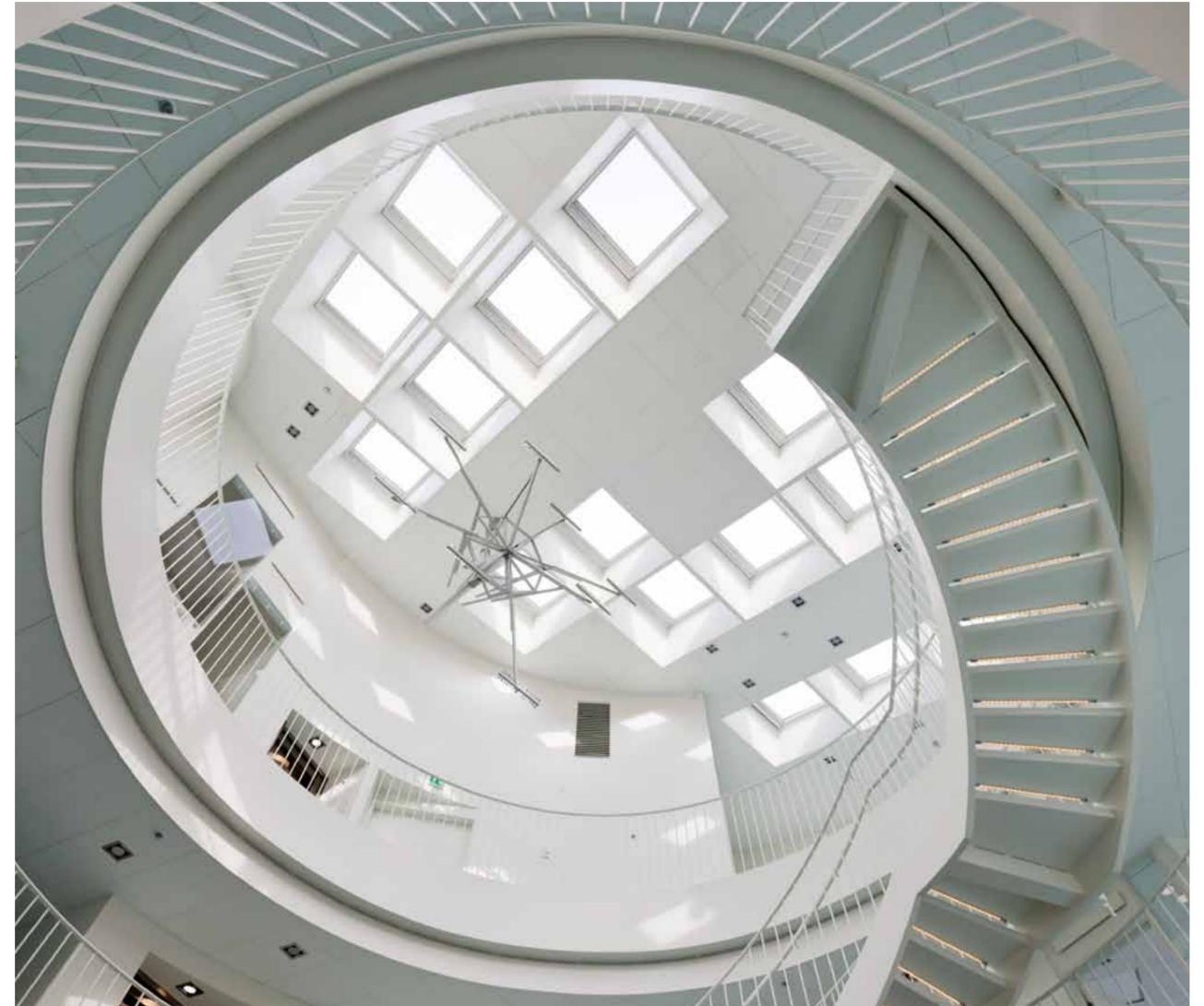
Evaluation of energy consumption after 1 year	Divergence from compliance tools, programme and assumed patterns of use	kWh/m ² /y	Consumption spread %
User Behaviour	Higher room temperature	18	46
	Manual override of ventilation programme		
	Lower internal heat load		
Control and Technology	Tuning of hybrid ventilation	10	26
	Heat recycling not operative		
	Efficacy of the mechanical ventilation		
	Efficacy of the control system		
Building Condition	Reduced tightness of envelope	11	28
	Cold bridges at punctures		

Green Lighthouse



Tagensvej 16, 2200 Copenhagen N, Denmark

Building owner: The Danish University and Property Agency
Strategic partners: The Municipality of Copenhagen, the Danish University and Property Agency, VELFAC and the VELUX Group
Architects: Christensen & Co Architects
Energy design: COWI
Turn-key contractor: Hellerup Byg



Green Lighthouse

The University of Copenhagen, The Danish University and Property Agency, the Municipality of Copenhagen, VELFAC and the VELUX Group have entered a strategic alliance to construct a new sustainable building with optimal balance between energy efficiency, architectural quality, healthy indoor climate and good daylight conditions. The building was ready at the end of 2009 and offers facilities for the dean, professors and students of the Faculty of Science at the University of Copenhagen.

The partners wanted the project to become a beacon for sustainable building in Copenhagen, Denmark and the rest of Europe. The Green Lighthouse, as it is known, served as a showpiece for the UN Climate Change Conference (COP15) held in Copenhagen in late 2009.

Green Lighthouse, the first public CO₂-neutral building in Denmark, has been endorsed by the European Commission's Sustainable Energy Europe Campaign as an Official Partner.



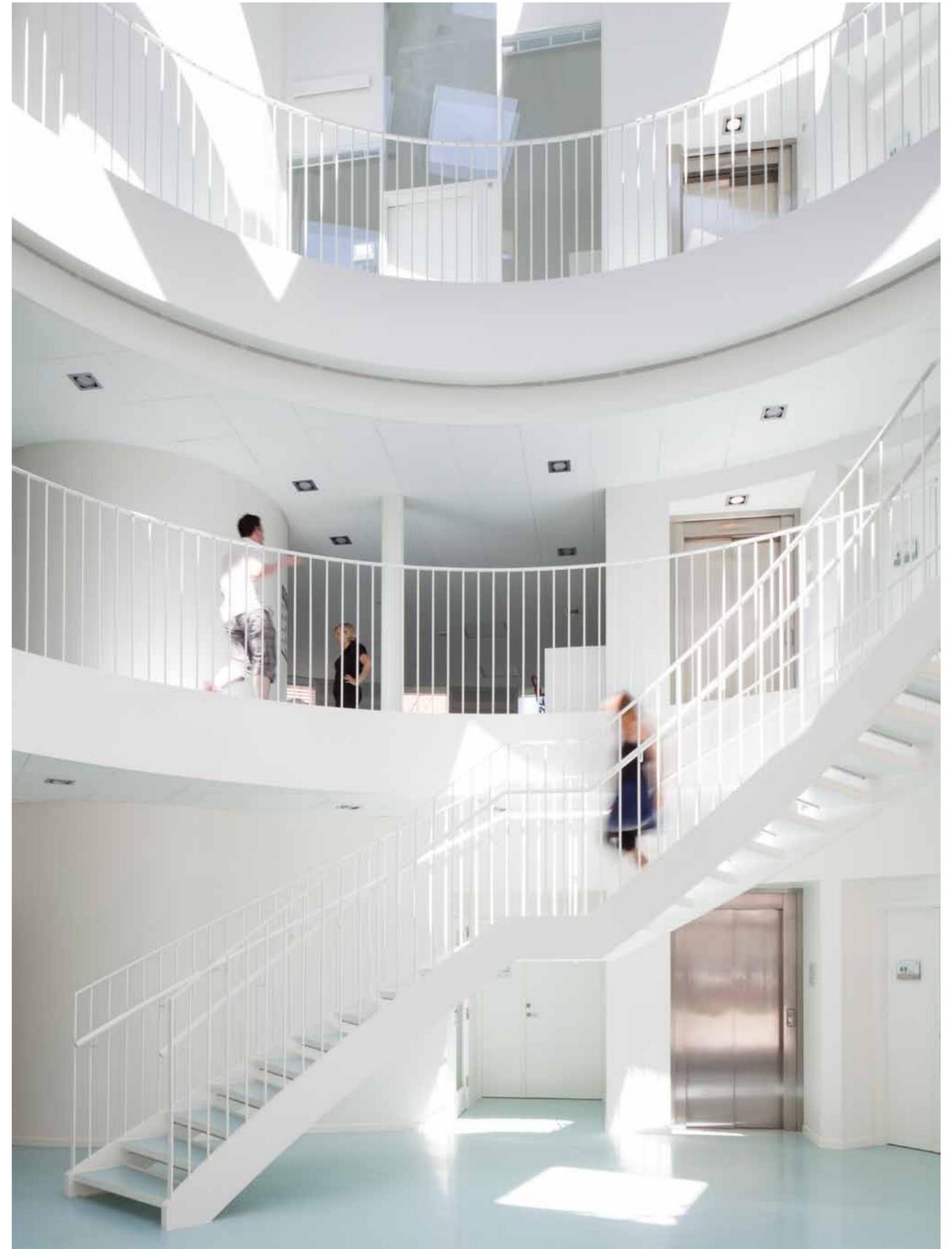
Testing and monitoring

Green Lighthouse is monitored and measured as part of a wide range of quantitative surveys. A qualitative user survey amongst the employees in Green Lighthouse is carried out by Post. Doc. Bettina Hauge.

EUDP, the Danish Energy Technology Development and Demonstration Programme, contributes to verifying whether the experiment Green Lighthouse succeeds or not. The final result is a status report. EUDP supports the Green Lighthouse project

with assistance during implementation and a follow-up energy measurement programme in a three-year period as well as communication of project results.

Green Lighthouse is certificated to the American LEED programme, in which points are awarded according to a long list of sustainability issues, such as water efficiency, energy consumption and atmosphere materials and resources, indoor climate, innovation and design.



Experiment # 2



Energy concept

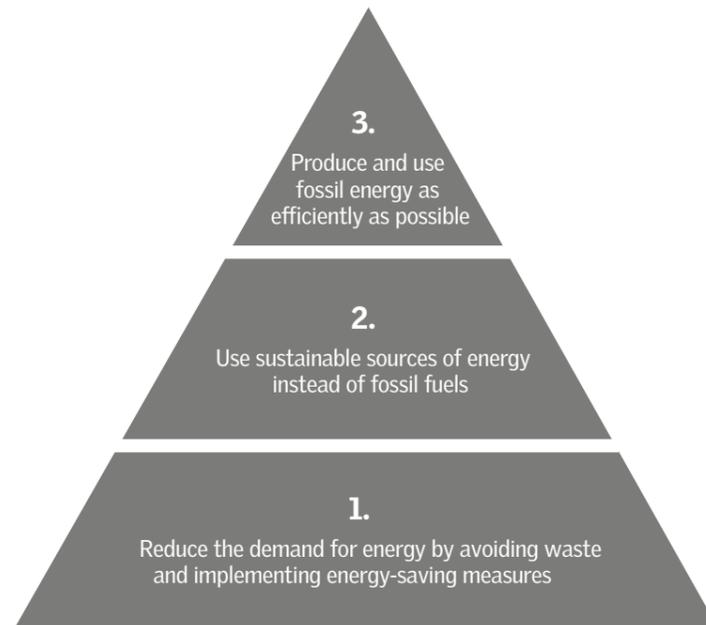
The purpose of the Green Lighthouse energy concept is to make the building CO₂-neutral. Green Lighthouse is a completely new experiment, with energy supply being a combination of district heating, solar cells, solar heating and cooling, and seasonal storage.

This energy concept, developed by COWI, is a new kind of solution using district heating to power a heat pump. By using district heating instead of electricity, less CO₂ is produced and energy is used far more efficiently.

The energy concept ensures the utilisation of renewable sources of energy. This interaction means that the sun is used not only for cooling during summertime, but also to improve the efficiency of the heat pump during winter.

Thermal solar energy is generated by VELUX solar collectors. It is used for hot water, floor heating or, when heating is not required, stored in the ground. A heat pump circulates solar heat, stored heat and cooling in the building. This ensures optimal utilisation of district heating, as it will only be used if solar heat is unavailable.

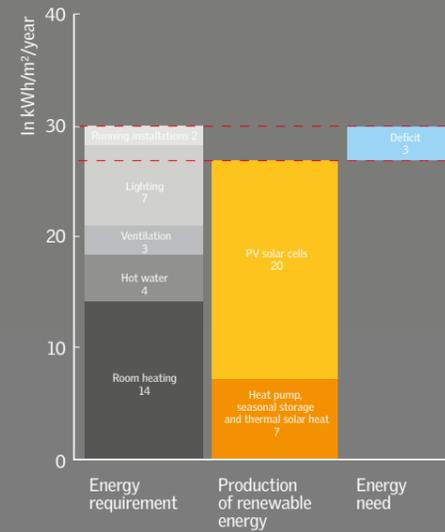
The energy concept is a real experiment and this is the first time it is applied in Denmark. In the long term, this solution could be used in construction of office and industrial buildings in most parts of Europe. The energy concept will undoubtedly be used when planning the energy supply of CO₂-neutral constructions in the future.



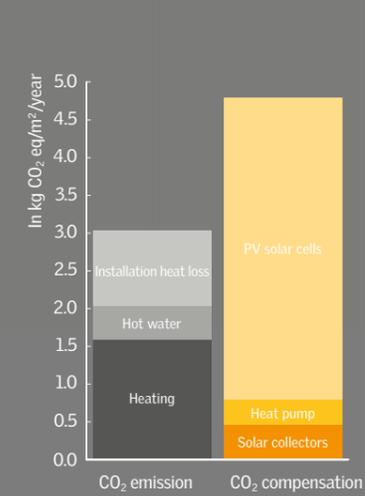
The energy concept of Green Lighthouse is based on Trias Energetica.

Energy design by COWI

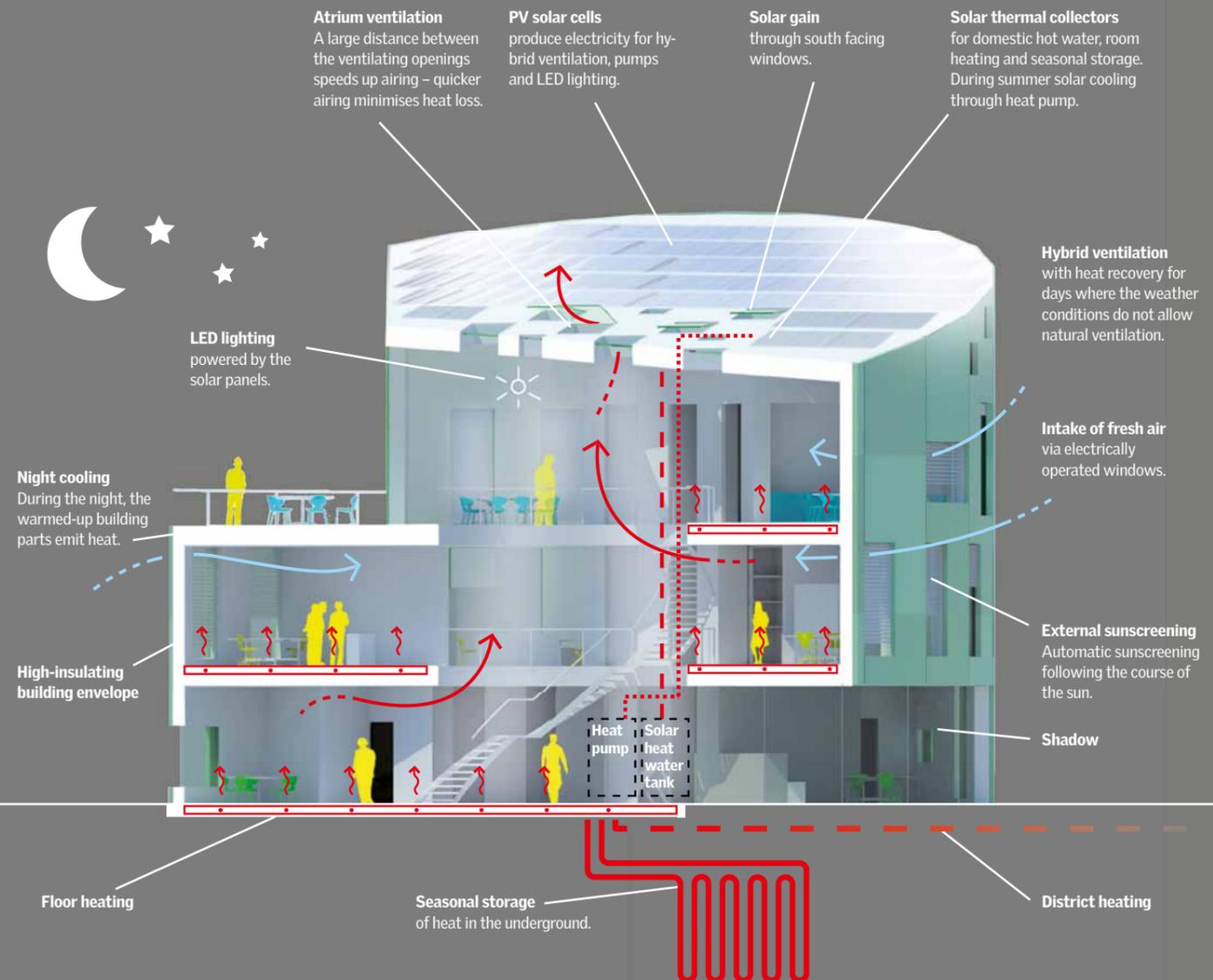
Net energy balance



CO₂ balance



The primary energy is calculated according to the Danish Energy Calculation tool BE 06.



Experiment # 2

Daylight in Green Lighthouse

The daylighting performance of Green Lighthouse has been specified using the daylight factor (DF) as performance indicator.

The daylight factor is a common and easy-to-use measure for the available amount of daylight in a room. It expresses the percentage of daylight available on an interior surface compared to that available at the exterior of the building under known overcast sky conditions. The higher the DF, the more daylight is available in the room. Rooms with an average DF of 2 % or more are considered daylight. A room will appear strongly daylight when the average DF is above 5 %.

The daylight factor analysis has been performed by COWI using computer simulations in Radiance. The figures on the right show the daylight factor levels obtained on each floor for two different variants evaluating the impact of the installed roof windows in the final design.

The results comparison shows the positive effects on the daylight conditions of Green Lighthouse of adding roof windows. The roof windows deliver high levels of daylight to the second floor's lounge area, providing the occupants with a healthy indoor environment, strongly daylight, and with contact to the sky. The use of roof windows also contributes to raising daylight levels on the lower floors via the bright atrium space, and results in a much better daylight distribution over the first floor's office area. Daylight invites people on the ground floor towards the stairway and upper floor activities.

“Working in daylight environments results in higher productivity.”

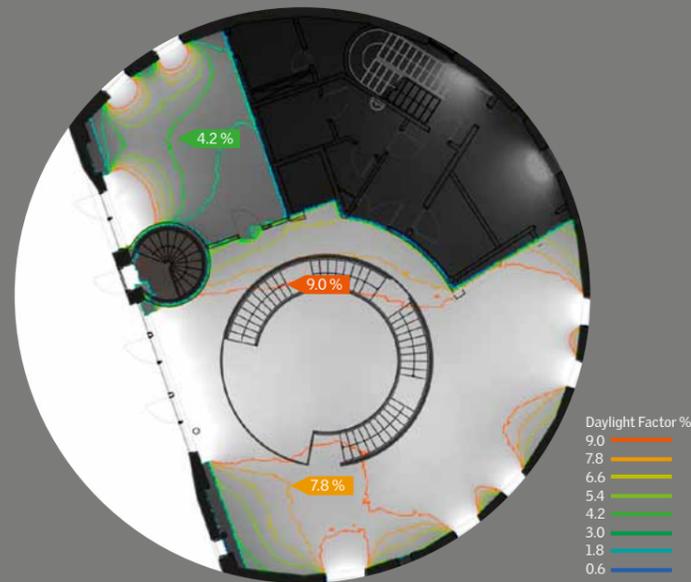
Visher 1989

“Learning in daylight environments results in more effective learning”

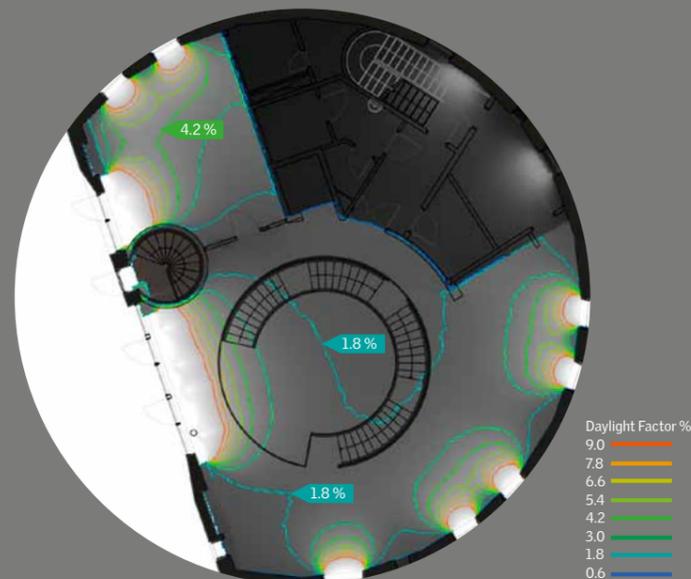
Heschong et al. 1999

Daylight performance, second floor

With roof windows

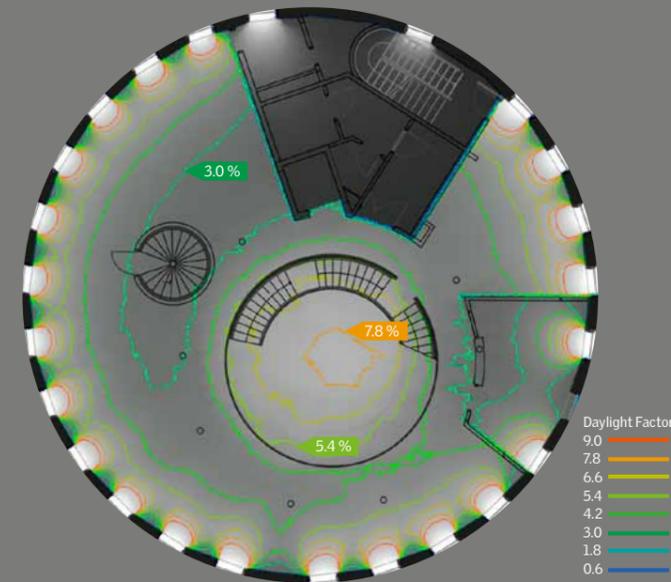


Without roof windows

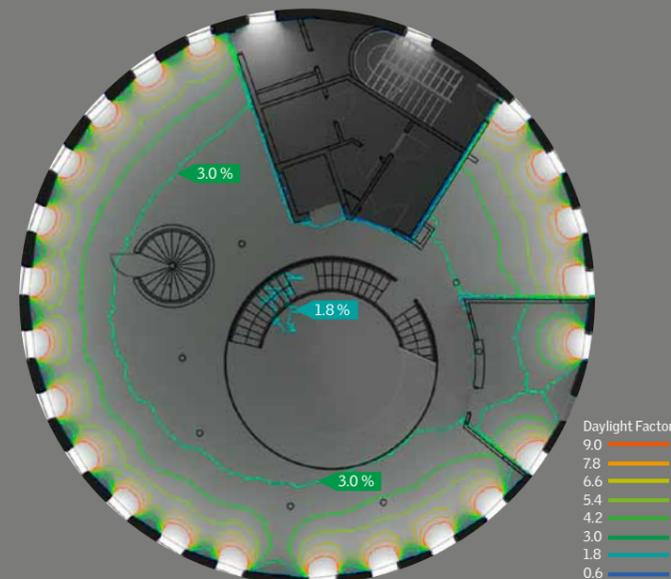


Daylight performance, first floor

With roof windows

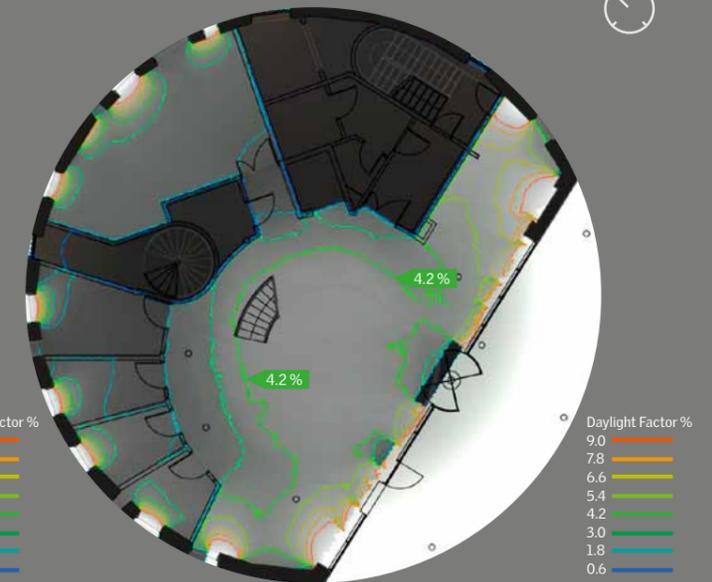


Without roof windows

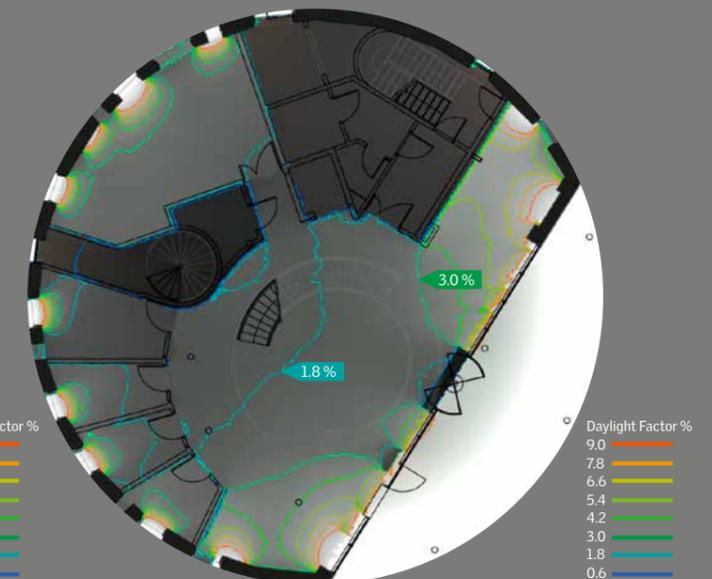


Daylight performance, ground floor

With roof windows



Without roof windows



Experiment # 2

Roof windows

- 18 safety-laminated triple-glazed centre-pivot roof windows with white polyurethane finish and solar window operators (GGU U08 006530)
- 18 solar window operators (KSX 100)
- 18 flashings for roof windows (EDL U08 0000)
- 18 installation sets (BDX U08 2000)
- 18 vapour barrier collars (BBX U08 0000L)
- 18 solar awning blinds (MSL U08 5060E)
- 18 solar roller blinds (RSL U08 4070E)

Thermal solar energy

- 22 solar collectors (CLI S08 4000), flex-tubes for solar collectors (ZFR EFO, ZFR 220, ZFM 015, ZFM 010 and ZFM 005) and thermo sensors (ZPT 1000)
- 2 modified combi flashings for solar collectors (special FLA ECX)

Workman's access roof window

- 1 safety-laminated triple-glazed top-hung roof window with white polyurethane finish (GTU S08 0073GK)
- 1 combi flashing for roof window (EKL S08 0021E)
- 1 installation set (BDX S08 2000)
- 1 vapour barrier collar (BBX S08 0000L)

Sun tunnel

- 1 sun tunnel with rigid tunnel (TLR 014 0124)
- 1 rigid extension tunnel (ZTR 014 0124)
- 1 double-glazed roof window with white polyurethane finish (GGU S08 0059) installed over the sun tunnel
- 1 combi flashing for roof window (EKL S08 0021E)



Prizes and mentions

Green Good Design Award 2010

Green Lighthouse won the Green Good Design Award 2010, selected from thousands of submissions from over 46 countries.

Honourable mention

Green Lighthouse received an honourable mention in the category of Homes and Commercial Buildings in Building of the Year 2009, presented by the Danish building trade magazine Building.

Innovative Cooperation

In November 2009, Green Lighthouse won the award for Innovative Cooperation presented by the Confederation of Danish Industry. The award was made for the unique fashion in which the partners worked together, resulting in a building that is CO₂ neutral, healthy and comfortable.

Official Partner

Green Lighthouse has been endorsed by the European Commission's Sustainable Energy Europe Campaign as an official partner. The Sustainable Energy Europe Campaign showcases activities dedicated to energy efficiency and renewable energy solutions. Specifically, the focus is on spreading best practice in sustainable energy technology, building alliances and inspiring new energy ideas and actions.

Nominations

Education & Learning

Green Lighthouse was nominated among 14 buildings worldwide in the category Education & Learning at the World Architecture Festival in Barcelona in 2010.

Climate Cup Partnership Award

Green Lighthouse was nominated for the Climate Cup Partnership Award on the occasion of the World Climate Solutions conference in 2010. The jury's motivation was that Green Lighthouse demonstrates that it is possible to build carbon-neutral buildings without compromising design, comfort and indoor climate.

Danish Light Award

Green Lighthouse was nominated for the Danish Light Award 2010 as one out of five projects.

Technical Data

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

Roof windows with pane --65

Roof pitch	90°	15° (South)
U_w (Heat loss U-value window)	1.0 W/m ² K	1.1 W/m ² K
U_g (Heat loss U-value pane)	0.5 W/m ² K	0.7 W/m ² K
g (Solar gain g-value)	0.45	0.45
τ (Light transmittance)	0.67	0.67

External awning blinds MSL 5060

The performance of the window is improved when the awning blind is rolled down.

Roof pitch	15° (South)
U_w (Heat loss U-value)	1.1 W/m ² K
g (Solar gain g-value)	0.1
τ (Light transmittance)	0.12

VELFAC facade windows

Roof pitch	90°
U_w (Heat loss U-value window)	0.93 W/m ² K
U_g (Heat loss U-value pane)	0.72 W/m ² K
g (Solar gain g-value)	0.5

Outer walls

U (Heat loss U-value)	0.095 W/m ² K
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Roof

U (Heat loss U-value)	0.084 W/m ² K
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Floor slab

U (Heat loss U-value)	0.085 W/m ² K
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Facts

The primary energy consumption for heating Green Lighthouse has been calculated to 30 kWh/m²/year.

A combination of the following energy sources is expected to supply heating for Green Lighthouse:

35 % solar energy from thermal solar collectors on the roof and storage of solar heat in the ground via a heat pump.

65 % eco-friendly district heating with an approx. 35 % share of renewable energy.

The heat pump increases the utilisation of the district heating by some 30 %.

76 m² of PV solar cells on the roof will cover the need for base lighting, ventilation and pumps.

The house is CO₂ neutral as to the primary energy need.

Sunlighthouse

VELUX®
MODEL HOME 2020

Grenzgasse 9, 3013 Pressbaum, Austria

The vision is to build a carbon neutral house with exciting and appealing architecture focusing on the sloping roof. The house with an unusually high proportion of daylight has to be affordable in respect of dimensions and appearance.

VELUX Austria is to build Austria's first ever carbon-neutral single-family house under the name of Sunlighthouse. The vision is to build a house with exciting and appealing architecture focusing on the sloping roof.

The architectural concept was found in a competition between nine rising Austrian architectural practices, and the winner is Hein-Troy Architekten.

Architectural concept

Juri Troy's architectural design responds perfectly to the difficult conditions of the plot: a very steep and leafy slope in partial shade facing south-east towards the Vienna woods. Shadows cast by the nearby mountain have been countered in the living room by elevated roof windows, which allow light to fall into the depths of the room.

The kitchen and dining areas are gathered around a protected, south-west-facing space. Windows – both roof and facade windows – are strategically positioned so as to provide a particular view while maximising passive solar energy gains, while also emphasizing the character of the house. All of these measures combined make for an unusually high proportion of daylight.

The project is supported by scientific partners Donau-Universität Krems and the Institute for Healthy and Ecological Building (IBO) and has already won the Austrian State Prize for Environment and Energy Technologies.

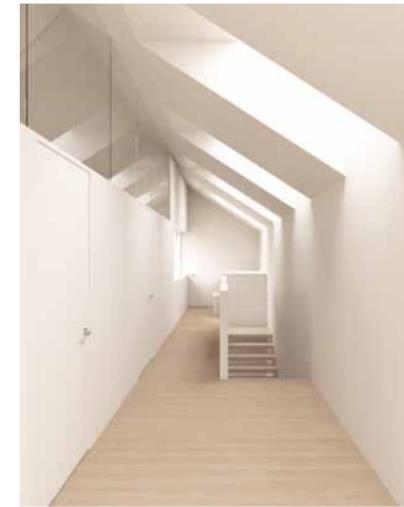
Experiment # 3



Daylight simulation with physical model in daylight laboratory performed by Arch. DI Gregor Radinger, Donau-Universität Krems.



Daylight simulation with physical model.



Daylight simulation with VELUX Daylight Visualizer 2.



Actual daylight conditions in Sunlighthouse.

Daylight

The use of daylight has been maximised to ensure the health and well-being of the residents. Donau-Universität Krems evaluated the daylight conditions in digital form and in a model under an artificial sky to arrive at an average daylight factor (according to DIN 5034-4) of at least 5 % for all living and working spaces to ensure balanced daylight levels throughout the two floors and to minimise the use of artificial light.

The location of the windows was planned strategically – they give the best view, maximum passive solar gain and natural ventilation. The total window area is equivalent to some 36 % of the net floor area.

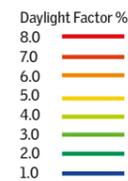
Daylight visualisations

To ensure that Sunlighthouse meets the expectations in terms of daylight quality, daylight levels are evaluated and defined through model studies in a light laboratory and simulations in VELUX Daylight Visualizer 2, a software tool dedicated to daylighting design and analysis. For more details and download, visit <http://viz.velux.com>



Ground floor

First floor



Project owner: The VELUX Group
 Architects: Hein-Troy Architekten
 Energy concept: Donau-Universität Krems, Department für Bauen und Umwelt
 Österreichisches Institut für Baubiologie und -Ökologie



Prizes and mentions

National Award of Environment & Energy Technology

Sunlighthouse won the Austrian National Award of Environment & Energy Technology 2010 in the category "special awards". The award was given for the outstanding innovative content, the degree of novelty and market potential and the market position already achieved.

Fourth prize in Active Architecture

Hein-Troy architects won fourth prize for the project Sunlighthouse in the international architecture award 2010 entitled Active Architecture organised by Fiandre.

Austrian PR Award

Every year, the Austrian PR association PRVA honours the best three PR cases with the "Best Practice" Award. In March 2011, VELUX Austria, together with its PR agency senft&partner, was awarded for their work on promoting VELUX Sunlighthouse.

Experiment # 3



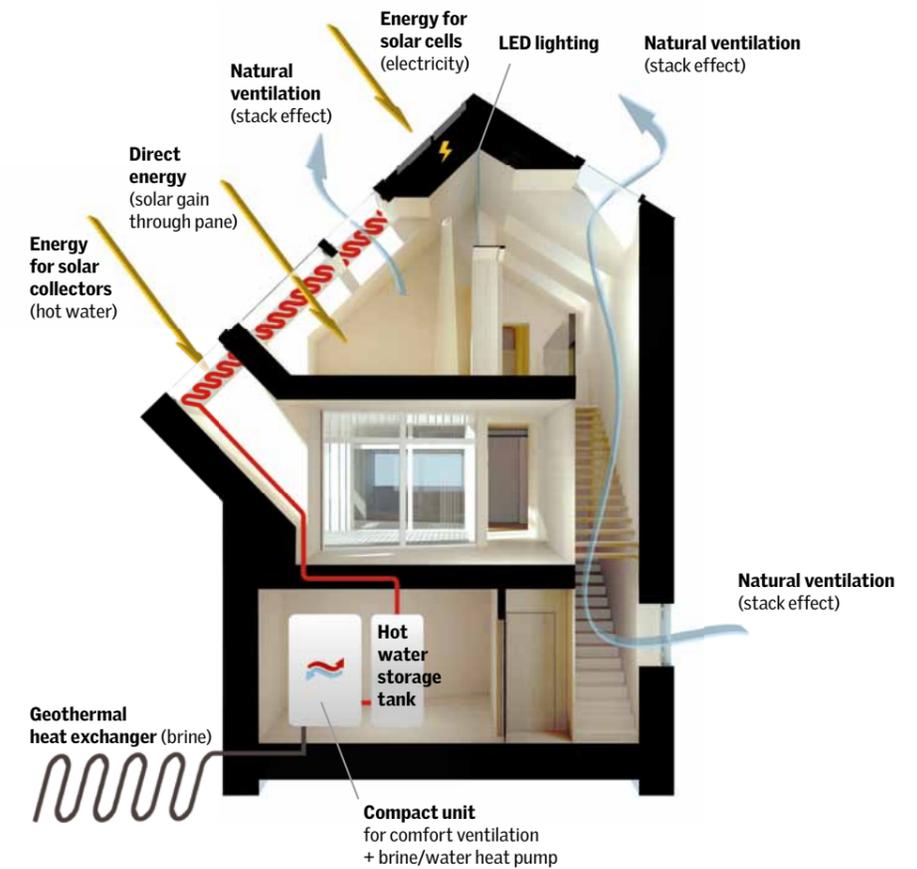
Energy design

The prime objective of Sunlighthouse was to reduce overall energy consumption, particularly primary energy, to a minimum without sacrificing living comfort.

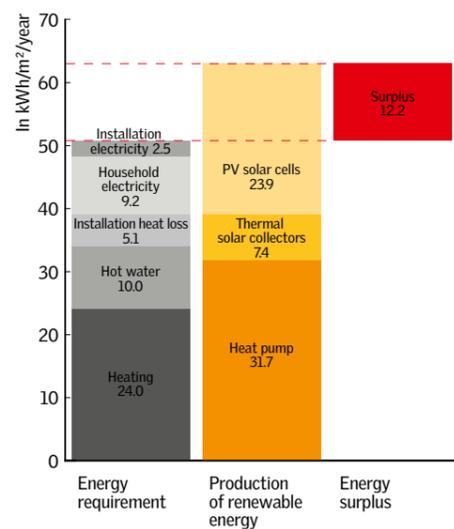
The features contributing towards a positive energy balance include a highly efficient brine/water heat pump, thermal solar collectors for the production of hot water, a PV solar cell system for generating electricity, and highly energy-efficient household appliances.

With its PV solar cells, thermal solar collectors and the brine heat pump, the house will use renewable energy exclusively.

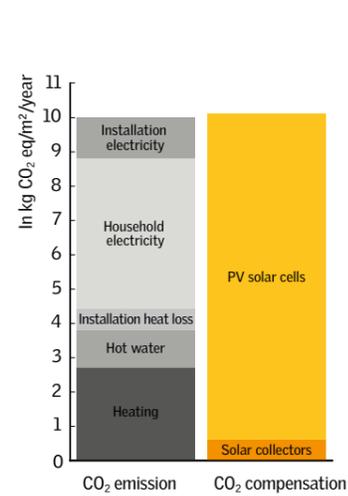
The payback time of emissions from construction, transport to the site, operation and domestic electricity is 30 years, after which the house will be carbon neutral.



Net energy balance



CO₂ balance



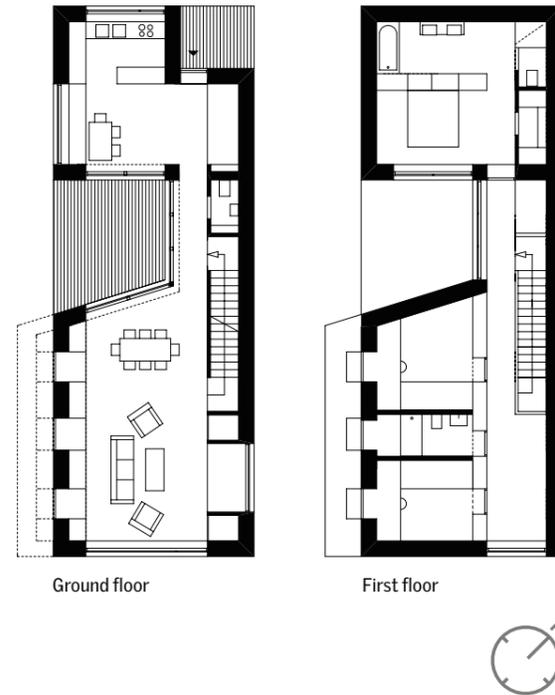
The calculation of the energy performance and production has been made according to national standards.

Ventilation

Intelligent control of windows will be the primary type of ventilation in spring, summer and autumn. In winter, this will be supplemented with mechanical ventilation with heat recovery. A comfortable summer indoor climate will be achieved by making use of the stack effect, night cooling and awning blinds on the windows. No energy is used for cooling.



Experiment # 3



Figures
The chart shows the technical characteristics of the VELUX roof windows in relation to heat loss, passive heat gain and daylight.

Roof windows with pane --65		
U _w (Heat loss U-value window)	1.1 W/m ² K	
U _g (Heat loss U-value pane)	0.7 W/m ² K	
g (Heat gain g-value)	0.48	
τ (Light transmittance)	0.68	
VELFAC facade windows		
	90°	
U _w (Heat loss U-value window)	0.76 W/m ² K	
U _g (Heat loss U-value pane)	0.47 W/m ² K	
g (Heat gain g-value)	0.46	
Outer walls		
U (Heat loss U-value)	0.13 W/m ² K	(395 mm insulation)
Roof		
U (Heat loss U-value)	0.12 W/m ² K	(540 mm insulation)
Floor slab		
U (Heat loss U-value)	0.12 W/m ² K	(500 mm insulation)
Fenestration		
Glass area	72 m ²	
Net floor area	201 m ²	
The glass area is equivalent to 36 % of the net floor area.		

Walk-in closet

- 1 low-energy centre-pivot window with white polyurethane finish 114 × 118 cm
- 1 frame extension
- 1 underfelt collar
- 1 vapour barrier
- 1 flashings
- 1 solar window operator
- 1 solar blackout blind
- 1 solar awning blind

Home office

- 1 low-energy centre-pivot window with white polyurethane finish 114 × 118 cm
- 1 frame extension
- 1 underfelt collar
- 1 vapour barrier
- 1 flashings
- 1 solar window operator
- 1 solar blackout blind
- 1 solar awning blind

Staircase/corridor

- 2 low-energy centre-pivot windows with white polyurethane finish 114 × 118 cm
- 2 frame extensions
- 2 underfelt collars
- 2 vapour barriers
- 2 flashings
- 2 solar window operators
- 2 solar blackout blinds
- 2 solar awning blind

Children's play area

- 2 low-energy centre-pivot windows with white polyurethane finish 114 × 118 cm
- 2 frame extensions
- 2 underfelt collars
- 2 vapour barriers
- 2 flashings
- 2 solar window operators
- 2 solar blackout blinds
- 2 solar awning blind

WC

- 1 low-energy centre-pivot window with white polyurethane finish 114 × 118 cm
- 1 frame extension
- 1 underfelt collar
- 1 vapour barrier
- 1 flashings
- 1 solar window operator
- 1 solar blackout blind
- 1 solar awning blind

Children's room 2

- 1 low-energy centre-pivot wooden window, white paint finish 114 × 160 cm
- 1 low-energy centre-pivot wooden window, white paint finish 114 × 118 cm
- 2 frame extensions
- 2 underfelt collars
- 2 vapour barriers
- 1 combi flashing
- 2 solar window operators
- 2 solar blackout blinds
- 2 solar awning blind

Thermal solar energy

- 6 solar collectors (4 114 × 118 cm and 2 114 × 140 cm) installed with combi flashing incl. flex-tubes and sealing collars

Bathroom

- 1 low-energy centre-pivot window with white polyurethane finish 114 × 118 cm
- 1 frame extension
- 1 underfelt collar
- 1 vapour barrier
- 1 flashings
- 1 solar window operator
- 1 solar blackout blind
- 1 solar awning blind

Master bedroom

- 1 low-energy centre-pivot window with white polyurethane finish 114 × 118 cm
- 1 frame extension
- 1 underfelt collar
- 1 vapour barrier
- 1 flashings
- 1 solar window operator
- 1 solar blackout blind
- 1 solar awning blind

Children's room 1

- 1 low-energy centre-pivot wooden window, white paint finish 114 × 160 cm
- 1 low-energy centre-pivot wooden window, white paint finish 114 × 118 cm
- 2 frame extensions
- 2 underfelt collars
- 2 vapour barriers
- 1 combi flashing
- 2 solar window operators
- 2 solar blackout blinds
- 2 solar awning blind

Children's bathroom

- 2 low-energy centre-pivot windows with white polyurethane finish 114 × 140 cm
- 2 frame extensions
- 2 underfelt collars
- 2 vapour barriers
- 1 combi flashing
- 2 solar window operators
- 2 solar blackout blinds
- 2 solar awning blind

Living room

- 3 low-energy centre-pivot windows with white polyurethane finish 114 × 140 cm
- 3 frame extensions
- 3 underfelt collars
- 3 vapour barriers
- 1 combi flashing
- 3 solar window operators
- 3 solar blinds
- 3 solar awning blinds

LichtAktiv Haus

Katenweg 41, 21109 Hamburg, Germany



Project owner: The VELUX Group
Architects: Katharina Fey (concept)
Prof. Manfred Hegger and
Tim Bialucha, TU Darmstadt ee
(design)
Ostermann Architekten
(project realisation)
Energy design: Prof. Klaus Daniels, HL Technik
Light planning: Prof. Peter Andres, PLDA
Statics: Prof. Karsten Tichelmann,
TSB-Ingenieure



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.



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.

Experiment # 4

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.

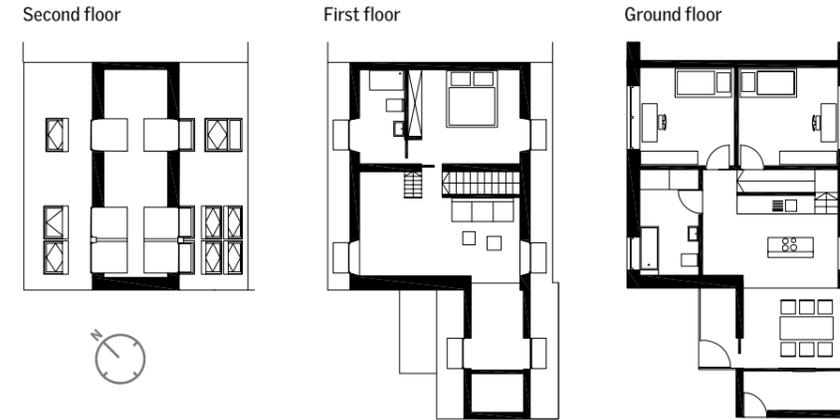
Premium modernisation



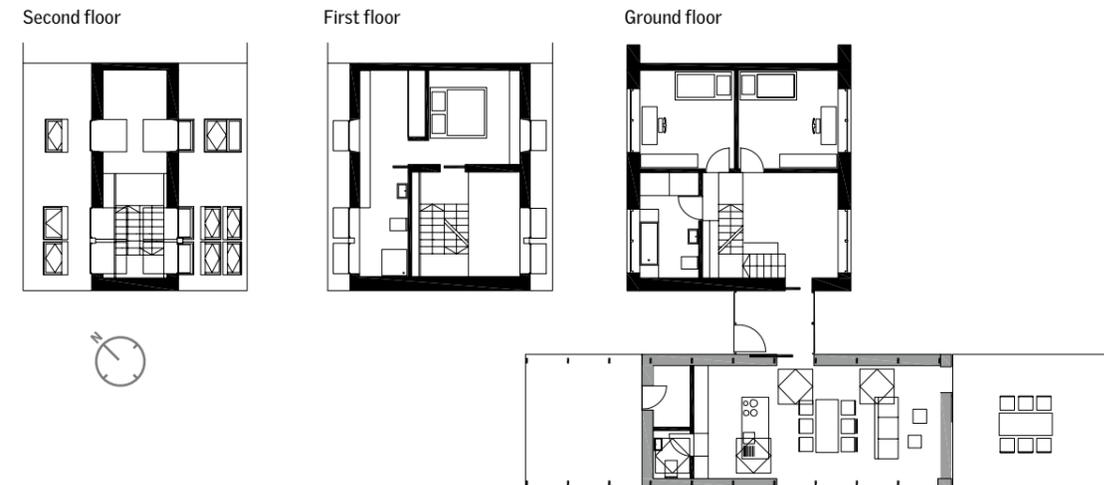
- Altered basic structure
- New extension
- Air-water-heat pump connected to thermal solar collectors
- PV solar cells
- 189 m²

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



Extended modernisation



Premium modernisation





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 m² in the old building to 60 m².

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



The old house in Germany prior to the modernisation.

Experiment # 4

Energy design

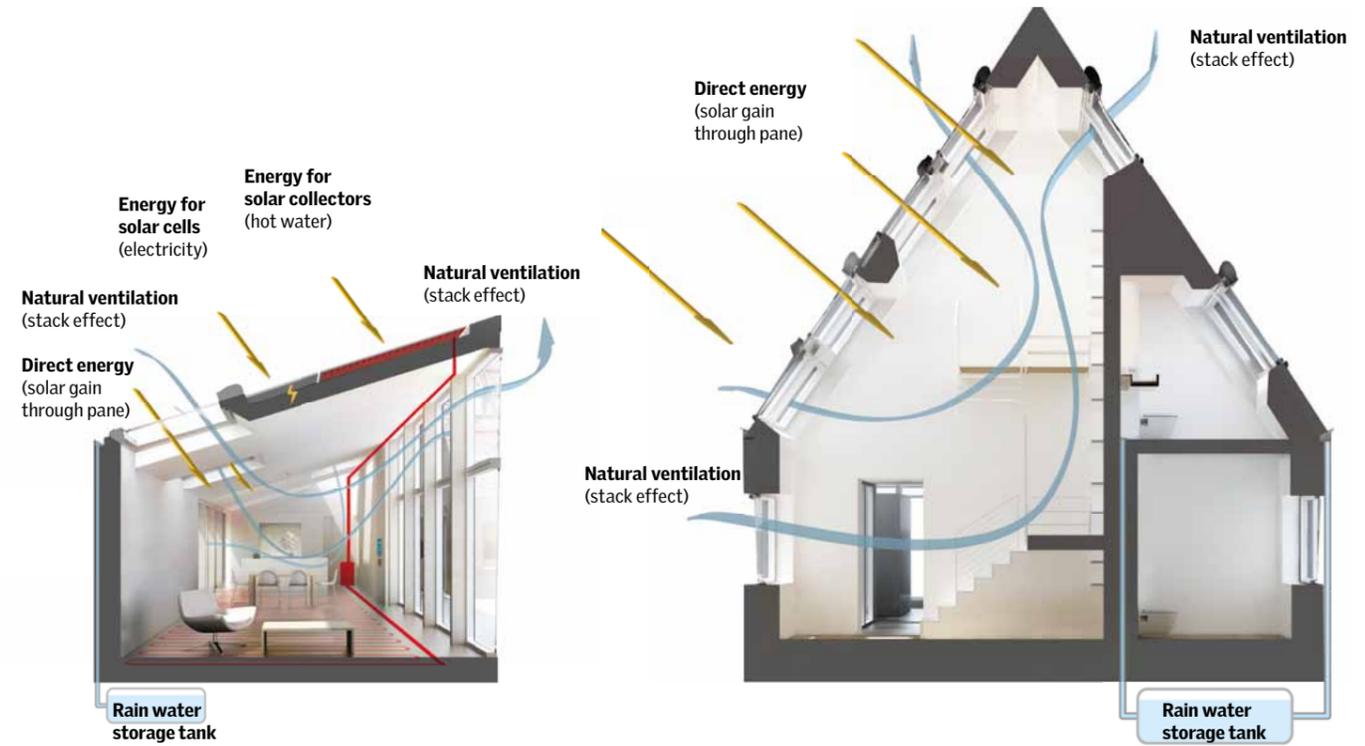
Future buildings should create healthier and more comfortable lives for their occupants without having a negative impact on the climate. Therefore, LichtAktiv Haus aims to cover its entire energy demand, including household electricity, by using renewable energy – without losing any of its high living 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.

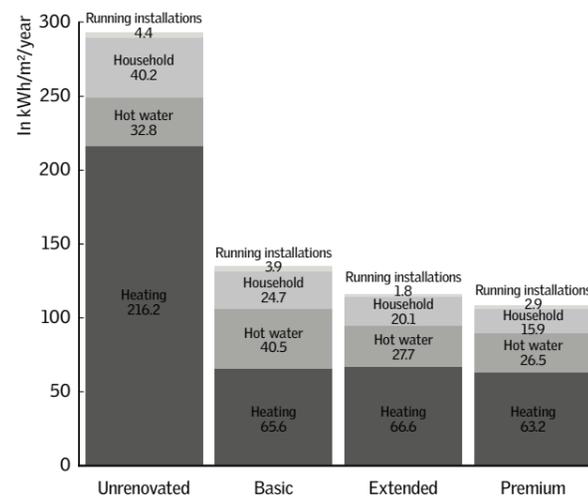
In the case of the VELUX experiment, a control system automatically opens and closes the windows, depending on temperature, CO₂ concentration and humidity – thus creating a comfortable and healthy indoor climate. To change air, the forces of nature are being used. The wind pressure on the building and 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.

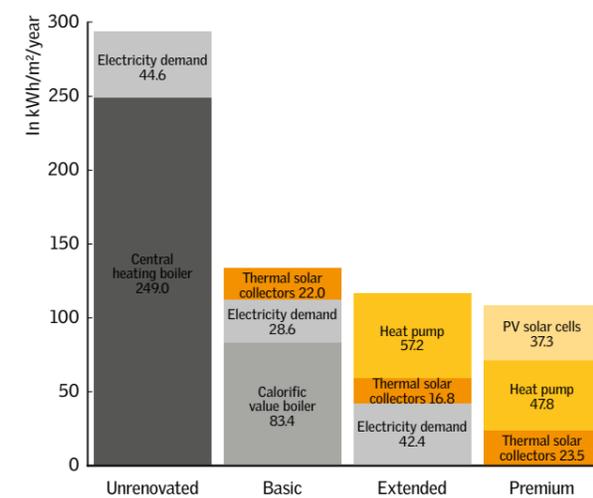
An air-water-heat pump and a solar thermal system create an innovative complete solution. The heat pump covers the larger part of the energy demand for heating and warm water. The unique feature of this system is that the solar thermal collectors are an integral part of the heat pump and provide heat 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. 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.



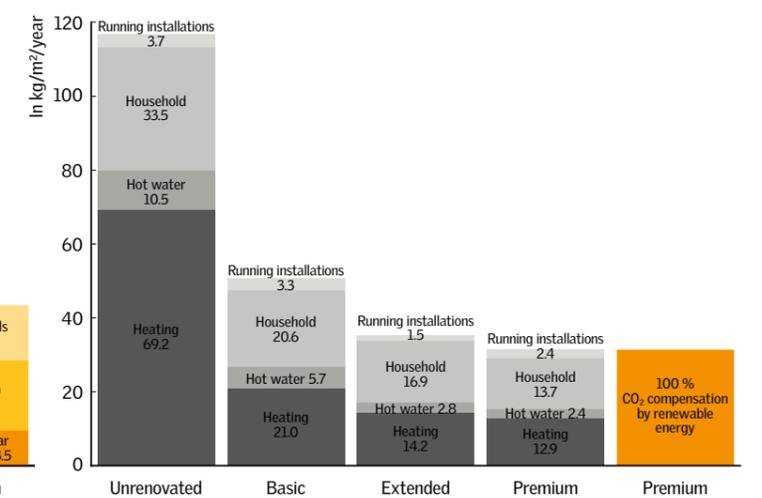
Overall energy requirement



Distribution of energy sources



CO₂ emissions





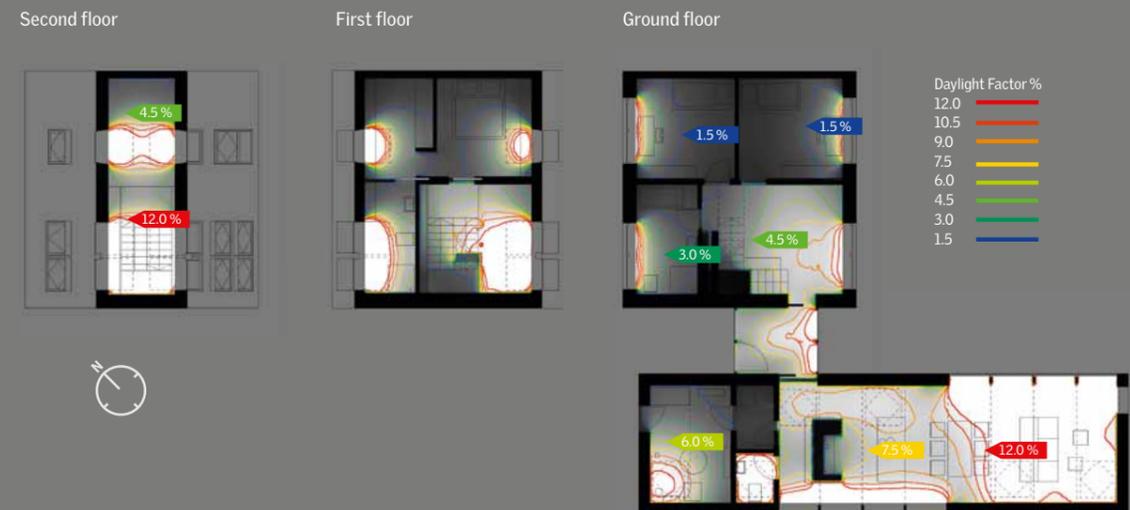
Daylight

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.



Experiment # 4

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 roller shutters (SSL U08)
- 2 solar roller blinds (RSL U08)

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)

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)

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)

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)

Kitchen

- 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)

CarbonLight Homes



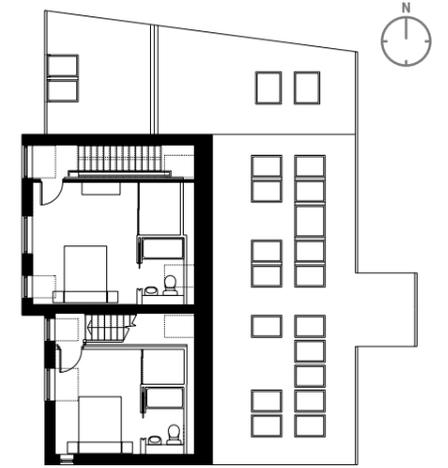
54+56, Horse Fair Lane, Rothwell, Northamptonshire, NN14 6GX, England



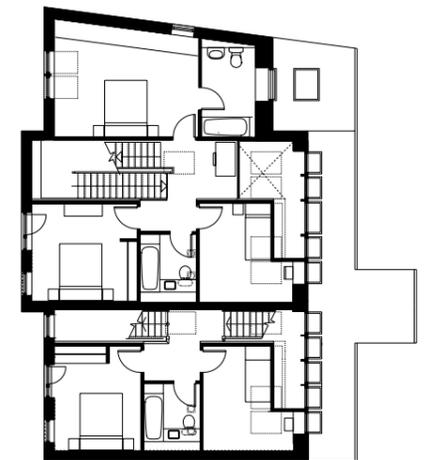
CarbonLight Homes are two semi-detached homes. They are proof that it is possible to build energy efficient, sustainable housing that is not only pleasant to live in, but also easy and affordable to replicate by the volume house builder. These homes are likely to be the first to be designed and built to the UK governments definition of zero-carbon housing and will achieve level 5 of the Code for Sustainable Homes.

The vision of CarbonLight Homes is to become a benchmark for future housing design, both at the local level (families) and the wider level (communities).

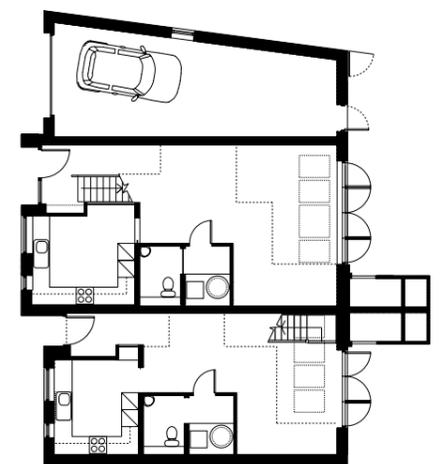
The design of these properties intends to minimise energy use among residents and generate a sense of community, while advocating a respect for the environment. The aesthetics of the scheme are sympathetic to the local context while also retaining an identity of its own.



Second floor



First floor



Ground floor

Daylight levels



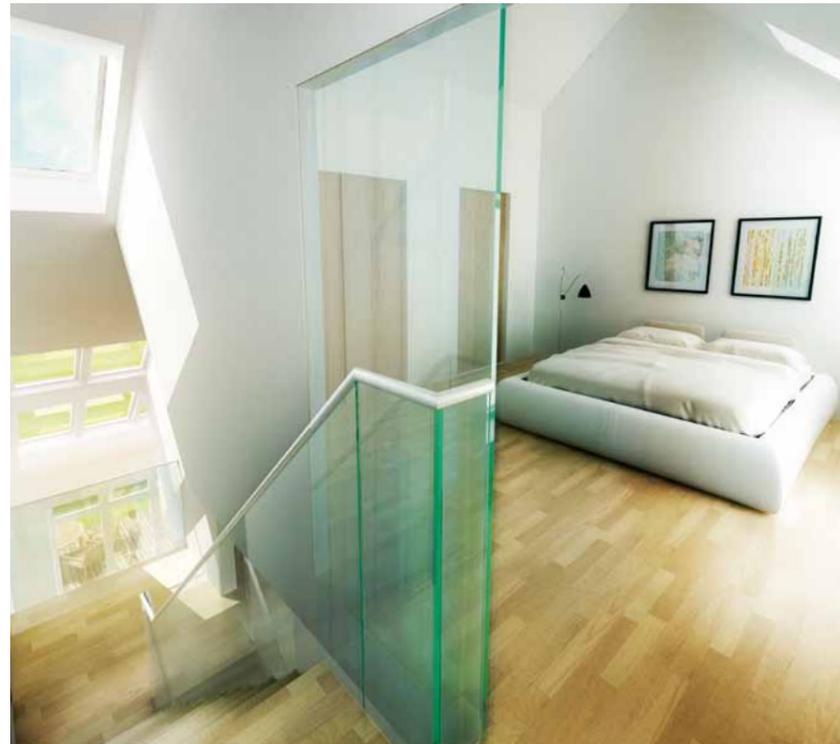
Second floor



First floor



Ground floor

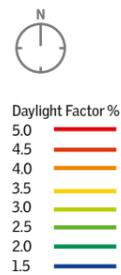


The architectural design

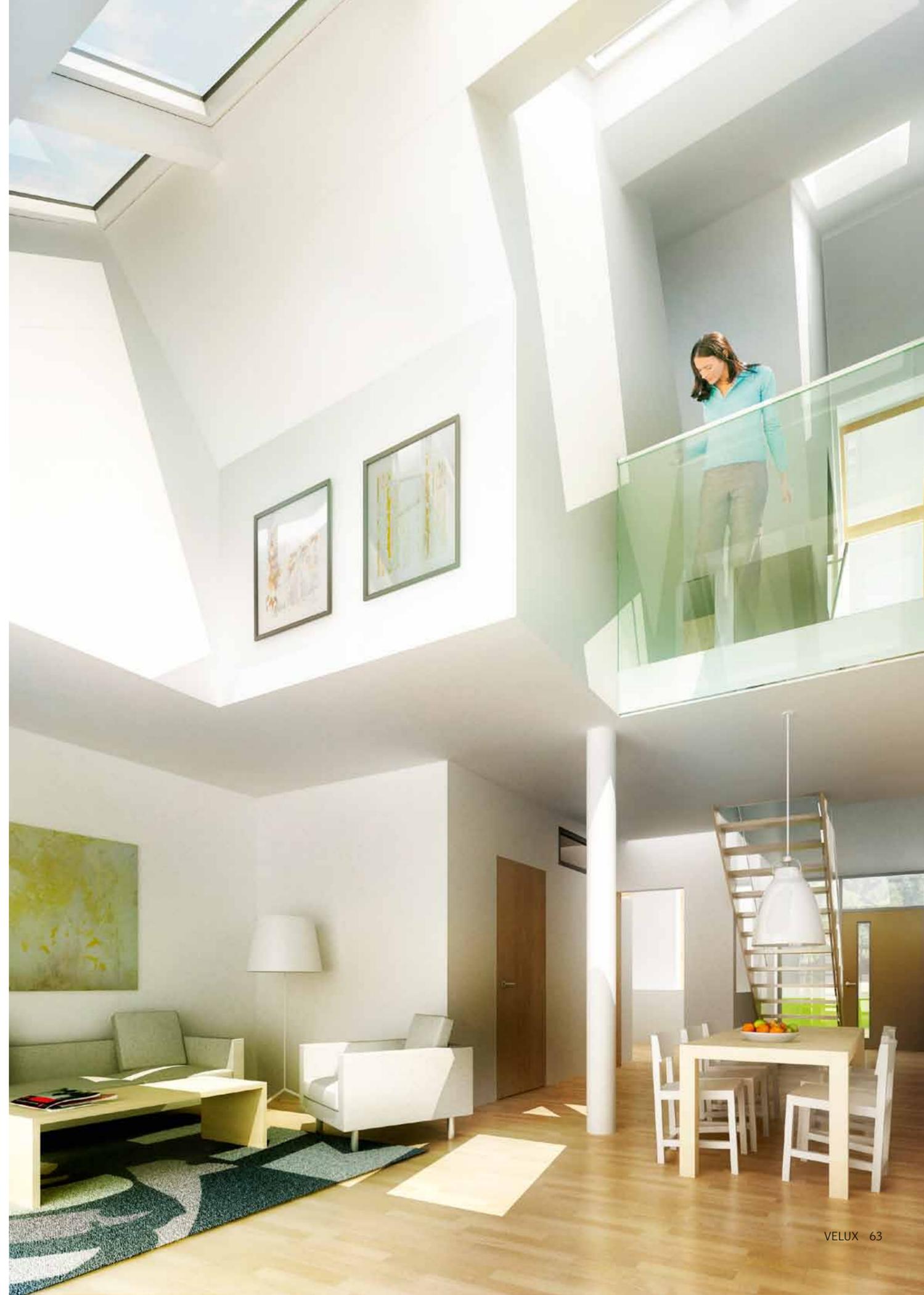
CarbonLight Homes are designed by HTA architects. The design is original with the use of building technology and the exciting way it captures natural daylight and ventilation to minimise energy consumption.

Daylight

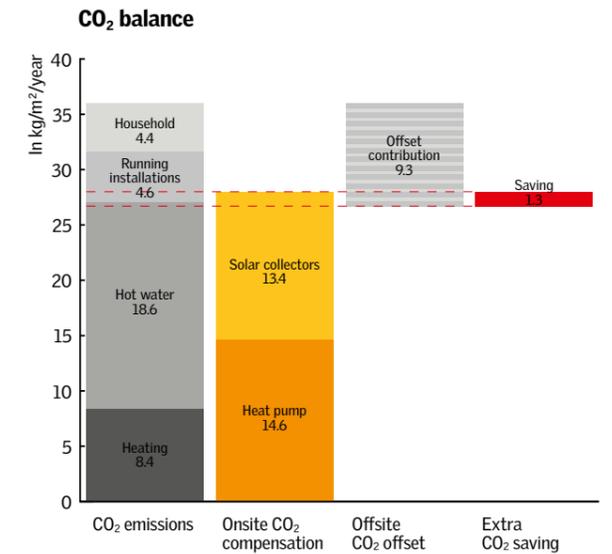
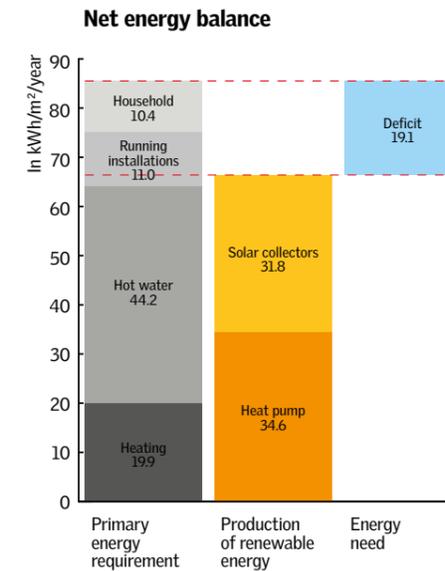
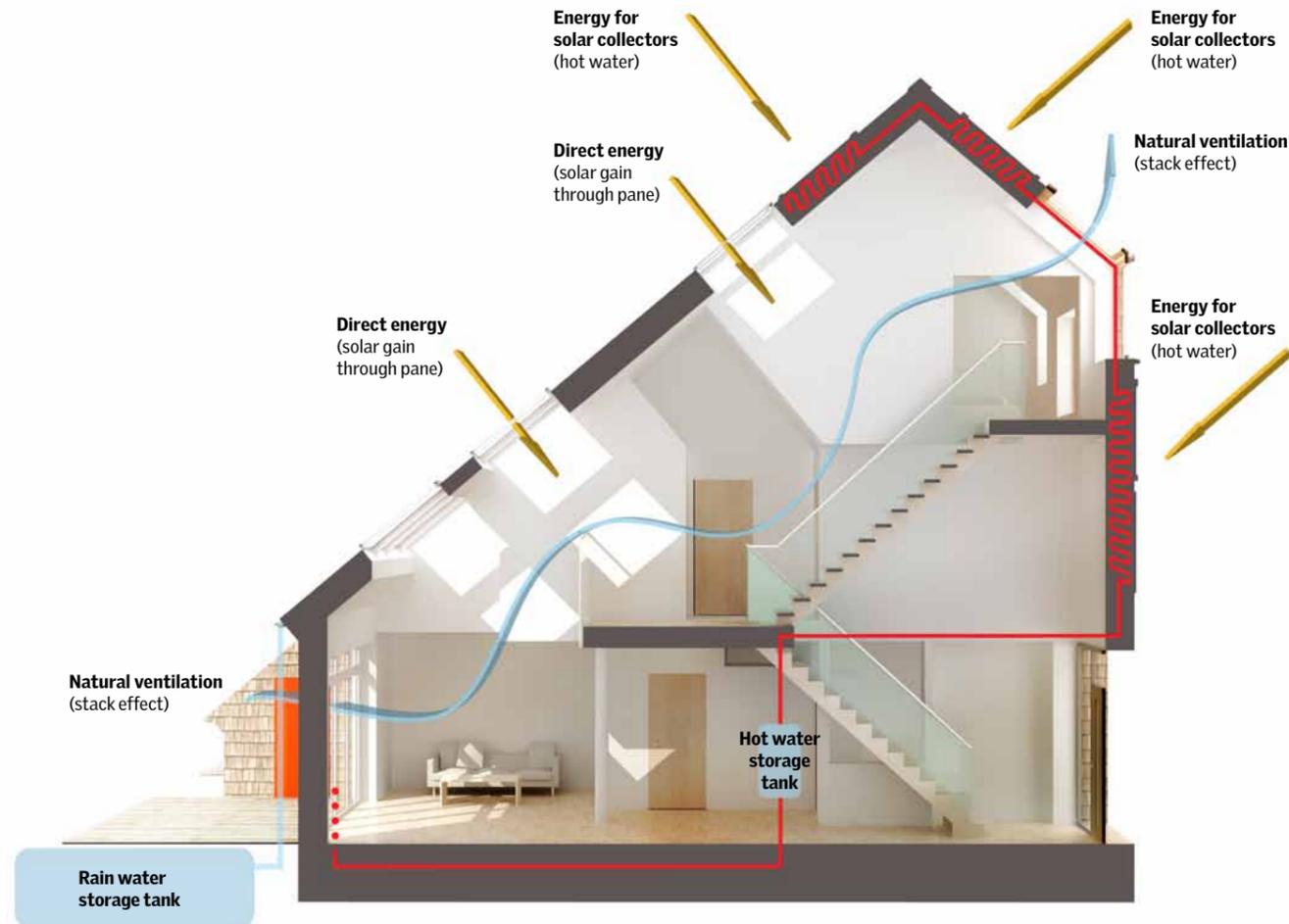
The starting point was to maximise daylight, which has many health and well-being benefits. Through extensive modelling HTA have achieved designs with a minimum average daylight factor of 5 % for the whole house – which is up to three times greater than that required by the Code for Sustainable Homes in living spaces.



Project owner: The VELUX Group
 Architects: HTA Architects
 Energy design: HTA Architects
 Turn-key contractor: Willmott Dixon



Experiment # 5



The calculation of the energy performance and production has been made according to national standards.

Energy design

The homes will achieve a 70 % reduction in CO₂ emissions, with the remaining 30 % of emissions being offset through an 'allowable solution'. The offsetting will be achieved in agreement with the Local Government office by carrying out improvements to the energy efficiency of existing local housing, which will more than offset the remaining emissions from the CarbonLight Homes, thus surpassing the required 100 % reduction in CO₂ emissions for the project.

Ventilation and heating

The houses are designed in such a way that fossil fuel energy (such as electricity), is reduced to a minimum. In the summer, natural ventilation is used for cooling and to create air movement that will push stale air out as well as bring fresh air in and maintain good levels of thermal comfort. During the winter, a Mechanical Ventilation system with Heat Recovery is used in addition to the natural ventilation system. This 'MVHR' system will extract heat from the kitchen and bath-

rooms and recycle it into the home to reduce the demand on the space heating system.

- Solar heating in combination with an air-to-water heat pump produces thermal energy that is used for hot water and space heating.
- Natural ventilation, as well as internal and external sun screening, ensures fresh air and a comfortable room temperature. Triple-height atriums around the stairs allow natural ventilation through both stack and cross ventilation. In the summer the homes can be opened up and cooled through massive purge ventilation.
- The control systems for the houses reduce energy consumption and ensure a healthy indoor climate.

Testing and monitoring

Unlike similar Eco building projects in the UK, the CarbonLight Homes are not prototypes to be showcased and monitored for an extended period of time, but designed to be real homes for real people. The testing and monitoring of the CarbonLight Homes will be part of a VELUX initiative where all six of the Model Home projects around Europe will provide data to be collated, reviewed and reported. Therefore, the energy consumption and performance of the buildings will be monitored for a twelve month period with test families in residence and afterwards the houses will be offered for sale on the open market.



Prizes and mentions

Design of future sustainable homes

The two zero carbon homes were selected for the accolade by a panel of industry experts. The judges commended the VELUX scheme for its original use of building technology and the exciting way it captures natural daylight and ventilation to minimise energy consumption. The properties were hailed as an exemplary benchmark for the design of future sustainable homes.

Winner of the Innovation Award

CarbonLight Homes emerged as the winner of the Innovation Award for Building Technology at the prestigious British Homes Awards (BHA) 2010.

Experiment # 5

Bedroom 1 en-suite

- 1 triple glazed, centre-pivot, polyurethane finish, solar powered roof window (GGU M08 0065G30R) + installation products BBX, BDX and EFL

Over stairs rear

- 1 triple glazed, centre-pivot, polyurethane finish, solar powered roof window (GGU M08 0065G30R) + installation products BBX, BDX and EFL
- 1 solar powered awning blind (MSL M08 5060E)

Bedroom 3

- 2 triple glazed, centre-pivot, polyurethane finish, solar powered roof windows (GGU M08 0065G30R)
- 1 triple glazed, top hung, polyurethane finish, manual roof window (GPU M08 0065G) + installation products BBX, BDX, EKL and EKY
- 2 solar powered roller shutters (SSL M08 0000E)
- 1 solar powered awning blind (MSL M08 5060E)
- 3 solar powered blackout blinds (DSL M08 1025E)

Over living area

- 5 triple glazed, centre-pivot, polyurethane finish, solar powered roof windows (GGU M08 0065G30R) + installation products BBX, BDX, EDL, EKL and EKY
- 5 solar powered awning blinds (MSL M08 5060E)

Bedroom 1

- 1 double glazed, centre-pivot, pine finish, solar powered roof window (GGL S06 3073G30R)
- 1 double glazed, side hung, pine finish, manual vertical window (VFA S38 3073G) + installation products BBX, BDX and EFL
- 1 solar powered awning blind (MSL S06 5060E)
- 2 solar powered blackout blind (DSL S06 + S08 1025E)

Over stairs front

- 1 double glazed, centre-pivot, pine finish, solar powered roof window (GGL M06 3073G30R)
- 1 double glazed, side hung, pine finish, manual vertical window (VFB M38 3073G) + installation products BBX, BDX and EFL
- 1 solar powered awning blind (MSL M06 5060E)
- 2 solar powered blackout blinds (DSL M06 + M08 1025E)

Thermal solar energy

- 10 flat plate solar collectors (CLI M08 + S08 4000) + installation products EFL

Master en-suite

- 1 triple glazed, centre-pivot, polyurethane finish, solar powered roof window (GGU M08 0065G30R) + installation products BBX, BDX and EFL

Thermal solar energy

- 12 flat plate solar collectors (CLI M08 + S08 4000) + installation products EFL

Over stairs rear

- 1 triple glazed, centre-pivot, polyurethane finish, solar powered roof window (GGU M08 0065G30R) + installation products BBX, BDX and EFL
- 1 solar powered awning blind (MSL M08 5060E)

Master bedroom

- 1 double glazed, centre-pivot, pine finish, solar powered roof window (GGL M08 3073G30R)
- 1 double glazed, side hung, pine finish, manual vertical window (VFA S38 3073G) + installation products BBX, BDX and EFL
- 1 solar powered awning blind (MSL M08 5060E)
- 1 solar powered blackout blind (DSL M08 1025E)

Over stairs front

- 1 double glazed, centre-pivot, pine finish, solar powered roof window (GGL S08 3073G30R)
- 1 double glazed, side hung, pine finish, manual vertical window (VFB S38 3073G) + installation products BBX, BDX and EFL
- 1 solar powered awning blind (MSL S08 5060E)
- 1 solar powered blackout blind (DSL S08 1025E)

Guest suite

- 2 double glazed, centre-pivot, pine finish, solar powered roof windows (GGL M08 3073G30R)
- 4 double glazed, bottom hung, pine finish, manual vertical windows (VFE M31 + M34 3073G) + installation products BBX, BDX and EFL
- 2 solar powered awning blinds (MSL M08 5060E)
- 6 solar powered blackout blinds (DSL M04 + M08 + M31 1025E)

Bedroom 3

- 2 triple glazed, centre-pivot, polyurethane finish, solar powered roof windows (GGU M08 0065G30R)
- 1 triple glazed, top hung, polyurethane finish, manual roof window (GPU M08 0065G) + installation products BBX, BDX, EKL and EKY
- 2 solar powered roller shutters (SSL M08 0000E)
- 1 solar powered awning blind (MSL M08 5060E)
- 3 solar powered blackout blinds (DSL M08 1025E)

Garage

- 1 double glazed, centre-pivot, polyurethane finish, manual roof window (GGU S06 0073G) + installation products BBX, BDX and EDL

Guest en-suite

- 1 triple glazed, centre-pivot, polyurethane finish, solar powered roof window (GGU S06 0065G30R) + installation products BBX, BDX and EFL

Bathroom (both houses)

- 2 rigid sun tunnels (TLR 010 2010E1) + ZTR rigid extension piece and ZTL light kit

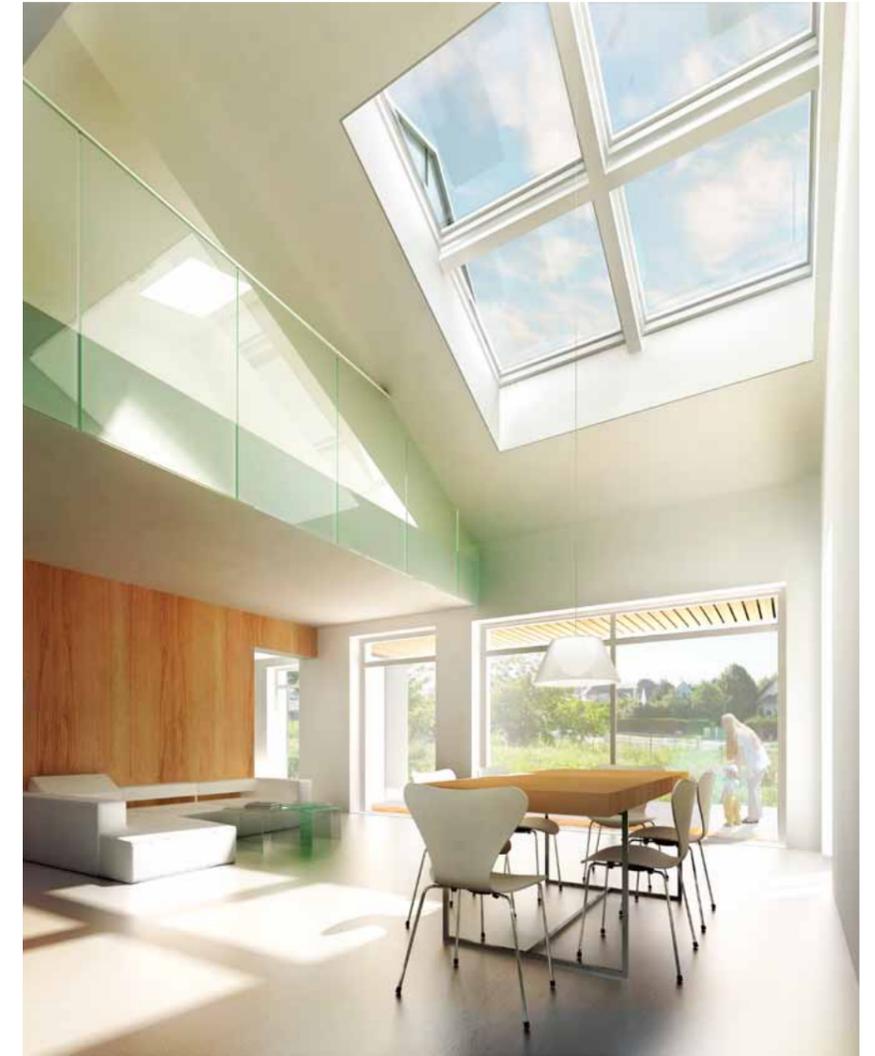
Over living area

- 6 triple glazed, centre-pivot, polyurethane finish, solar powered roof windows (GGU M08 + S08 0065G30R) + installation products BBX, BDX, EKL and EKY
- 6 solar powered awning blinds (MSL M08 + S08 5060E)

Maison Air et Lumière



35 Chemin des Justices, 91370 Verrières-le-Buisson, France



The vision is to build a detached house with a positive energy balance and a neutral environmental impact, with the living conditions of the residents at the focal point.

Maison Air et Lumière is based on a modular architectural concept of the pitched roof, enabling it to be adapted to different contexts depending on the house's location, orientation and use. The house combines three volumes fitted into one another, a design that contributes to the quality and variety of the interior. The pitched roof is part of France's cultural heritage. Roof pitches vary in steepness according to region and climate – and to meet the need for light and solar gain. This also allows a wide variety of interior spaces to suit personal preferences.

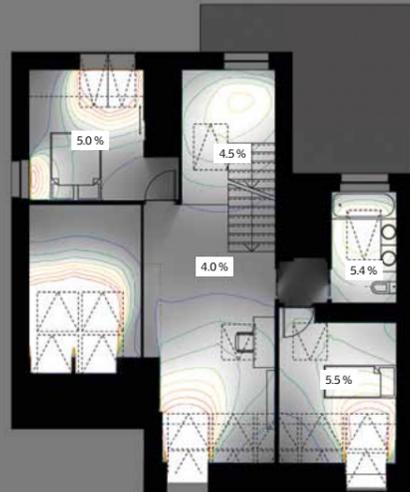
Architectural concept

The architecture of Maison Air et Lumière is adapted harmoniously to its site. The slope of the site is used to organise the floor levels, creating an intermediate level between the garden level and the upper floor. In addition to this integration to the site, the modular concept of the house allows adaptation to create variants to suit other contexts, such as terraced or urban houses. Whether the house is small or large, in town or in the country, the flexibility of the concept enables the type and number of modules to be varied, making it possible to transpose the principles of comfortable living, energy

efficiency and environmental quality of Maison Air et Lumière to a wide range of contexts. The 130 m² floor area extends over one and a half storeys, with the spaces under the roof put to full use. Maison Air et Lumière, using a design principle that integrates architectural quality and energy efficiency, manages to place the emphasis on interior comfort whilst respecting the energy and environmental objectives for new detached houses for 2020.

Experiment # 6

Daylight levels



First floor



Ground floor



Daylight

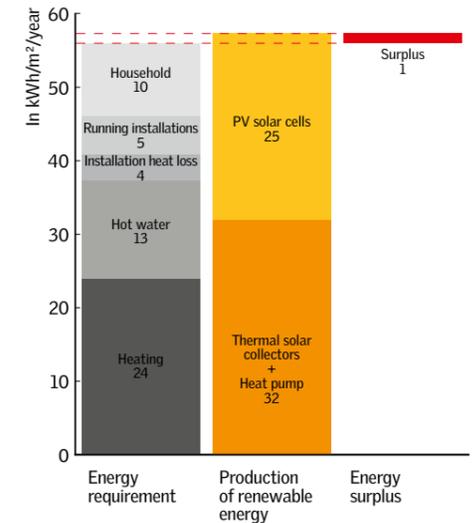
Particular attention has been paid to daylight to ensure the physical and psychological health and well-being of the residents, and to enlarge the visual perception of the indoor spaces whilst saving energy by reducing the need for artificial lighting. The amount of daylight and the quality of its distribution have been studied scientifically using VELUX Daylight Visualizer 2.

Ventilation

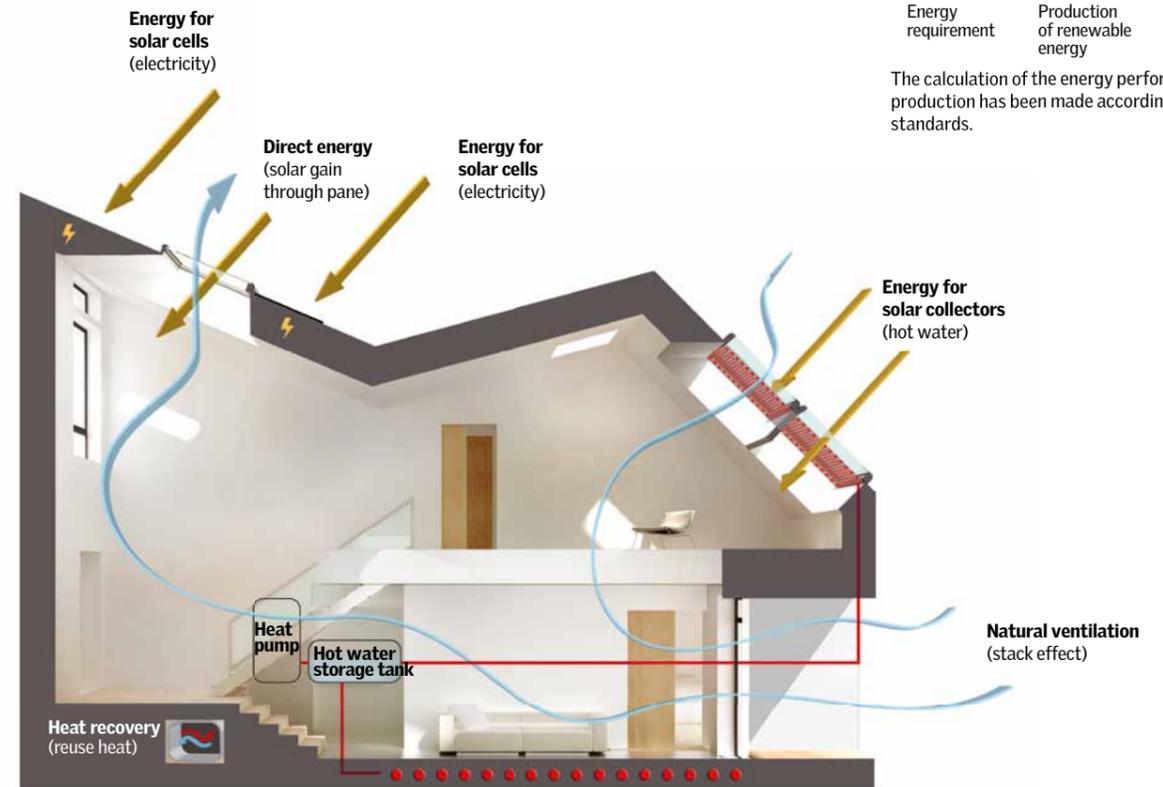
According to the season and weather conditions, ventilation is provided by a hybrid system that combines the advantages of mechanical ventilation with heat recovery in winter and, in summer, natural ventilation by window opening (supplemented by mechanical extraction in bathroom and kitchen).

Project owner: The VELUX Group
 Architects: Nomade Architectes
 Energy design: Cardonnel Ingénierie

Net energy balance (preliminary calculations)



The calculation of the energy performance and production has been made according to national standards.



Energy design

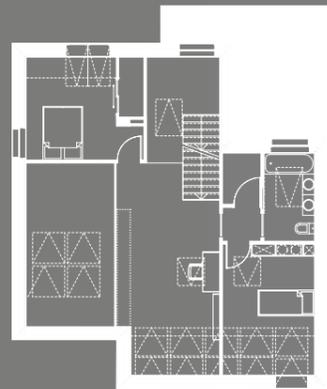
The energy concept of Maison Air et Lumière is based on the maximum use of renewable resources (solar energy, natural light, fresh air) in order to minimise the need for air-conditioning in summer, to reduce heating in winter and to reduce artificial lighting. The combination means a neutral environmental impact and maximum comfort for the residents. The house, which is built on a concrete slab on an earth platform insulated on the underside, is constructed with a well-insulated wooden frame and with a window-floor ratio of nearly 1:3.

With its interplay of roof structures, the building is compact and very well insulated and, in order to create a stable and comfortable room temperature, the interior walls are lined with terracotta tiles, appreciably improving the thermal inertia of the building. The efficiency of the insulation combined with the recovery of free internal heat and solar gains through the windows will make it possible to reduce the heating demand to a minimum. Heating and hot water are provided by a heat pump connected to VELUX thermal solar panels and a low-temperature underfloor heating system.

The artificial lighting, domestic appliances and multimedia equipment were selected on the basis of their low consumption. Moreover, to reduce electricity consumption further, the washing machine and dishwasher can be directly connected to a cold and hot water inlet.

All electric power consumption will be offset by the contribution from 35 m² of photovoltaic panels integrated in the roof. In normal use of the building, the overall energy balance is positive.

Experiment # 6



First floor



Ground floor



Entrance hall

- 1 solar powered centre-pivot roof window, white polyurethane finish, double glazed (GGU P08 0073G30R)
- 1 solar powered roller shutter (SSL P08 5060)
- 1 insulation collar + installation set (EDJ P08 2000)
- 1 vapour barrier collar (BBX P08 0000LX)

Upstairs bathroom

- 1 solar powered centre-pivot roof window, white polyurethane finish, double glazed (GGU P08 0073G30R)
- 1 insulation collar + installation set (EDJ P08 2000)
- 1 vapour barrier collar (BBX P08 0000LX)

Downstairs WC

- 1 sun tunnel – rigid tube (TLR 014 2010)
- 4 rigid extension sections (ZTR 014 0124)
- 1 low-energy light kit (ZTL 014)

Downstairs bathroom

- 1 sun tunnel – rigid tube (TLR 014 2010)
- 4 rigid extension sections (ZTR 014 0124)
- 1 low-energy light kit (ZTL 014)

South-facing bedroom

- 1 solar powered roof window, wood finish, double glazed (GGL S08 3073G30R)
- 1 centre-pivot roof window, wood finish, double glazed (GGL S08 3073G)
- 2 solar powered awning blinds (MSL S08 5060)
- 2 solar powered blackout blinds (DSL S08 1100)
- 2 insulation collars (BDX S08 2000)
- 2 vapour barrier collars (BBX S08 0000LX)
- 1 solar powered roof window, wood finish, double glazed (GGL P06 3073G30R)
- 1 solar powered awning blind (MSL P06 5060)
- 1 solar powered blackout blind (DSL P06 1100)
- 1 insulation collar + installation set (EDJ P06 2000)
- 1 vapour barrier collar (BBX P06 0000LX)
- 1 vertical window (VFE S34 3073GV)
- 1 solar powered blackout blind (DSL S04 1100)
- 1 vapour barrier collar (BBX W34 0000LX)

North-facing bedroom

- 2 solar powered roof windows, wood finish, double glazed (GGL M10 3073G30R)
- 2 solar powered blackout blinds (DSL M10 1100)
- 2 insulation collars + installation set (EDJ M10 2000)
- 2 vapour barrier collars (BBX M10 0000LX)
- 2 vertical windows (VFE M34 3073G)
- 2 solar powered blackout blinds (DSL M04 1100)
- 2 vapour barrier collars (BBX W34 0000LX)

Guest suite

- 4 solar powered centre-pivot roof windows, white polyurethane finish, double glazed (GGU S06 0073G30R)
- 4 solar powered blackout blinds (DSL S06 1100)
- 4 solar powered awning blinds (MSL S06 5060)
- 4 insulation collars + installation set (EDJ S06 2000)
- 4 vapour barrier collar (BBX S06 0000LX)
- 2 support rafters, white painted finish (EKY W35 2000)

Mezzanine

- 1 solar powered centre-pivot roof window, wood finish, double glazed (GGL S08 0073G30R)
- 1 centre-pivot roof window, wood finish, double glazed (GGL S08 3073G)
- 2 solar powered awning blinds (MSL S08 5060)
- 2 solar powered blackout blinds (DSL S08 1100)
- 2 insulation collars (BDX S08 2000)
- 2 vapour barrier collars (BBX S08 0000LX)
- 1 solar powered roof window, wood finish, double glazed (GGL P06 0073G30R)
- 1 solar powered awning blind (MSL P06 5060)
- 1 solar powered blackout blind (DSL P06 1100)
- 1 insulation collar + fitting sections (EDJ P06 2000)
- 1 vapour barrier collar (BBX P06 0000LX)

Thermal solar energy

- 6 solar panels (CLI S08 4000)
- 2 additional length flexible flow and return pipes (ZFM 020)
- 4 flex tubes for side-by-side installation of collectors (ZFR EFO)
- 1 flex tubes for side-by-side installation of collectors (ZFR 220)
- 1 temperature sensor (ZPT 1000)
- 4 sealing collars (ZFT 0003)



Learning – from theory to practice and back to theory

All Model Home 2020 projects will be monitored in terms of quantitative and qualitative aspects. We monitor energy consumption and indoor climate and compare the actual results with the assumptions made in the planning process.

What we have learned so far shows that there is a distinct gap between theory and practice. The real challenge is to establish a bridge of dialogue to close this gap in order to qualify theory and thereby future practice. The development goes from theory to practice and back into theory by way of testing and iterative loops, continuously developing throughout the whole project. The key target is that we enable ourselves to build houses based on qualified theory that meet the requirements for user well-being.

The experience from the first project, Home for Life, is that the theory and benchmarks defined at the beginning of the project must be revised for the next project of this kind. Key facts are that the test family used the house differently from what was assumed by the engineers and product developers. One example is that the family used a particular product in the house more often than the engineers had calculated. Another is that this family demanded a heating comfort of 23 degrees, whereas Danish calculation standards in compliance tools assume 20 degrees.

A second key factor learned is that not only do good programming and planning matter, but construction quality is also vital. A sustainable building will be no better than the people who actually build it or the people who manage the start-up optimisation. These people must understand how the house works if they are to build in a way that avoids punctures and leaks, leading to heat loss. In sustainable buildings, the quality of the envelope – roof, walls and floor – is vital and efficient airtightness is a must to prevent the uncontrolled escape of hot air from the house.

The Model Home 2020 project takes innovation as its starting point. When it comes to monitoring the experiments, we wish to share the results for all the demo houses with the building industry and to elaborate on them in order to stimulate a culture where learning, positive as well as negative, is taken onwards.

By sharing the experience and knowledge we obtain from the Model Home 2020 projects with other projects and other experts in the building industry, we hope to be able to contribute to the development in the building industry of sustainable buildings.

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