

**VELUX®**

# Healthy Home Townhouses

Active House settlement in Stjørdal, Norway

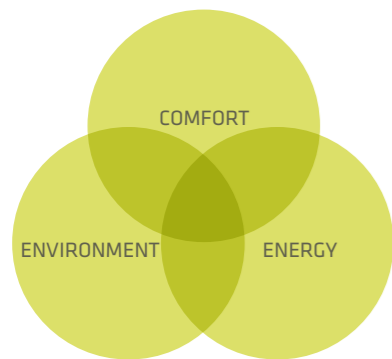


# Active House

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

Active House proposes a target framework for how to design buildings that contribute positively to human health and well-being by focusing on the indoor and outdoor environment and the use of renewable energy.

Healthy Home Townhouses are built on experience. The VELUX group has participated in making Active Houses all over Europe, Canada and the USA. Many of the houses were designed as built experiments to gain knowledge and know-how to share with the building industry.



The Active House vision defines highly ambitious long-term goals for the future building stock. Its objective is to unite interested parties, based on a balanced and holistic approach to building design and performance, and to facilitate cooperation on building projects, product development, research initiatives and performance targets that can move us further towards realising the vision.

An Active House is evaluated on the basis of the interaction between energy consumption, indoor climate conditions and impact on the external environment.

**Daylight could save 15 000 000 tons of CO<sub>2</sub> every year in Europe.**

Daylight cuts the energy used for lighting.

The icon shows a stylized house with a sun above it and a person sitting on the floor inside, representing the impact of daylight on energy consumption.

## So much more than a roof window

Since the foundation of the VELUX Group in 1941, the importance of daylight in buildings and people's quality of life have been cornerstones in our business strategy. Today, our business is still closely linked to building design that brings daylight and fresh air into people's everyday lives and, at the same time, saves energy and reduces the impact on the environment.

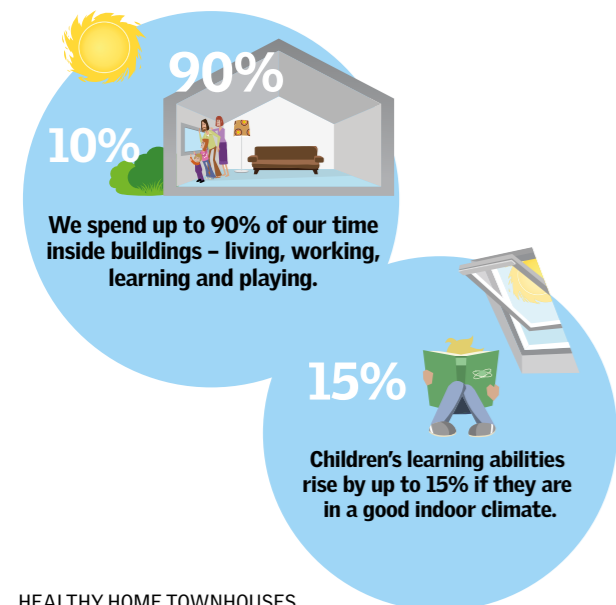


# Affordable excellence

A home is the framework of daily life. It should create optimal living conditions at an affordable price. Healthy Home Townhouses in Stjørdal, Norway were designed and built as houses that offer beautiful design, a healthy indoor environment and minimal energy consumption.

By combining the Active House principles with local expertise and experience, Healthy Homes can be offered at a price far lower than most energy-efficient constructions:

“The unique feature of these townhouses is a range of exclusive details and Active House standards that come at a square-metre price similar to that of a traditional newbuild townhouse in the same area,” says real estate agent Torstein Nordby of Stjørdal.



# Open your eyes and breathe in: daylight and fresh air bring well-being and good health

In modern societies, we spend up to 90% of our time indoors. Obviously, the buildings in which we work and play have the potential to either enhance or impair our health and well-being.

The Active House initiatives focus on creating a healthy and comfortable indoor climate. By applying new technologies and well-proven solutions, Active House constructions are able to combine low energy consumption with a pleasant and healthy indoor environment. Among the main features in Healthy Home Townhouses are VELUX INTEGRA® roof windows, which provide natural ventilation, high levels of daylight and integrated sunscreening products. The roof windows can be programmed to open 2-4 times a day for renewal of the indoor air and thereby provide better air quality in the house throughout the day.

To better understand the impact of indoor air on our health, we need to consider the amount of air we breathe per day. An average person consumes 2 kg of food and water per day, whereas the intake of air is 15 kg per day. The health impact is clearly important (C. Nilsson, Air, Swegon Air Academy, 2008). Good indoor air quality contributes to the prevention of illnesses like asthma and allergy, especially among children. In Healthy Home Townhouses, good air quality is ensured with a simple CO<sub>2</sub> control system, which sends a signal to the VELUX INTEGRA® roof windows to open if the CO<sub>2</sub> levels in the room reach more than 1000 ppm. Outdoor air contains approximately 400 ppm. A set range for CO<sub>2</sub> of 750 - 1000 provides very good air quality, while a CO<sub>2</sub> concentration above 1200 ppm indicates poor air quality.

Daylight is a crucial component in the architecture of Healthy Home Townhouses. Good work light enhances productivity and concentration among children as well as adults. Natural light has a positive influence on the mood and well-being, and being able to sense the movements of the sun connects a busy modern lifestyle to the rhythms of nature.



- Healthy indoor climate is especially important in children's bedrooms. Playing and sleeping increase levels of CO<sub>2</sub>. The air can quickly be removed by opening the roof windows.
- VELUX roof windows allow you to control the flow of daylight and fresh air into your home, enabling you and your family to live a healthy indoor life.
- Sufficient daylight in the children's rooms improves learning abilities and well-being.
- High light levels during daytime and darkness at night-time improve circadian entrainment which in turns improve sleep quality.

# About the Healthy Home Townhouses



Overview. Visualisation of the Active House settlement in Stjørdal. The Healthy Home Townhouses and the Future Active House Norway.

Located in the Stjørdal Active House residential complex outside the Norwegian city of Trondheim, the six townhouses form two rows of terraced houses. The settlement also includes one detached active house called Future Active House Norway, built in 2012.

Connected by a street separated from the main road, the Healthy Home Townhouses are surrounded by a safe environment. Residents of the area have a view over the Trondheim fjord and enjoy the proximity to the mountains. Each townhouse has a floor area of 138 square metres distributed between two floors. All of them have a terrace.

With several bedrooms, a convenient laundry room and a spacious terrace, each house has a range of facilities for families of different sizes and life styles. The focal point of the house is the large kitchen-dining room on the upper floor. Here, roof windows provide daylight from above and facade windows ensure a great view to the surrounding area.

Each of the three bedrooms, two on the ground floor and one on the first floor, are equipped with windows that allow residents to create fast, natural ventilation. Good sleep does not happen by chance – and one of the contributory factors is adequate fresh air. In addition, a regular change of air helps prevent indoor environment problems such as mould and humidity damage.

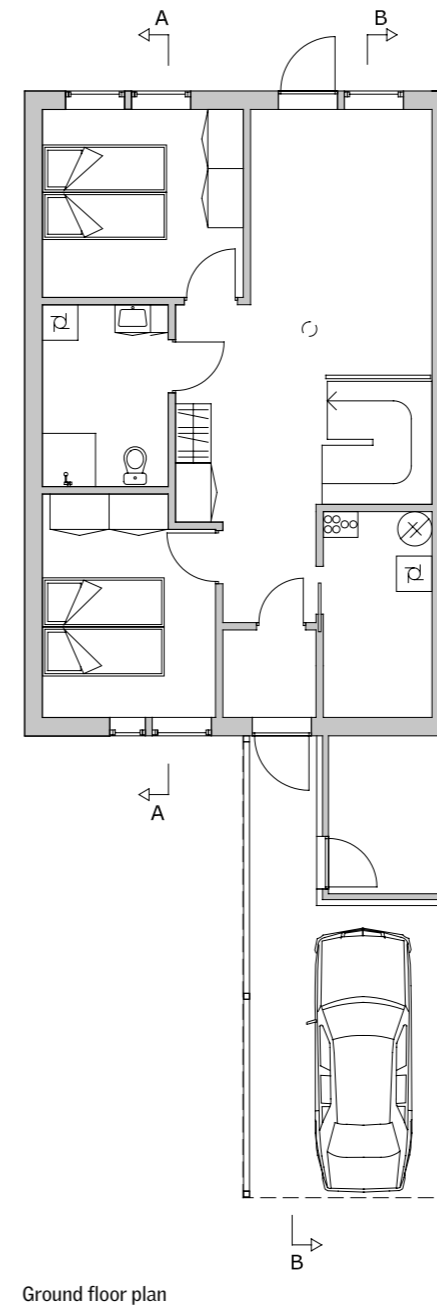
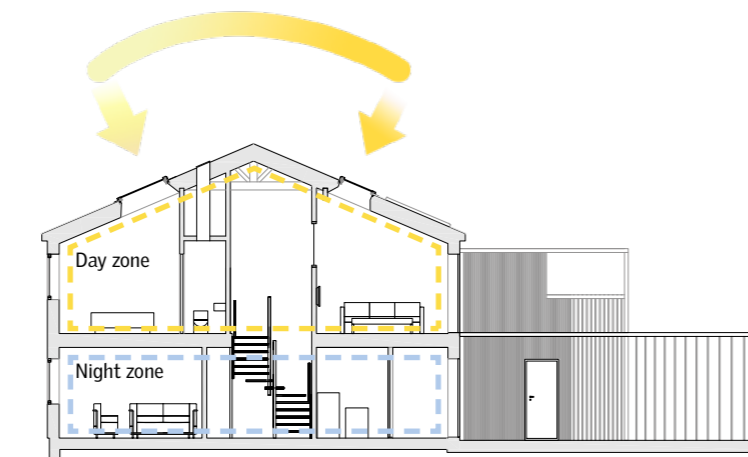
In the ground floor living room, residents can enjoy sunlight from above. Thanks to a sun tunnel in the ceiling, natural daylight is led into the room, thereby reducing the need for electrical lighting.

In Healthy Home Townhouses, wood is a material frequently applied on the outside as well as inside. Besides offering a beautiful and pleasant structure, wood can be sourced locally and has been used as a building material in Norway for centuries. So the experience of local carpenters and suppliers ensures work of high quality.

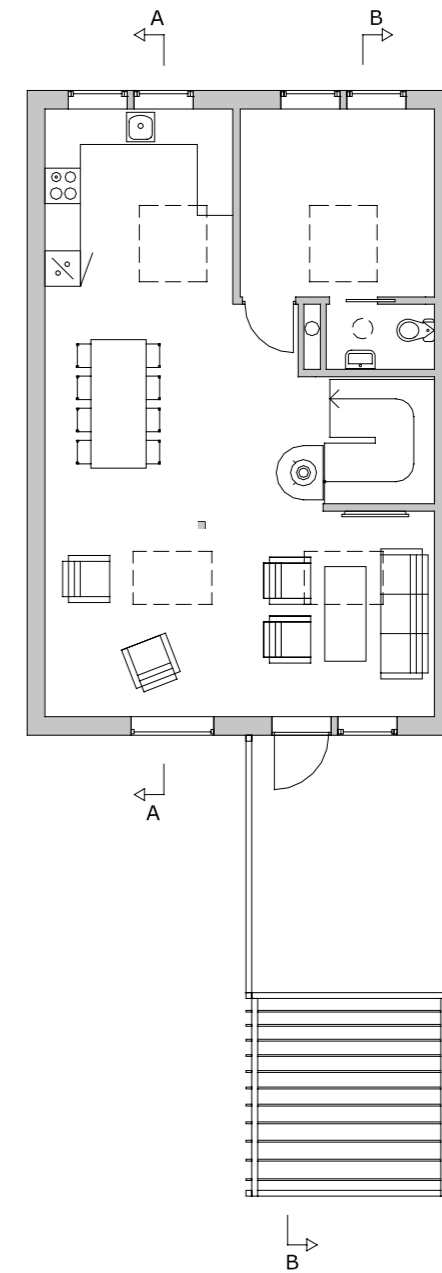


The Healthy Home Townhouses are located in Hjelset in Stjørdal, Norway.

**Orientation**  
Shape of the house is optimised to the climate and site conditions. Thanks to that, daylight conditions in the houses are optimised. Moving the living room to the second floor made it possible to create evenly lit day zone with better use of the narrow plot.



Ground floor plan



First floor plan



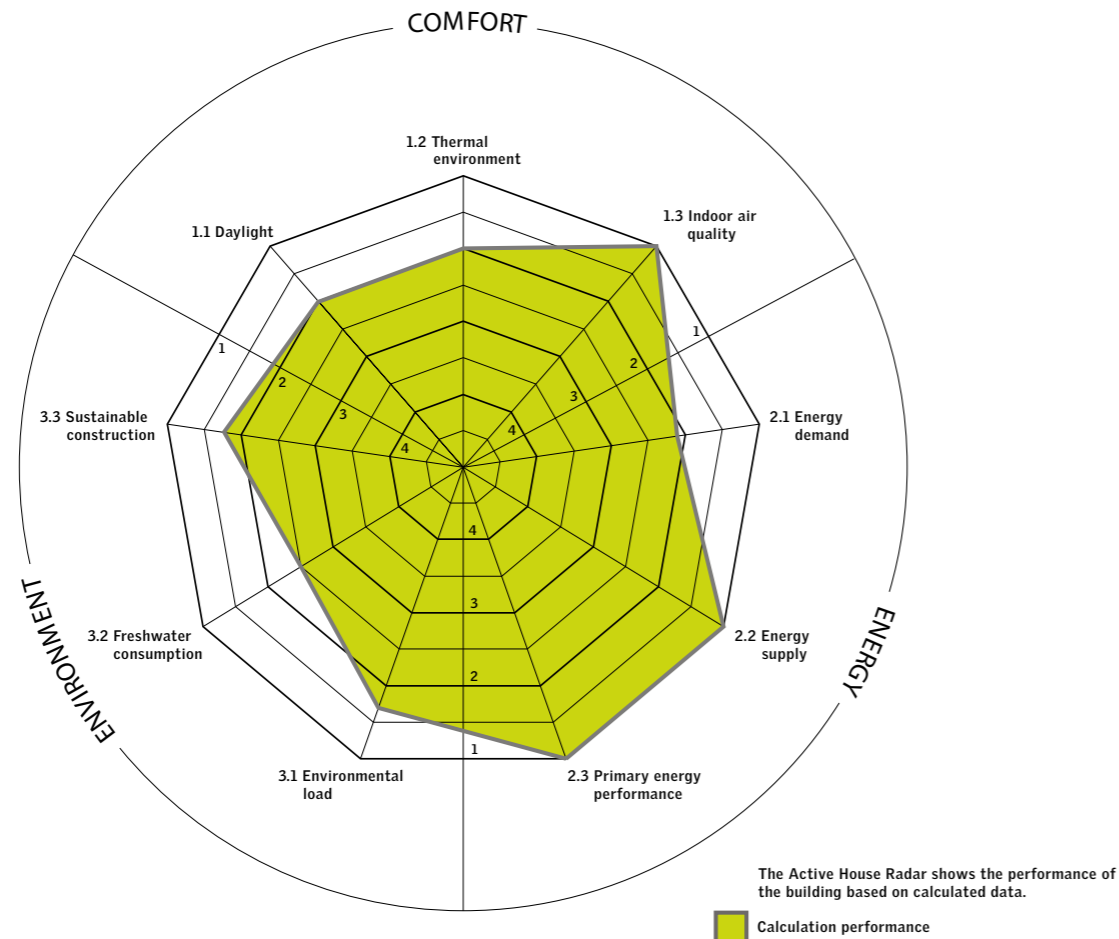
**Design tips:**  
Roof windows combined with vertical windows make the room feel even bigger.

Use both facade and roof windows to maximise stack effect. Placing windows on both sides of the room optimises cross-ventilation.

Sun tunnels provide light to the ground floor, and to the bathroom in the second floor, saving energy for electricity.



The Active House Radar shows at a glance to what extent the individual criteria comfort, energy and environment have been met. This figure also shows how the parameters within the individual criteria are interconnected.



## Key principles of Active House:

### Indoor climate

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

### Energy

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

### Environment

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

[www.activehouse.info](http://www.activehouse.info)

Active House is an initiative supported by the VELUX Group

## Comfort

### Daylight

- Healthy Home Townhouses have good daylight conditions. Even in the event of an overcast sky, the top floor appears bright and evenly illuminated.

### Thermal environment

- Thanks to the roof windows' external and internal sunscreening, the solar load can be considerably reduced in midsummer.
- In summer, targeted night-time ventilation via strategically positioned windows (ventilative cooling), makes it possible to keep room temperatures below 26°C for 97% of the time.
- Heating can be regulated in a user-friendly way to attain comfortable room temperatures.

### Indoor air quality

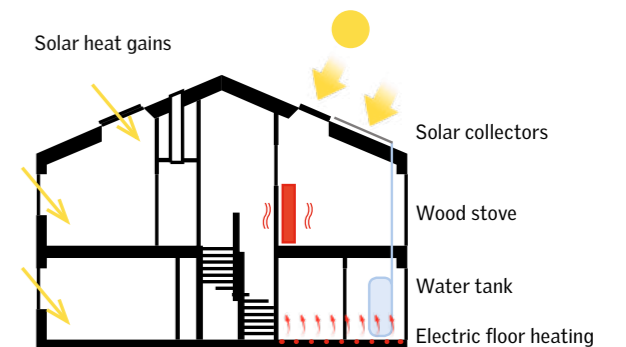
- With a combination of natural and mechanical ventilation, Healthy Home Townhouses provide air quality with a very low CO<sub>2</sub> concentration. Indoor air quality is usually measured in ppm, parts per million, with a concentration of 1000 considered to represent good air quality. Healthy Home Townhouses provide a ppm lower than 1000 –all year round.



- Mechanical ventilation in winter
- Heat recovery system
- CO<sub>2</sub> - level control

## Energy

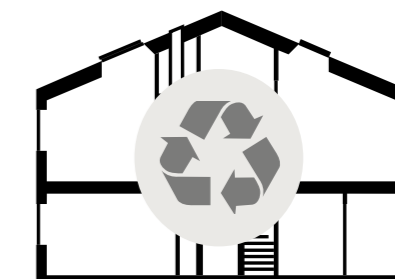
- The total energy demand in Healthy Home Townhouses is 51 kWh/m<sup>2</sup> per year for heating, water heating, ventilation, technical installations and electricity for lighting. That is 63% less than the average detached house in Norway.
- The goal is that the energy supply to an Active House should be based on renewable and CO<sub>2</sub> neutral energy sources. In Stjørdal, 100% of all energy supplied to the houses comes from hydropower sources.
- Thermal collectors installed on the roof provide 11 kWh/m<sup>2</sup> per year for the production of hot water.
- In the winter, mechanical ventilation takes fresh outdoor air into the house and preheats it in a heat exchanger, thereby reducing the energy required for warming cold air.
- Each house is equipped with a wood-burning stove as an environment-friendly alternative heating source.



- 100% of all energy supplied to house comes from hydropower source
- Daylight utilisation

## Environment

- Thanks to the lightweight construction, made entirely of local wood, more than 23% of the building can be recycled at the end of its life span.
- Water consumption is reduced with water saving fittings on shower and sink.
- A detailed life cycle analysis certifies that the building has a very good environmental balance.





# Comfort - daylight

## Light up your life

Achieving good daylight conditions can be a challenge in townhouses, since they often only have light from two sides. But in Healthy Home Townhouses, both facade windows and roof windows provide vibrant light to the centre of the floor plan on the first floor. Roof windows often provide twice as much light as vertical windows. An integrated design tool was used to optimise the daylight conditions in the Healthy Home Townhouses, enabling some of the light from the high-positioned roof windows to reach the ground floor through an open staircase. In addition, the windows can also be used to regulate thermal comfort.

## Daylight factor analysis

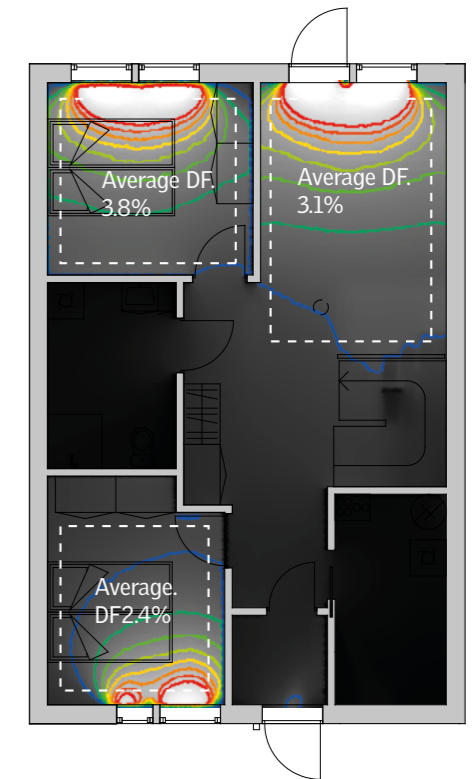
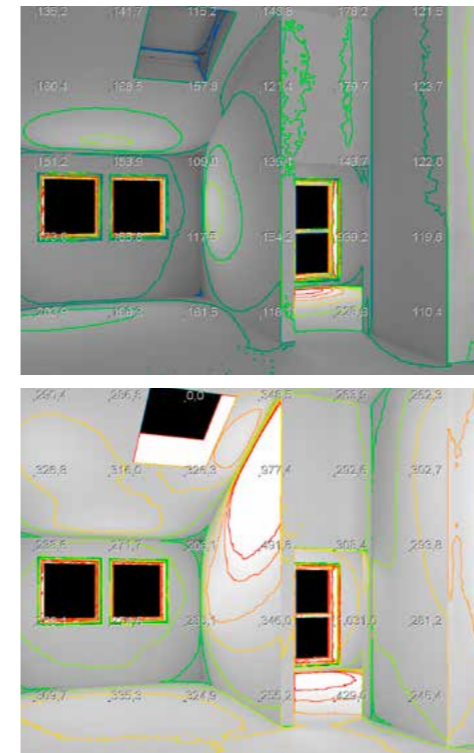
The daylight factor (DF) is a recognised performance indicator to evaluate the available amount of daylight in a room. It expresses the percentage of daylight available inside on a work surface compared to the amount of daylight available outside the building unobstructed and under overcast sky conditions. The higher the DF, the more daylight is available in the room. An average DF below 2% generally makes a room look dull and electric lighting is likely to be frequently used, whereas an interior will look substantially daylighted when the average DF is above 5%.

The figures on the right show the daylight factor levels on each floor and the impact of the installed roof windows. High levels of daylight in the living area on the first floor, together with generous views, provide the occupants with full experience of the daily rhythms of the surroundings.

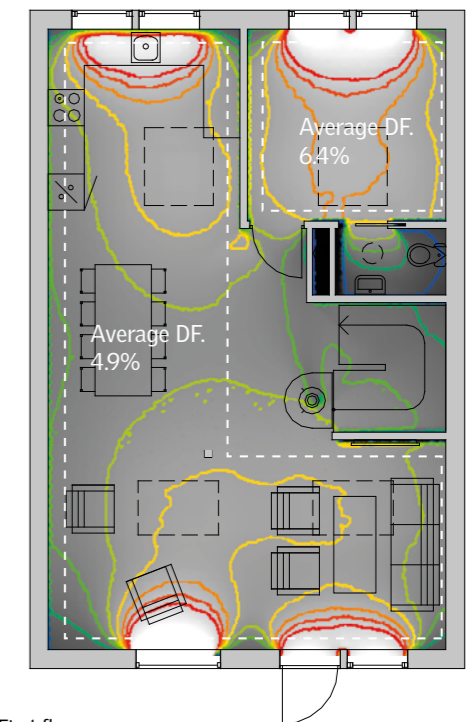
## Impact of roof windows

Illuminance renderings were prepared to compare the situation with and without roof windows on the indoor illumination levels. The figures on the renderings below show the differences in illuminance measurement in the kitchen with and without a roof window. The roof windows not only supply the room with twice as high light levels but also provide more equally distributed light at eye level and floor level.

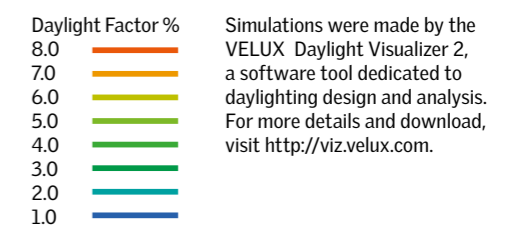
Illuminance is the measure of the amount of light received on the surface. It is typically expressed in lux.



Ground floor daylight factor plan



First floor daylight factor plan



# Thermal comfort

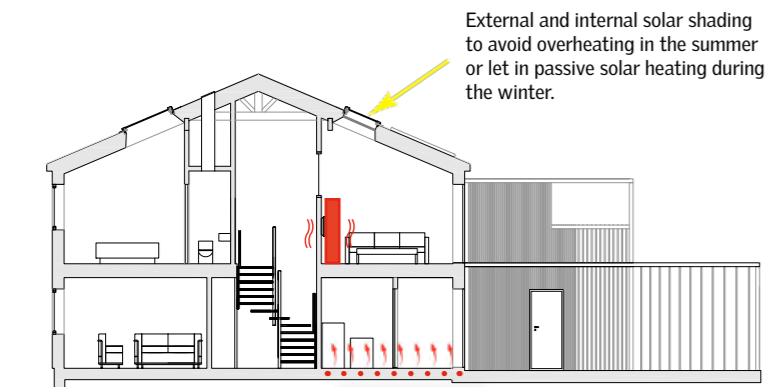
## Changing seasons, constant well-being

An Active House is designed to provide optimal thermal comfort both during winter and summer periods. The Energy Balance program makes it possible to automatically lower or raise window blinds to avoid overheating in the summer or let in passive solar heating during the winter.

Thermal comfort not only depends on the air temperature, but on a range of factors such as activity, clothing and individual preferences of the occupants. Six parameters have a major influence on the sensation of thermal comfort:

- The activity of a person
- What clothes a person is wearing
- The movement of air
- The radiant temperature [°C]
- The air temperature [°C] in the room
- The relative humidity in the room.

The air velocity and relative humidity are influenced by the use of the windows for ventilation; both the ventilation flap and normal opening have an influence. The air temperature and radiant temperature are influenced by the heat transfer and sunlight through the windows, and by the use of accessories such as blinds and shutters.



## VELUX INTEGRA® Active climate control

Intelligent systems are important in modern homes to help optimise the indoor climate. VELUX INTEGRA® Active climate control is a sensor-based control system that automatically adjusts shading in relation to sunlight and temperature outside the house.

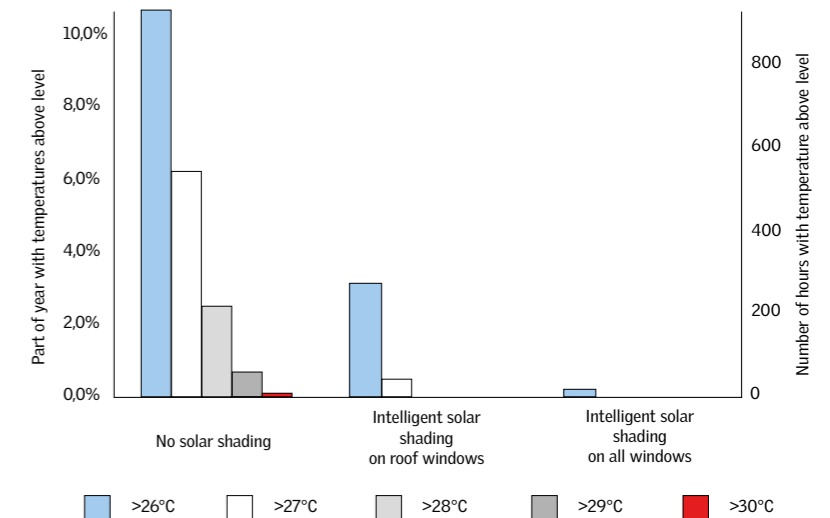
The Healthy Home Townhouses are equipped with automatic control of the external blinds. VELUX INTEGRA® Active climate control provides fully automatic control of external sunshading and internal blinds for optimising thermal indoor comfort and energy performance.

During the cooling season, the control system ensures that sunshading is rolled down when the sun's rays would create overheating. This reduces the cooling demand to a minimum and ensures a steady comfortable indoor temperature. During the heating season, the intelligent algorithm ensures that sunshading is open at times when the passive solar gains can be used for heating the building, thus reducing heating demand. At the night, the sunshading will close to add insulation to the windows, thereby further reducing heating demand.



## Thermal comfort performance of solar shading

Results of a study of the active solar shading in the house (see figure below) show that the parts of the year when experienced temperature is out of the comfort range are minimised significantly with intelligent solar shading.



Calculated thermal indoor climate in the living room, dining room and kitchen; three different solar shading cases over 1 year. The results in figure above show the number of hours/part of the year when experienced temperature is out of the comfort range.

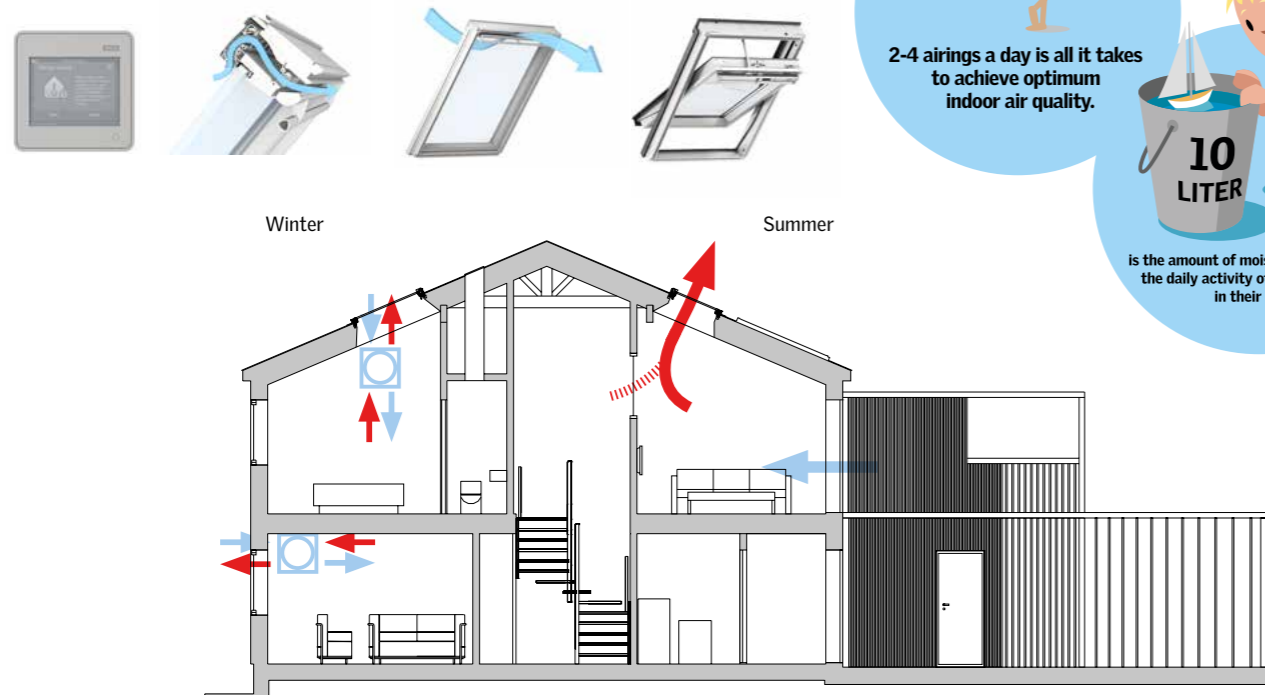
# Comfort - indoor air quality

A breath of fresh air instantly relieves and refreshes the body. In addition, good air quality has a number of benefits on health, well-being and concentration. But it can be hard to achieve. Air pollution can stem from electronics and volatile organic compounds, and from toys and furniture. CO<sub>2</sub> is used as an indicator of air quality and efficiency of the ventilation system. CO<sub>2</sub> concentrations caused by people breathing are often higher than recommended in standards, which indicates that the rooms are insufficiently ventilated.

Opening windows provides the occupants with an immediate change in the indoor environment, i.e. with a direct effect on air temperature, air velocity and air change rates. Efficient airings can be achieved by having more than one operable window and locating them in different orientations or at different heights in each main room. There should also be good options for cross- and stack ventilation between rooms and through the building.

## Fresh air with minimum energy loss

The Healthy Home Townhouses have a hybrid ventilation solution that provides good indoor air quality throughout the year. Fresh air is supplied by natural ventilation through the VELUX INTEGRA® roof windows. The roof windows can be programmed to perform automatic, natural ventilation when needed, operated with remote control. The natural ventilation is combined with a balanced mechanical ventilation system with heat recovery, which saves both energy and money.



Indoor air quality during a year

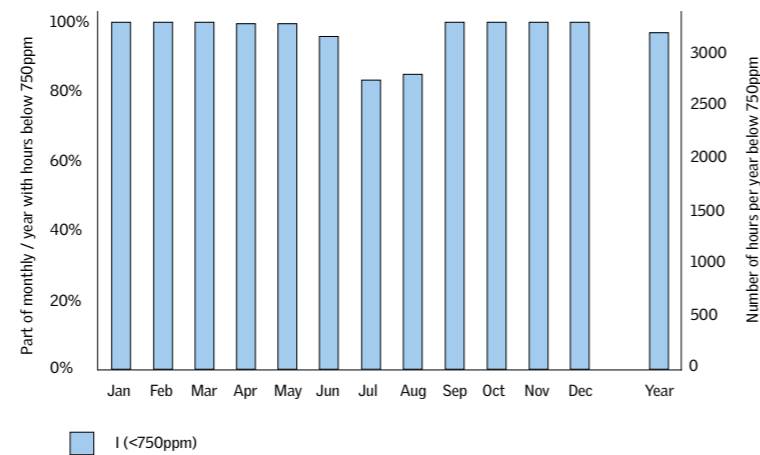


Figure shows the part of the year with CO<sub>2</sub> level below 750 ppm in the master bedroom. This is achieved for more than 95% of the year. The values are also expressed as the percentage of occupied hours and are used as an indicator of good air quality in the room.

VELUX Energy and Indoor Climate Visualizer is used to evaluate the performance of single-family houses in terms of energy, ventilation and indoor climate.

**Hybrid ventilation**  
Combined natural and mechanical ventilation. Mechanical ventilation is used in the heating period and natural ventilation for the rest of the year. The principle provides a good energy performance for new-build houses and works well with VELUX INTEGRA® roof windows.



# Energy

Minimising dependence on fossil fuels is a priority for societies all over the world. Cutting energy consumption in buildings is one of the major ways of achieving the goal. However, energy efficiency all too often comes with a risk of impractical or even unhealthy solutions.

Active Houses focus on the fact that the most sustainable energy source is the energy we do not use. So the main focus in the design phase of the Healthy Home Townhouses was to reduce the energy demand, the shape and orientation of the house and active use of daylighting to reduce need for energy for electricity.

Healthy Home Townhouses have several heating sources. Floors are equipped with additional insulation and, in the

bathroom floor, electrical heating cables. Domestic water is heated by solar collectors on the roof, while basic room heating is provided by electric radiators and a very well proven technology: wood stoves. They provide pleasant and efficient heating on cold days, and sustainably sourced wood is carbon neutral. In addition, wood stoves add to a cosy atmosphere.

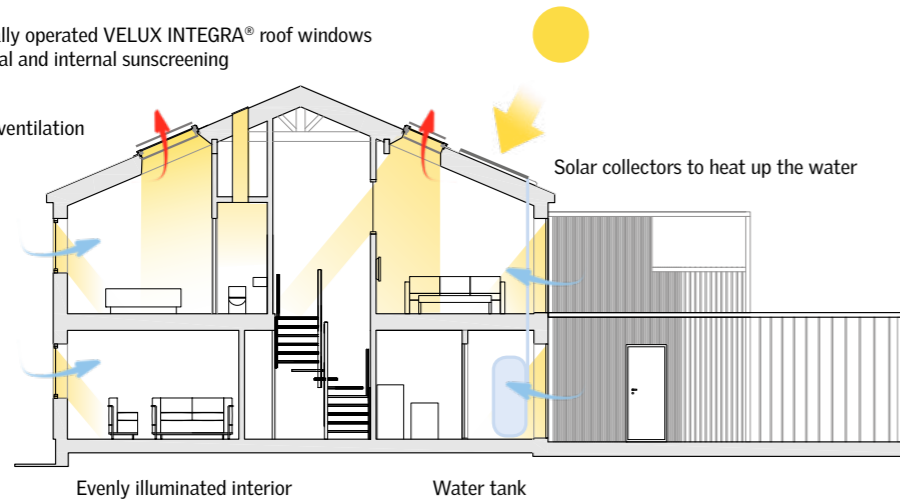
Annual energy consumption is estimated to be around 51 kWh/m<sup>2</sup> per year. For comparison, an average terraced house in Norway consumes approximately 140 kWh/m<sup>2</sup> per year. Healthy Home Townhouses are constructed in accordance with the Norwegian building standard TEK 10, which includes requirements for visual quality, health, safety, environment and energy.

## Summer

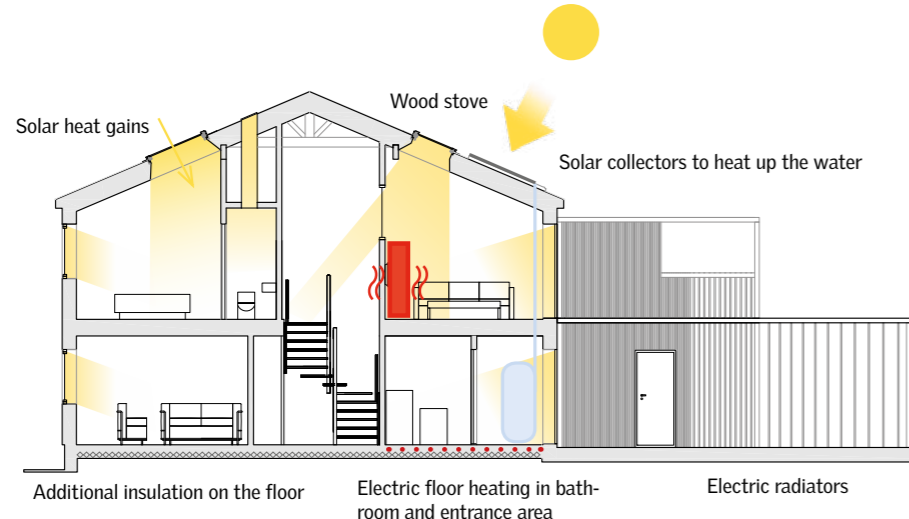
Natural ventilation

Automatically operated VELUX INTEGRA® roof windows with external and internal sunshading

Night-time ventilation cooling



## Winter



Mechanical ventilation with heat recovery system

100% of all energy supplied to house comes from hydropower source

Daylight utilisation

# Environment

## Environment and materials: local sources, global impact

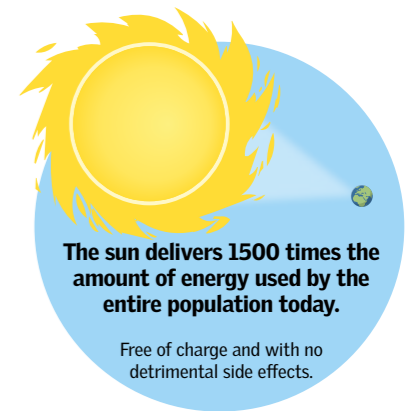
Following the vision that the environment-friendly house must be easily adapted to regional conditions, the construction of Healthy Home Townhouses was in hands of local builders and suppliers.

According to Active House specification, buildings should have as little environmental impact as possible. In order to evaluate Healthy Home Townhouses environmental loads, a detailed life cycle assessment was conducted.

Life cycle assessment (LCA) is a tool to reveal and quantify environmental impacts along the complete supply chain of a product (mining and extraction of raw materials, manufacturing, distribution, use of products, until the end of its life). Among other results, the LCA analysis of the Healthy Home Townhouses showed that more than 23% of the building can be recycled.

All materials used in Healthy Home Townhouses meet the EU REACH regulation on chemical substances. The building frame consists of beams of laminated spruce. Walls and roof are equipped with 25 and 35 centimetres of Glava mineral wool insulation respectively. On top of the insulation, houses are clad with stained pine. Terraces are made of treated pine and laminated spruce.

Living in an energy-efficient building doesn't have to be a complicated or expensive challenge. Nor do you have to sacrifice appealing architecture or good indoor climate. The Healthy Home Townhouses in Stjørdal are designed to meet the needs of modern families. If you value flexibility, cost efficiency and a healthy environment, you have found your future home.



A wood stove gives efficient heating on cold days and adds a cosy atmosphere.



## Fresh air and a better indoor climate

Fresh air helps to feed your brain, and a pleasant indoor temperature can improve your comfort. That's why the VELUX INTEGRA® control pad has pre-set programs that automatically open your roof windows to let in fresh air and lower your blinds to block the heat. This boosts energy levels for everybody in your family.



### Indoor climate program:

Opens the roof window automatically four times a day for 15 minutes, replacing all the air in a room of 16 m<sup>2</sup>. A rule of thumb is to air out at least three times a day to maintain a healthy indoor climate.

You can easily customise this program to match your daily routine.



### Ventilation program:

Opens the roof window 50% for 15 minutes and then closes automatically. Activate it after a bath, when cooking or whenever immediate airing is needed and you don't want to think about closing the window again



### Energy Balance

The Energy Balance program uses historical weather data from 25 different European locations to give you optimal indoor comfort, any time of year.

This data is used to automatically lower or raise your blinds and shutters to avoid overheating in the summer, and to let in passive solar heating during the winter in order to create the best possible indoor climate while saving energy costs in all seasons.



### Sunscreening program:

Automatically lowers your blinds or shutters during the hottest hours of the day to maintain a comfortable indoor temperature and prevent your furniture from fading. Automatic sun screening also reduces the need for electrical cooling. You can easily customise this program to match your daily routine.



## A good night's sleep

Create the perfect conditions for a good night's sleep. VELUX INTEGRA® automatically airs out your bedroom, lowers your blinds for complete darkness and raises them on command to wake you gently with morning daylight.



### Goodnight program:

Automatically airs out for 15 minutes just before you go to bed, then lowers your shutters or blinds to provide darkness and privacy.



### Good Morning:

Opens your shutters or blinds slightly to let in a little morning light. 10 minutes later, the window will open. After another 10 minutes, the shutters will roll completely up and five minutes later, the window will close automatically.

You can easily customise this program to match your daily routine.

 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](http://www.io-homecontrol.com)



## Use less energy

Let your VELUX INTEGRA® blinds and shutters play an active role in saving energy in your home. Reduce the need for air conditioning in summer and keep the heat inside during winter. Maintain the temperature you want, no matter what climate you live in.



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### Sunscreening program:

Automatically lowers your blinds or shutters during the hottest hours of the day to maintain a comfortable indoor temperature and prevent your furniture from fading. Automatic sunscreening also reduces the need for electrical cooling. You can easily customise this program to match your daily routine.



## Worry-free home security

Most families have busy mornings. That's why the VELUX INTEGRA® control pad lets you lock all roof windows and doors at the touch of a button before you leave home. When you go on vacation, the system even activates a program to make it look like you're still at home, with blinds going up and down during the day.



### Leaving Home program

Closes all windows with one touch. Door locks and gates will also automatically close if they are connected to the system. If any other VELUX INTEGRA® programs are running, they are overruled, ensuring that no window, door lock or gate will open automatically once the program is activated.



### On Vacation program:

Lowers and raises interior and exterior blinds and shutters at different times during the day and week to make it appear as if you're home. And with the KFD adaptor, VELUX INTEGRA® can even turn on electrical appliances (lights, radio, etc.) to a pre-set schedule. The On Vacation program can be customised to do exactly what you want – and be activated with a single touch.

Please note: The On Vacation program allows adjustment of VELUX INTEGRA® blinds, shutters, electric lights and on/off switches at fixed times during the day, typically morning and evenings. Weekdays differ from weekends. All time settings can easily be adjusted to suit your needs.



All VELUX INTEGRA® roof windows are pre-fitted with a rain sensor that closes the window at the first drop of rain. If you try to open the window during a shower of rain, the control pad display will inform you that it is raining. If you still want to open the window, you can override the control, but only to 50% of the maximum opening position.

# VELUX products

## About the VELUX Group

The VELUX Group creates better living environments with daylight and fresh air through the roof. The VELUX product programme contains a wide range of roof windows and skylights, along with solutions for flat roofs. The Group also supplies many types of decoration and sunscreening, roller shutters, installation products and products for remote control. The VELUX Group, which has manufacturing companies in 11 countries and sales companies in just under 40 countries, represents one of the strongest brands in the global building materials sector and its products are sold in most parts of the world. The VELUX Group has about 10,000 employees and is owned by VKR Holding A/S, a limited company wholly owned by foundations and family. For more details, visit [www.velux.com](http://www.velux.com).

## VELUX INTEGRA® roof windows

If you want ultimate comfort, VELUX INTEGRA® is the answer. This innovative system of remote controlled windows, blinds and shutters lets you open and close them with just one touch of the control pad.

VELUX INTEGRA® is the ultimate choice for fresh air and a better indoor comfort.



## Exterior VELUX INTEGRA® suncreening - awning blind model MML-electrically operated.

The exterior awning blind blocks the sun's rays before they hit your window pane and reduces passive heating. It helps keep your room comfortable on a warm, sunny day. Awning blinds are transparent, so you can still enjoy your view out and get light in.



## Interior VELUX INTEGRA® Electrically operated blinds.

Elegantly designed blinds for easy control and blackout effect



## VELUX sun tunnel

Use natural daylight to turn your dark hallways into something special. A VELUX sun tunnel uses a highly reflective tube to pass dynamic daylight through your roof to areas that you never thought possible. You can add a sun tunnel anywhere there is 6m or less between roof and ceiling.



Healthy Home Townhouses are built by Framtidens Aktivhus AS, a company established by wholesale company Tore Ligaard AS and VELUX Norge AS.

## Partners



## Product partners



## Supporting Organisation



For more information contact: [velux-no@velux.com](mailto:velux-no@velux.com)  
Read more at: [www.velux.no](http://www.velux.no)

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