De Poorters van Montfoort

Renovating existing buildings into Active Houses

New eyes on existing buildings

Approximately half the current European building stock dates from between 1945 and 1980. A large number of these buildings are now worn out and are lagging behind new constructions in terms of comfort and indoor climate. Buildings in the Netherlands are no exception. In the next ten years, at least two million of the country's two and a half million social housing homes will be in need of renovation. This presents a tremendous challenge. But it also makes the Netherlands an excellent case for rethinking renovation.

All images by photographer Torben Eskerod

The challenge – To prepare for the future

De Poorters van Montfoort is a refurbishment initiative based on the Active House principles using the solar solution. It involves a range of partners from the building industry and housing sector. (read more about the solar solution on p. 10). Their vision was realised in the Dutch town of Montfoort, but it is relevant everywhere – existing buildings are in need of change: renovation is not just about maintaining the past – it is a chance to prepare for the future.

The Poorterstraat district of Montfoort is an area with social housing. The 92 single-family houses have provided affordable homes for local families since the 1970s. However, after almost 40 years, the houses had become worn and uncomfortable by the standards of the 21st century. When the residents had their say, they came up with a list of shortcomings: draughty, gloomy, soaring energy costs and a general lack of space.

The owner, housing association GroenWest, decided to embark on a major renovation and teamed up with the VELUX Group. The renovation involved all houses, but ten homes were chosen for a sustainable transformation of greater scope. They were turned into buildings that produce energy, offer excellent living conditions and provide maximum daylight. In other words: Active Houses.

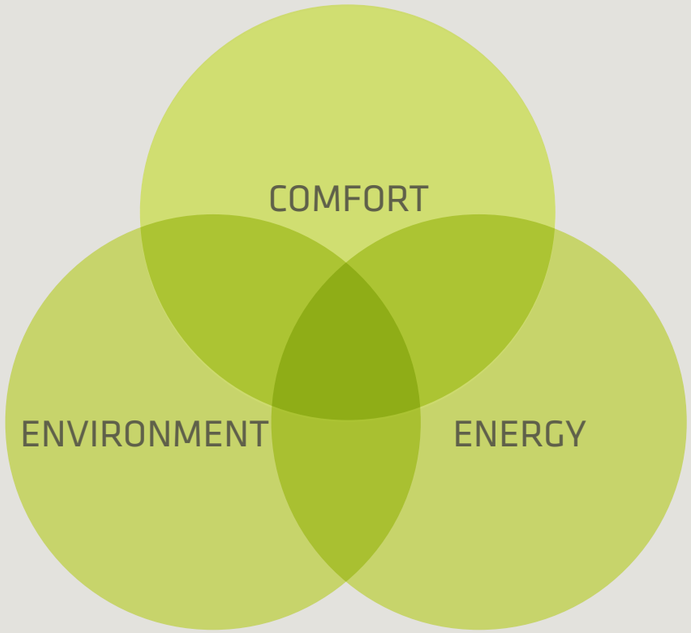
activehouse.INFO
NETWORK AND KNOWLEDGE SHARING

Buildings that give more than they take

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 such activities as building projects, product development, research initiatives and performance targets that can move us further towards the vision.

The Active House principles propose a target framework for how to design and renovate buildings that contribute positively to human health and well-being 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 environment.



The Active House key principles are as follows:

COMFORT

- a building that provides an indoor climate that promotes health, comfort and sense of well-being
- a building that ensures good indoor air quality, satisfactory thermal climate and appropriate visual and acoustical comfort
- a building that provides 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

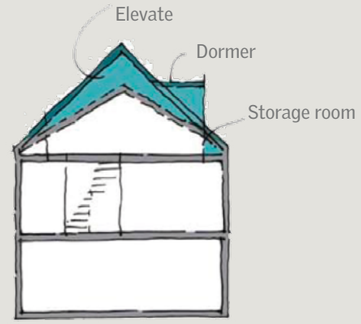
- a building that exerts the minimum impact on environmental and cultural resources
- a building that avoids ecological damage
- a building that is constructed of materials that can be recycled.

Active House is an initiative supported by the VELUX Group

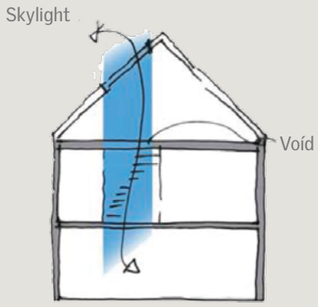
Life of the residents – A new start

The remodelling of the Poorterstraat houses has revitalised the design and upgraded the appearance of the buildings. But, most importantly, it has changed the lives of the residents. Edwin Hamelink is one of them. After living in Poorterstraat for 18 years with his wife and four children, he has experienced both the shortcomings of the past and the new possibilities of the future: "It would be fair to say that comfort was very bad before the remodelling. That has changed now," he says. He especially appreciates how the remodelling has improved the daily life of his family. "We are amazed by the extra space in the attic. Thanks to this extension, we now have four bedrooms. That is great for a family with four children," explains Edwin Hamelink. The transformation has left him looking forward to living in Poorterstraat for a long time: "It is truly a brand new start that will hopefully go on for many years."

The Active House renovated buildings in Poorterstraat have attained energy label A++. The renovation is expected to reduce the energy costs per house by around 130 euro a month, which is more than the rent increase needed to pay for the renovation.

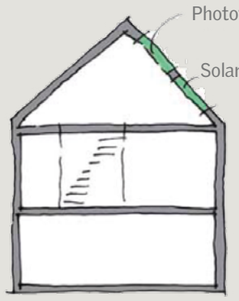


Space

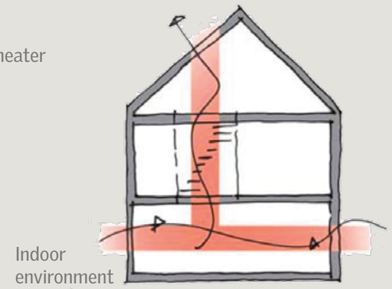


Spatiality

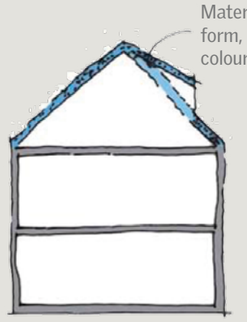
Energy saving



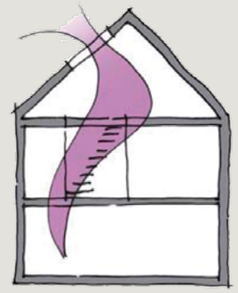
Energy generation



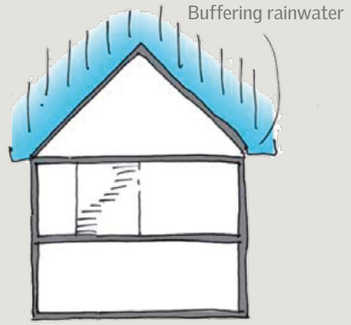
Indoor environment



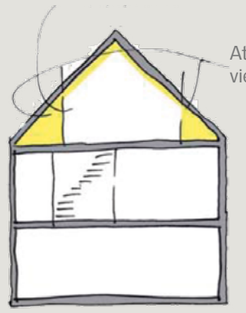
Appearance



Daylight



Water regime



Equipment

Nine stories about Active House – Design concept developed by the BouwhulpGroep.

Solar solution – A new way of implementing the Active House principles

Solar solution is a concept for the renovation of terraced houses and townhouses. Applying the Active House principles in existing buildings requires a different approach from that used in new build houses. In cooperation with Danfoss, the VELUX Group has developed the award-winning solar solution concept. Already implemented in a number of residential areas, solar solution inspired the refurbishment of the Poorterstraat houses.

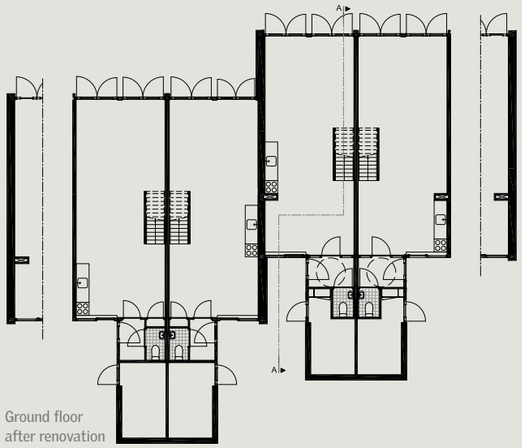
Solar solution combines roof windows, solar-generated heat and electricity, ventilation, heat pumps and geothermal heating, with every aspect under full control. Well-proven technology makes it easy to monitor and manage indoor climate and energy consumption.

When it comes to remodelling existing houses, one size does not fit all. But solar solution can be adapted to almost every need.

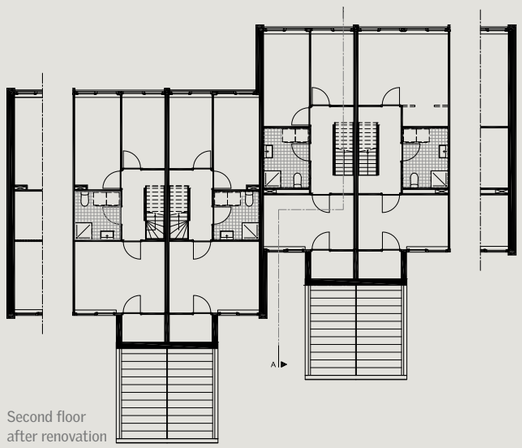
Turning existing buildings into Active Houses – Take leaps, not steps

The Active House refurbishment of the Poorterstraat houses has benefits for all stakeholders involved. The GroenWest housing association now has a more valuable housing stock, while tenants experience greater comfort and energy costs that are approaching zero.

GroenWest is pleased with the result and performance of the Active House refurbishment. Project Manager Bernard van Dam of GroenWest advises other housing associations to consider renovations as an opportunity to add extra value to their housing stock and prolong the life of existing buildings: "Think lifetime. A house should not be demolished after 50 years; it should be capable of lasting at least 100 years. So do not think in small steps, but in leaps".



Ground floor
after renovation

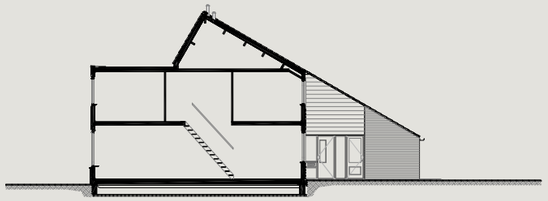


Second floor
after renovation

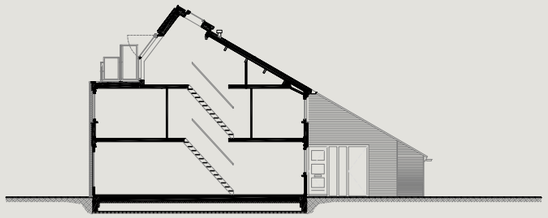
Refurbishment – Increased space and enhanced light

Architect company BouwhulpGroep was given the task of implementing the Active House principles in the construction of the Poorterstraat houses. They decided to add extra space and light by making use of the houses' unutilised attics. Every attic was enlarged and became an entity on its own, resulting in a new room and a rooftop terrace.

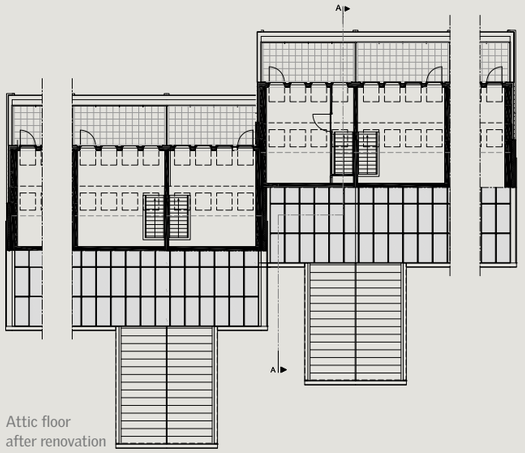
The ground floor, first floor and staircase were also remodelled to ensure that the daylight and air from above would benefit the entire house. Thanks to the abundant amounts of daylight, the rather narrow and deep buildings now feel light and spacious.



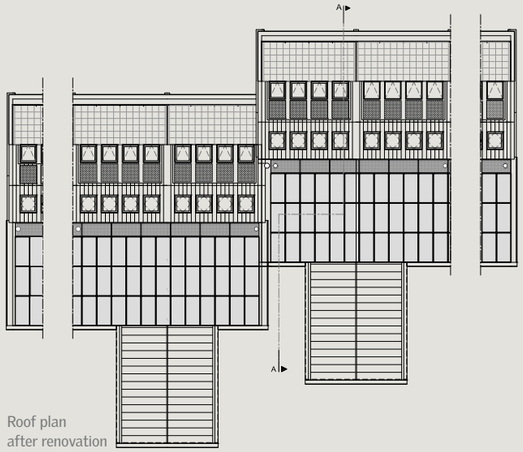
Section A-A before renovation



Section A-A after renovation

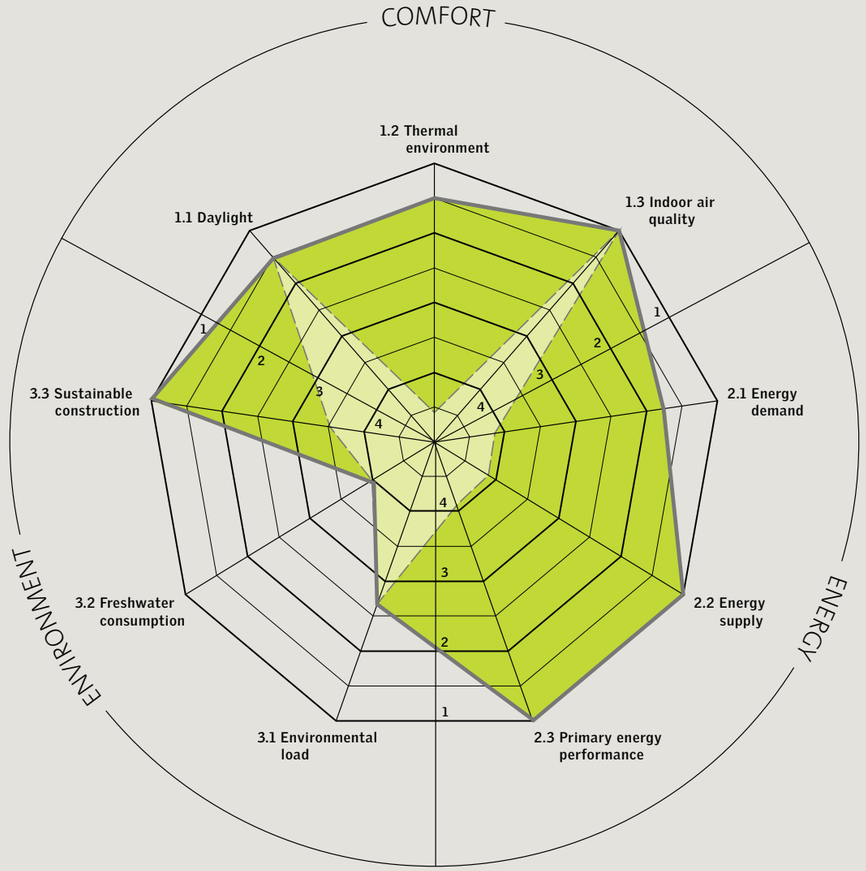


Attic floor
after renovation



Roof plan
after renovation

Active House Radar evaluation



The general Active House Radar is calculated based on the performance before and after the renovation.

Calculation performance after renovation
Calculation performance before renovation

Evaluation result of the quantitative parameters

An Active House is the result of efforts to actively integrate the three main principles of comfort, energy and environment in the design of a building and in the finished building.
The Active House Radar shows the level of ambition of a building in each of these three main principles, each of which are further sub-divided into three parameters. For each of these parameters, the level of ambition is indicated by four levels ranging from 1 to 4, where 1 is the highest level and 4 the lowest. As long as the parameters in each principle are better than or equal to the lowest level of ambition, the building is an Active House. The Active House Radar has a dual function. Upon completion of the building, it is a tool for displaying the ambition reached with the building and the calculated values. When the building is inhabited, the Radar can also be a useful tool for monitoring, evaluating and improving the building. The diagram on this page shows the evaluation results for De Poorters van Montfoort both before and after the renovation. The improvement becomes clearly visible, particularly in the fields of comfort and energy. Some parameters, such as environmental loads and change to freshwater consumption, were not evaluated before the renovation, hence a comparison in these areas was not possible. The renovated houses achieve optimum results particularly in terms of daylight, indoor air quality, and thermal environment. This is a clear result of the attention paid to good daylighting and natural ventilation in the design process.

Project description

Building name:	De Poorters van Montfoort	Primary constructions:	Internal and external walls of bricks. Bearing interior walls of concrete. Concrete slabs.	**Heated floor area:**	
Building type:	10 terraced single-family homes	Primary heating supply:	Electricity	Gross m^2	131 m^2
Location:	Montfoort, the Netherlands	Heating system:	Water-water heat pump supplemented by thermal solar collectors	Net m^2	122 m^2
Active House evaluation basis:	Renovation	Renewable energy:	Thermal solar collectors and heat pump for hot water supply and room heating. PV for electricity generation.		
No. of storeys and areas	3 floors				

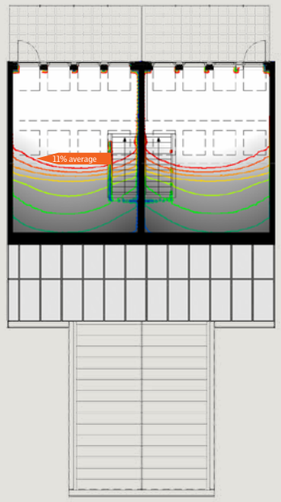
Comfort

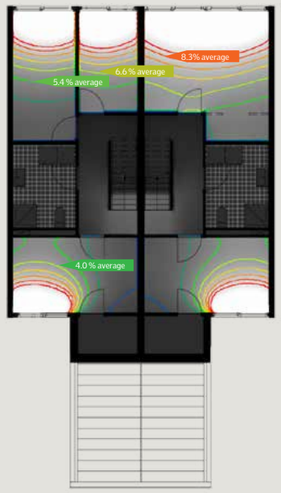
An Active House provides excellent indoor comfort

Since we spend 90% of our time indoors, the quality of the indoor climate has a considerable impact on our health and comfort. A good indoor climate is, therefore, a key quality of an Active House. It must be an integrated part of the design of the house to ensure good daylight conditions, thermal environment and indoor air quality.

Good ventilation in De Poorters van Montfoort is ensured in several ways: facade and automatically operated roof windows are strategically positioned on all floors of the building, from ground level right up to the roof ridge. On the one hand, they provide horizontal cross-ventilation on the different floors; on the other, opening the roof windows on the top floor creates a (vertical) chimney effect around the open stairwell that channels the stale air up from both the floors below, and allows it to escape through the roof in to the open.

This strategy ensures, above all, that there is some welcome cooling in the houses in the summer. In winter, a mechanical ventilation system with CO_2 sensors guarantees a comfortable and healthy circulation of air. The Active House evaluation shows that the maximum CO_2 levels in the rooms are in the range of 325 to 350 ppm above the outdoor CO_2 concentration – far below the 500 ppm threshold required to achieve level 1 in the Indoor Air Quality parameter.





Daylight Factor %
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0

Daylight

An Active House also offers optimal daylighting. Adequate lighting and especially well-designed daylight penetration provide an array of health benefits to people in buildings. High levels of daylight and an optimised view out positively influence people's mood and well-being.

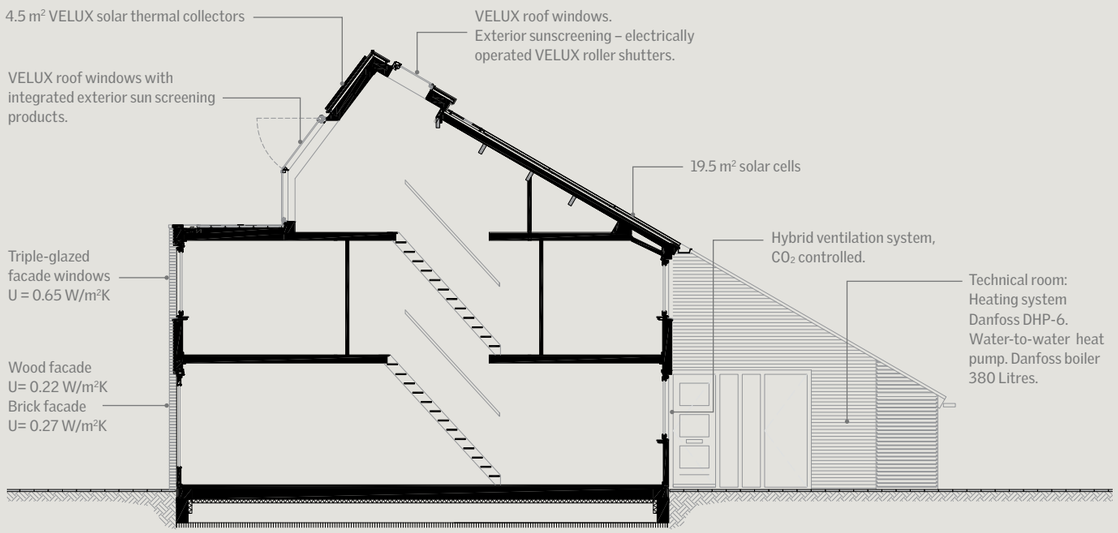
At De Poorters van Montfoort, good daylighting is ensured by the large windows and by a careful selection of bright indoor surfaces that reflect daylight deep into the spaces. The diagrams on these pages show the distribution of daylight factors in the different rooms of one house. The daylight factor indicates what percentage of the daylight outdoors reaches a given point inside the building under standardised (overcast) weather conditions. It can be seen that in large parts of the attic space, as well as close to the windows on the other floors, daylight factors are well above 8%. More importantly, the average daylight factors in the rooms (which are indicated in the diagrams) are between 3.6% and 11%. This is far above the current standards in most European countries, which recommend average daylight factors of 1 to 2% - and often less – in buildings.

Simulations were made by the VELUX Daylight Visualizer 2, a software tool dedicated to daylighting design and analysis. For more details and download, visit http://viz.velux.com.

The daylight factor (DF) is a common and easy-to-use parameter for 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 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 adequately daylit. A room will appear strongly daylit when the average DF is above 5%.

Energy

Active Houses realise the great potential to use energy more efficiently in buildings using a solar solution

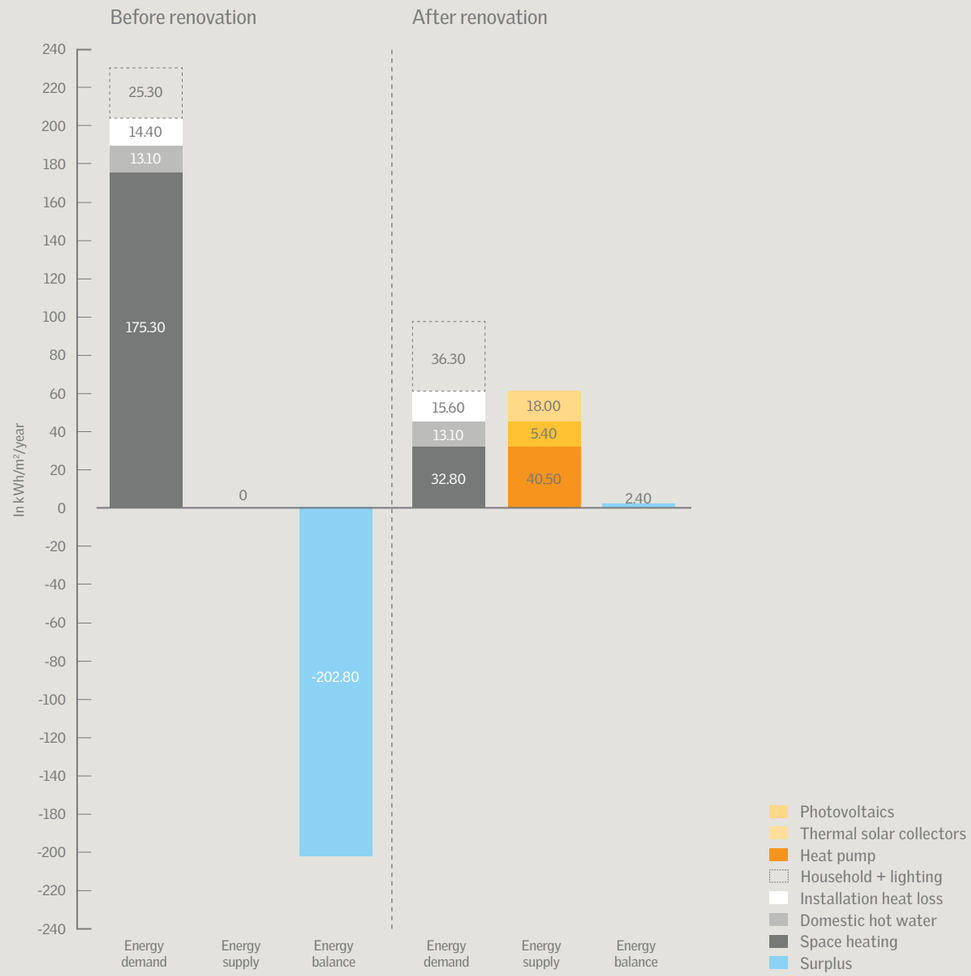


An Active House is energy efficient and supplied by renewable energy sources integrated in the building or from the nearby collective energy system and electricity grid.
Globally, heating, cooling and electricity in buildings account for 40% of all energy consumption. Considering the total energy consumption throughout the whole life cycle of a building, the energy performance and energy supply are important issues in the concern about climate change, reliability of supply and reduced global energy consumption.

The design and orientation of an Active House, as well as the building components used in it, are therefore optimised to use as little energy as possible and to utilise renewable energy sources.

The energy concept of De Poorters van Montfoort follows a three-step approach called the Trias Energetica, which has become rather common in the design of highly energy-efficient buildings. In the first step, the energy demand is reduced as far as possible by insulating the building and installing energy-efficient appliances. In the second step, renewable energy sources on or near the site are tapped to supply the building. In the third step, the remaining energy demand that cannot be covered on site should be met either through the use of off-site renewables or through very efficient conversion processes using fossil energy, such as cogeneration.

Energy performance



At De Poorters van Montfoort, all parts of the building envelope were newly insulated. An entirely new roof was added; the existing facades received new insulation and a new brick facing, and the old, poorly insulated windows with their thin, aluminium frames were replaced with new, triple-glazed models with timber frames. The existing floor was replaced with a new highly insulated concrete floor.

To supply the houses with energy, a 19.5 m² photovoltaic array and 4.5 m² of solar thermal collectors were installed on each roof. The new heating system in the houses uses neither gas boilers nor chimneys. Instead, each house is heated by a heat pump. The heat pump takes its power from the PV modules on the roof. All the essential technical installations – heat pump, hot water tank and inverters for the PV system – are concentrated in a utility room in the annex facing the street.

The outcome of all these measures can be seen on the two diagrams: the heating demand in the houses has been reduced by a factor of more than five due to the renovation, and the overall energy demand is less than half of what it used to be before the renovation. With the exception of the electricity used for lighting and appliances in the households, all the energy used in the houses is covered by renewable sources, i.e. the solar thermal panels, the PV system and the heat pump. In total, 100% of the buildings' energy use now comes from renewable sources.

Environment

Active Houses aim to have a positive impact on the environment

Like any building, an Active House will have an impact on the environment – and this impact should be as positive as possible. This means that any harm to environment, soil, air and water should be minimised. Environmental challenges are a reality on local, regional and global levels, ranging from CO_2 emissions to dwindling freshwater resources, acid rain and soil erosion. When developing an Active House, it is therefore important to consider how building materials and resources are used. The key parameters to consider are:

- Consumption of non-renewable energy resources
- Environmental loads from emissions to air, soil and water
- Freshwater consumption.

At De Poorters van Montfoort, retaining the primary structure of the existing houses has significantly reduced the resource use for the refurbishment. Concrete and masonry, the materials that the party walls and floor slabs of the houses are made of, are particularly energy-intensive to produce, with the global cement industry alone causing 4-5% of all CO_2 emissions worldwide.
To evaluate the environmental impact of the houses in further detail, engineering office Grontmij performed a life cycle analysis (LCA). In this analysis, all stages of the buildings' life cycle were taken into account: the production of building materials, the construction processes, the operation and maintenance of the building for an assumed life span of 75 years, and the demolition at the end of the life cycle. All of these processes were evaluated for the energy consumption that they cause, as well as for five important environmental impact categories. These include the global warming potential (caused mainly by CO_2 emissions) and the acidification potential, which is caused by pollutants such as sulphur dioxide (SO_2) and nitrogen oxides (NO_X).
A closer look at the evaluation reveals that two thirds of the overall CO_2 emissions of the building are caused during its operation phase, and one third by the materials production and construction activities. With the acidification potential, the situation is reversed: the construction materials account for two-thirds of this impact category. Hence, in future buildings, it will become ever more important to specify sustainable materials. For example, all timber used in De Poorters van Montfoort is either FSC or PEFC certified. In terms of water, the predicted freshwater use in the homes is roughly 7% below the average for residential homes in the Netherlands.

VELUX products

De Poorters van Montfoort

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 sun screening, roller shutters, installation products, products for remote control and thermal solar panels for installation in roofs. 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.

VELUX roof windows

Model GGL INTEGRA®. Pivot hung. Electrically-operated roof window including remote control and rain sensor for automatic closing in the event of rain.

VELUX roof terrace

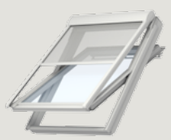
Model GEL/VEA/VEC.
Terrace roof windows.
The four windows provide light and natural ventilation.
The lower window on the left window can also open as a door which allows access to the terrace.

VELUX thermal solar collectors

Model CLI. VELUX solar collectors for hot water supply.

Sunscreening products

Model MHL.
Exterior sunscreening – manually-operated VELUX awning blind model MHL on the top window of terrace roof windows for shutting out summer heat.



VELUX awning blinds provide effective heat protection because the rays of the sun are stopped before they reach the glass. The blind stops the heat, keeping the home cool and airy. Best of all, it does not block the view to the outside.

Model SML.
Exterior sunscreening – electrically-operated VELUX roller shutters. Every VELUX roller shutter provides six protective functions in one, shutting out summer heat, saving energy in the winter, protecting the window pane from damage, reducing noise, controlling light and ensuring safety and privacy.

Other products

De Poorters van Montfoort

Roof
Prefabricated elements: RC>5m²K/W.
Roof insulation: Xtratherm.
PV panels: LG Electronics inc. Solar 250S1-K All Black.
Bitumen: Wedeflex. D4ZK.

Facade
Bricks: CRH Clay solutions.
Facade finish: Werzalite. Ash finish.
Insulation: Kingspan. TW50w.
Mortar: Beamix.

Facade windows
Window frames: De Vries Gorredijk. Vrigoplus, Oregon Pine (FSC).
Glazing: triple 4-(14a-4-14a(tgi))-4. Uw 0.65 W/m²K.
Vertical sunscreening products:
Somfy
Smits Rolluiken
Ventilation units: DUCO. Ducotop 50 ZR Corto/ Ducofit 50 ZR.

Doors
Door set solution: Berklon door and Berdo frame.
Hinges and locks: Siegenia-Aubi. PKVW.

Floor
Ground floor: VBI. PS insulation floor. 173S. 200 mm.
Rc 3.0 m²K/W.

Heating
Heat pump: Danfoss. DHP-C with extender DWH.
Boiler: Danfoss. 380 litre.
Floor heating: WTH. 16x2.7.

Ventilation and air treatment
Ventilation system: J.E. Storkair. ComfoFan CO_2.

General
Airtightness: qv10kar < 0.4 dm³/s.m².
Energy index: 0.36 (label A++). Original: 2.14 (label E).

Participants

De Poorters van Montfoort

Client

GroenWest

Partners

Danfoss
VELUX®

Developing partners

BouwhulpGroep
advies en architectuur
bam woningbouw

Advisors

Raadgevende Ingenieurs Nieman
Bouwfysica, -techniek en -regelgeving

Active House radar calculation

Grontmij

Supporting Organisation

activehouse.info
NETWORK AND KNOWLEDGE SHARING

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