



The smart use of glass in sustainable buildings

GLASS
FOR • EUROPE



The smart use of efficient glazing already helps to design and build low energy buildings

Glass and sustainable low energy buildings: only the beginning of a success story

Over the last fifty years glass technologies for buildings have undergone radical changes and extended the functions and applications of glazing in modern architecture. Thanks to the continuous improvement in thermal insulation performance, combined with new methods of modulating solar heat and light transmission, glazing has strengthened its position as an essential construction material for low energy buildings.

Despite the availability of these high performance glass technologies, a preconceived idea that glass is the weak point in the building envelope still persists. This goes against existing evidence that demonstrates the positive role of glass in sustainable low energy buildings.

This booklet provides real life examples of low energy buildings from all over Europe in which glass plays a fundamental role in achieving high energy performance standards.

It shows that the smart use of efficient glazing solutions already helps to design and build stylish and comfortable low energy buildings.

Research and development projects will continue delivering improved glass technologies and products for buildings. The story of low energy buildings and glass still has many bright and sustainable years ahead.



In most European climates and for most building types, larger glazed surfaces contribute positively to low energy buildings



St George's School in Wallasey, UK.

The key contributions of glass to sustainable, low energy buildings

All of us look through glass and windows so many times a day that we no longer notice it. While we all take for granted that buildings must be equipped with glass, its numerous benefits in buildings are mostly ignored. Beyond its critical role in terms of aesthetics, safety, durability, sound insulation, etc. **glass is integral in designing truly sustainable and low energy buildings.**

Glass is a major contributor to energy efficient buildings

Half a century ago, even before the advent of modern glass technologies, energy savings minded architects were using glass in a smart and innovative manner to design what we now call 'nearly-zero energy' buildings. One pioneering example was the design and construction of St George's School in Wallasey, UK, back in 1961. The school successfully captured free solar heat gains to minimise heating needs to the extent that its heating system did not have to be used for the first 16 years.

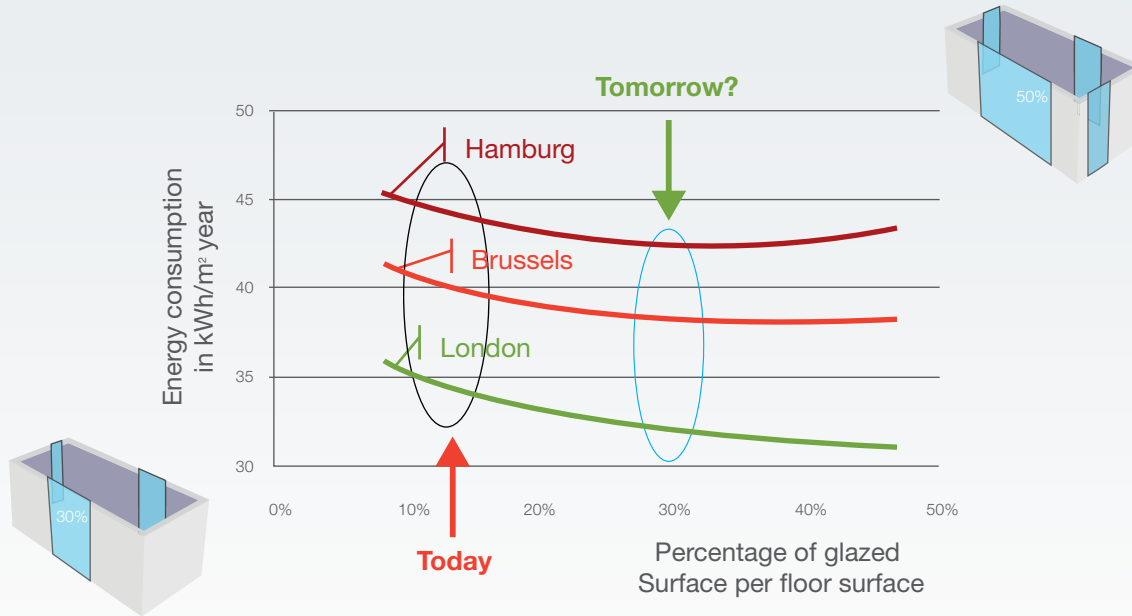
In the subsequent decades, the increased focus on intelligent building design and constant technological advances in glass products mean that integrating large glazed surfaces in low energy buildings has now become even more achievable.

Technological innovation such as the use of double and triple glazed units with inert gas filling and invisible low-emissivity coatings have significantly improved the insulation properties of windows and facades.

Such glazing products allow maximum natural daylight into buildings and can maximise or limit solar heat gains, depending on the desired thermal objectives and energy balance.

Nowadays, **a vast array of glass and glazing solutions exists to satisfy the needs of the most ambitious architects and building engineers** who want to design and construct low energy or passive buildings.

Simulation of thermal performance and glazed areas in residential buildings



In most climates enlarging size of high-performance windows helps to reduce energy consumption

Source: Saint-Gobain Glass

Improvements in the thermal performance of buildings mean that the relative share attributable to heating and cooling in a building's overall energy consumption decreases, while that of artificial lighting increases.

Unlike any other construction material, **glass helps lower artificial lighting needs** and consequently the associated share of energy consumption as well.

In well designed buildings fitted with the right glazing solutions, **glass offers both a positive balance of energy through the building envelope, and the provision of sufficient daylight to reduce artificial lighting needs.**

Therefore, it is no surprise that many energy and thermal simulations suggest that, in most European climates and for most building types, **the average glazed surface to floor ratio in buildings can and should ideally be increased.**



Sustainable buildings profit from the minimal environmental impacts of glass

As new constructions become increasingly energy efficient, their main environmental impact will no longer be considered in terms of their energy consumption. Based on a complete life-cycle approach, the impact of manufacturing the building materials, as well as the construction and demolition phases, become critical to improving a building's sustainability.

In this respect, **glass generates minimal environmental impact, which makes it a product of choice for sustainable buildings.** For instance, the total CO₂ equivalent emitted by the manufacturing of by an energy efficient double glazing unit is offset on average within only 3 to 10 months by the energy savings realised compared to the same

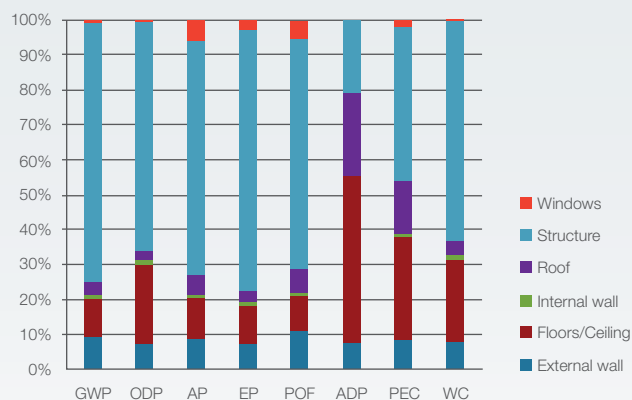
building equipped with inefficient glazing. In addition, glass is made of abundant non-polluting raw materials, its manufacturing process is highly energy efficient, requires low levels of water and generates little waste. In fact, recent life-cycle studies have shown that windows represent a very minor share of a building's environmental impact from the cradle to the construction phase.

Moreover, the vast majority of **glass products for buildings are recyclable** at the end of their lives. This contributes to even lower environmental impact. When recycled in new glass products, glass waste helps to economise both raw materials and energy in manufacturing new glass products.

Glass generates minimal environmental impact, which makes it a product of choice for sustainable buildings

Life-Cycle Inventory of the construction of 1m² of office area

Cradle to delivery of a new office building: use and demolition phase not taken into account



Source : CIRCE, UNESCO, uniTwin, Tecnalia, Technical analysis in support of development of EU Ecolabel and GPP criteria for Office Buildings

Getting daylight into buildings is a key element of sustainable building design



Glass is essential to buildings fit for their occupants

Given that we spend over 80% of our lives inside buildings, the design of buildings and in particular daylight provision is critical to our quality of life. **Thanks to its transparency, glazing enables daylight to penetrate the interiors of buildings and provides a view to the outside world.** These characteristics are unique among building materials and provide many benefits to building occupants.

By providing daylight and a connection with the outside world, glazing enhances the interiors of buildings, and improves comfort and the sense of well-being. Numerous research studies* have found that access to daylight in various types of buildings provides a healthier – and healing – environment (e.g. hospitals), and increases focus, learning and productivity (e.g. educational buildings and offices) while en-

hancing the aesthetic of internal spaces with direct economic benefits, for example with boosted sales in daylight retail establishments.

Low energy and truly sustainable buildings must continue to be designed so as to be fit for the people who will be using them. **Glazed surfaces, by allowing daylight into buildings and providing a visual contact with the outside world, contribute to enhancing the economic and social pillars of sustainability in buildings.** They help to harvest wider societal benefits such as enhanced productivity and lower healthcare costs because of lower rates of absenteeism and shorter hospital recovery days, better education, etc. The distinctive benefits of glazing deserve to be fully grasped in new constructions and major renovations.



* D. Strong ; The distinctive benefits of glazing, the social and economic contributions of glazing to sustainability in the built environment.

A whole pallet of glass products is available for the glazing to meet different functions in the building envelope. Glass is fit for all climates.

Glazed and efficient: existing low energy buildings make smart use of glass

Thanks to the unique properties of today's glazing solutions, architects now have complete freedom to incorporate as much glazing as they wish in their designs, in the knowledge that glazing can help them achieve the best energy performance, minimise overall environmental impact and provide a comfortable and desirable place for occupants.

The following pages present a non-exhaustive list of such buildings. Their shared feature is that they are among the most energy efficient constructions in their countries and that their glazed surfaces are largely above average for similar buildings.

Furthermore, **many of these buildings have won prizes or obtained 'top grades' of sustainability certification** schemes for minimal environmental impact.

Hundreds if not thousands of buildings could have been included in this booklet. This sample is only meant to present a **variety of building types**, from high-rise office buildings to single family homes, but also schools and universities, hospitals, convention centres, etc. It ranges from the latest in architectural design to more conventional buildings.

With the same approach in mind, it shows **buildings located in different regions of Europe**. As previously explained, a whole pallet of glass products is available for the glazing component to meet different functions in the building envelope. Glass is fit for all climatic conditions.

Finally, although many of these buildings are **new constructions**, some of them achieved high energy performance after **deep renovation works**. When the deep renovation of a building is carried out, architects and engineers have leeway to drastically improve a building's energy performance and, if they wish, to increase the glass area.

Take a look at Europe's low energy building stock...
... take a fresh look at glass performance

Low energy buildings that use large glazed areas intelligently already exist throughout Europe.

These buildings are the most compelling evidence of the high energy efficiency performance of glass products.





European Investment Bank Luxembourg City, Luxembourg

The 11,000m² doubled layer glass façade stands 35m high, 170m long and is suspended from specially designed, curved, steel beams. This glass shell allows to make maximum use of natural light in every office space. It also provides thermal insulation to keep energy consumption to a minimum with winter gardens and atria providing natural ventilation.



- Office building: Headquarters of the European Investment Bank.
- The building was the first in Europe to obtain the new BREEAM International BESPOKE certification. The certification means that the building exceeds legislative requirements and/or compliance with best practice guidance in the country of origin.
- New building completed in 2008.

Credits: Ingenhoven Architekten
Source: EIB



Casa EntreEncinas

Villanueva de Pría, Spain



- Single family house.
- The building is built in accordance with the Passive House standard.
- New building completed in 2012.

Credits: DUQUEYZAMORA Arquitectos
www.estudioquyezamora.es
Tania Diego Crespo (photography)



Ecole ZAC Claude Bernard Paris, France



In addition to the traditional benefits of using large glazed areas, the architects also used it for obvious aesthetics reasons. The pattern on one of the glass panes creates an interesting atmosphere inside the building.



- Primary school.
- The building is certified HQE. HQE is a French certification standing for High Environmental Performance.
- New building completed in 2012.

Credits: Olivier Brenac,
Xavier Gonzalez (architects)
Sergio Grazia (photography)



Zebra Tower

Warsaw, Poland



- Office building.
- The building obtained the LEED Gold certification.
- New building completed in 2011.

Source: Guardian
Credits: Martin Troethan Hoffmann
Architekten
Piotr Bujnowski (photography)

The 17-storey office building of 18.280m² is the first commercial property in Poland designed, constructed and commissioned in accordance with LEED Core (Leadership in Energy and Environmental Design) & Shell standard.



Natura Towers

Lisbon, Portugal



- Office building.
- The building won the 2011 European Green Building Award.
- New building completed in 2010.

Credits: © Carlos Noronha – Crusader
MSF Group Head office





Energy + House

Braunschweig, Germany



- Single family house.
- The house obtained the Energy Plus House standard. This German standard is attributed to buildings which generate more energy than they need throughout the year.
- New building completed in 2012.

Credits: Prof. Dr Manfred Norbert Fisch (architect)
Source: Intelligent Glass Solutions



Solhuset Hørsholm, Denmark



Active House is a vision of buildings that create healthier and more comfortable lives for their occupants without negative impact on the climate. Among the specifications are requirements to achieve nearly-zero energy standards, to include renewable energy, to achieve good levels of daylight availability and to ensure a good indoor environment.

www.activehouse.info

Solhuset is the most climate friendly daycare centre in Denmark. It is a unique building, self-sufficient in energy and with a healthy indoor climate. All the rooms receive daylight from at least two sides.



- Daycare centre.
- The building meets the 2020 NZEB requirements and was built in accordance with Active House principles.
- New building completed in 2011.

Credits: Christensen & CO Arkitekter
Adam Mørk (photography)
Source: The VELUX Group





Torre de Cristal

Madrid, Spain



- Office building.
- The building was granted an A-level certificate for its high energy performance.
- New building completed in 2008.

This impressive building is 250 meter high spread over 52 floors. At the time of its construction, it was the second tallest building in Spain.

The total glazed surface of the building reaches 40.000m². Selective solar-control glass was used to equip this building to reduce air-conditioning needs as much as possible while ensuring a good insulation performance and maximum daylight penetration.

Source: Saint-Gobain Glass
Credits: Cesar Pelli



Carbon Light Home

Kettering, UK



- Single family home.
- Carbon Light Homes are two semi-detached homes that meet the 2020 NZEB requirements and the UK zero carbon housing standard.
- New building completed in 2011.

Carbon Light Homes are built according to the Active House vision, which is a vision of buildings that create healthier and more comfortable lives for their occupants with impacting negatively on the climate. An active House is evaluated on the basis of the interaction between energy consumption, indoor climate conditions (e.g. good levels of daylight) and impact on the environment. www.activehouse.info

The houses are a proof of that it is possible to build energy efficient, sustainable housing that is not only pleasant to live in with plenty of daylight, but also easy and affordable to replicate by the volume house builder.

Credits: Adam Mork (photography)
Source: The VELUX Group



Litex Tower, Sopharma Complex Sofia, Bulgaria



- Complex made of three office buildings with a shopping area on the ground floor.
- The building meets NZEB requirements and obtained the DGNB Gold certification.
- New building completed in 2012.

Credits: Arhitektonika Studio Ltd.
Sopharma Properties REIT
Litex Tower JSC Contractor
Koester Lichtplanung
Kiril Velkovsky

The glazed surface of the façade is 76% visible from outside and virtually 100% from inside. The double skin façade is a key component in achieving better energy-efficiency by using daylight and solar energy. The type of glass was selected to provide the best possible transfer of energy and light to the interior. Depending on weather conditions, the smart integrated blind system activates to avoid excessive heat gains while still allowing maximum daylight to enter the building.





Kindergarten Montebelluna, Italy

- Nursery school.
- The building was granted an A-level certificate for its high energy performance.
- New building completed in 2008.

Credits: Giorgio Bedin
(architect/engineer)





Modemet Stockholm, Sweden



- Office building.
- The building won the 2010 EU Green Building Award.
- New building completed in 2010.

Credits: Wingårdhs (architect)
Source: Vasakronan



Maison Saint-Gobain Multi-Confort Beaucouzé, France



- Single family home.
- The building is certified HQE. HQE is a French certification standing for High Environmental Performance. The energy needs of this 162m² house are as low as 39 kWhEP/m²/year whereas its renewable energy installations generate 61 kWhEP/m²/year. This is therefore a positive energy house which generates more energy than it consumes.
- New building completed in 2011.

Source: Saint-Gobain Glass

Credits: Laure Levanneur (architect) Thierry Mercier (photography)

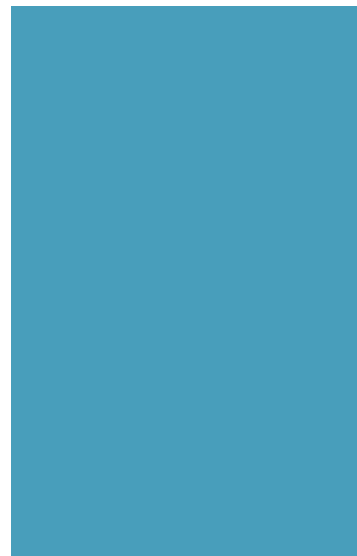


Andersia Business Center Poznan, Poland



- Office building.
- The building won the 2012 CEE Green Building Award.
- The building was initially built in 1954 and fully renovated in 2012.

Source: Guardian
Credits: Marek Leykam





Imprenta Regional Murcia

Murcia, Spain



- Office building: local government offices.
- The building has won five prizes among which the Regional Energy Agency Prize and the Endesa second prize for the most sustainable building in Spain.
- Refitted in 2008 to 2010.

Credits: Ecoprojecta
www.ecoprojecta.es
 (project & site supervision)
 David Frutos (photography)
<http://davidfrutos.com>

In a climate as that of the South of Spain, the glass facade can be used to let daylight enter the building while avoiding over-heating. For this building, the use of a glass pergola combined with photovoltaic cells serve to filter direct solar radiation and to generate renewable electricity. 60% of the building's electricity usage is generated by the PV installations on-site.





AGC Glass European headquarters Louvain-la-Neuve, Belgium



This building is designed to be a nearly zero energy building. Its façade combines a solar-control double glazing with thermal insulation covered by a unique system of silk screen-printed automatic louvers to improve the solar protection and glare control. All glass products used in the building obtained a cradle-to-cradle certification at silver level.

- Office building
- The building obtained the BREEAM Excellent certification in Design Stage (interim-certificate).
- New building completed in November 2013.

Source: AGC Glass Europe
Credits: Philippe Samyn and Partners,
architects & engineers - BEAI,
architects





Enfield Town Library London, UK

- Public library.
- The building obtained the BREEAM Excellent certification. It also won the 2011 Best Built Project at the London Planning Awards.
- A building from the Edwardian era refurbished and extended in 2010.

Source: Cantifix
Credits: Shephard Epstein Hunter
Architecture
George Sharman Photography





Karela Office Park Athens, Greece



- Office building
- The building was the first in Greece to obtain the LEED Gold certification
- New building completed in August 2012

Source: Saint-Gobain Glass
Credits: Kokkinou
Kourkoulas (architect)
Tassos Ringas Artemis Halari
(project architects)
Nikos Daniilidis (photography)





Osram Cultural Centre Copenhagen, Denmark



- Cultural centre.
- The building has been renovated according to the Active House principles. The heating demand has been reduced by a factor 4 and simultaneously the access to daylight and fresh air has been tremendously improved.
- The building was built in 1953 and renovated in 2008/2009.

Credits: Torben Eskerod (photography)
Architects: Karl Weidemann Petersen
MAA and W. Marke.
Source: he VELUX Group



Fox Vakanties

Hoofddorp, Netherlands

- Office building.
- The building obtained the BREEAM Excellent certification. This building's concept was inspired by the 'cradle-to-cradle' philosophy.
- New building completed in 2011.

Source: AGC Glass Europe
Credits: Edward van Dongen (architect)





Hohe Wand Vienna, Austria



- Single family home.
- The building was built in accordance with the Passive House standard.
- New building completed in 2009.

Credits: Georg W. Reinberg (architect)
Lopas (photography)





Riga 2 Stockholm, Sweden



In addition to glazed facade meant to maximize heat gains and natural light, the office space is constructed around a large atrium with internal glass partitioning in order to maximise light distribution and to ensure natural ventilation.

- Office building.
- The building obtained the LEED Gold certification. It also won the 2011 EU Green Building Award.
- New building completed in 2010.

Credits: Aros (architect)
Source: Vasakronan





Effizienzhaus Plus Berlin, Germany



This house is fully glazed on certain orientations. The rest of the building shell is interestingly covered by glass panels. This feature was incorporated primarily for aesthetic reasons (shiny look and reflection of the surroundings) rather than for reaping the traditional benefits of glass.



- Single family home
- The building was built in accordance with the German Efficiency House Plus certificate
- New building completed in 2011

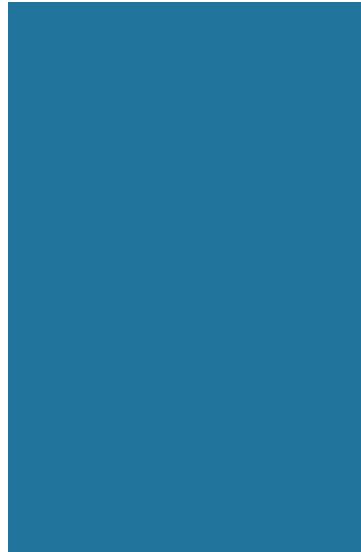
Credits: Werner Sobek (architect)
Source: Bundesverband Flachglas



Hôtel Région Rhône Alpes Lyon, France

In addition to the relatively large glazed facade throughout all orientations, the roof is largely glazed above large atria and corridors. Internal glass partitioning helps ensure that nearly all office space have access to natural light.

Around this building, many new office buildings and apartment blocks were built that use large glazed surfaces. This urban development called 'Confluence' was conceived as a 'green neighborhood' with all buildings meeting the most stringent energy efficiency standards.



- Local government office building.
- The building is certified HQE. HQE is a French certification standing for High Environmental Performance.
- New building completed in 2011.

Credits: Atelier Portzamparc (architect)
Sergio Grazia (photography)





Private Home Moxhe, Belgium



- Single family house
- The building was built in accordance with the Passive House standard
- New building completed in 2010

Source: AGC Glass Europe





Euro Tower

Bucharest, Romania



- Office building.
- The building was granted an A-level certificate for its high energy performance and was the first Green building in Bucharest.
- New building completed in 2010.

Source: Saint-Gobain Glass
Credits: Dorin Ștefan (architect)



Stapelbädden

Malmö, Sweden

- Office building.
- The building obtained the BREEAM Excellent certification.
- New building completed in 2012.

Credits: Arkitekturkompaniet
Source: Vasakronan





Brent Civic Centre London, UK

- Public building, local government offices and citizen services.
- This was the first building in the UK to obtain a BREEAM Outstanding certification.
- New building completed in 2013.

Credits: Brent Council (client)
Hopkins Architects (architectural design)
Morley von Sternberg (photography)
Skanska UK (design and build contractor)
URS (town planning, engineering design, environmental and sustainability services)
Turner & Townsend (quantity surveyor and project manager)





City Green Court Prague, Czech Republic



- Office building.
- The building obtained the LEED Platinum certification.
- New building completed in 2011.

Source: Guardian
Credits: Richard Meier & Partners
(architect)



R128

Stuttgart, Germany

Zero energy – the building does not consume more energy than it can generate from renewable sources. Zero emissions – the building does not emit CO₂ or any other detrimental emissions. Zero waste – 100% of the building can be recycled and it does not leave any waste.



- Single family house.
- The building was designed as triple zero building: zero energy, zero emissions and zero waste.
- New building completed in 2000.

Credits: Werner Sobek (architect)
Roland Halbe (photography)





Tefken Oz Levent Istanbul, Turkey



- Office building.
- The building obtained the LEED Gold certification.
- New building completed in 2011.

Source: Siseçam
Credits: Swanke Hayden Connell
Architects

The double-glazed facade of this building combines both Low-Emissivity and Solar-control properties to minimize heat losses in winter and avoid excessive heat gains in summer.

Extra clear glass is also used to ensure a high daylight transmission to let daylight flood into the internal space and thus minimize the need for artificial lighting.





Kindergarten, Deutsch Wagram Vienna, Austria

- Nursery.
- The building was built in accordance with the Passive House standard.
- New building completed in 2009.

Credits: Georg W. Reinberg (architect)
Andreas Buchberger (photography)





Main Point Karlin Prague, Czech Republic



- Office building.
 - The building obtained the LEED Platinum certification.
- It also won the MIPIM Award 2012 for the Best Office and Business Development.
- New building completed in August 2011.

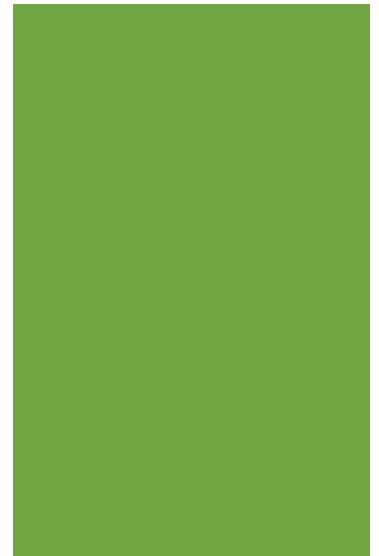
The double-glazed facade of this building combines both Low-Emissivity and Solar-control properties to minimize heat losses in winter and avoid excessive heat gains in summer.

Beneath the vertical colored stripes on the external shell, the facade is nearly fully glazed from the inside.



Solar Wooden Wintergarden

Delden, Netherlands



- Single family house.
- This home meets the Dutch energy coefficient index of 0.16, which makes it an A-rated building according to the Dutch energy performance scale.
- New building completed in 2012.

Credits: Schipper Douwes (architect)
Thea van der Heuvel (photography)
Source: Intelligent Glass Solutions





Saint-Gobain Laboratory

Milan, Italy



- Laboratory.
- The building was built in accordance with the Passive House and Class A energy standards of the Lombardy region.
- Retrofit 2011-2012.

Source: Saint-Gobain Glass

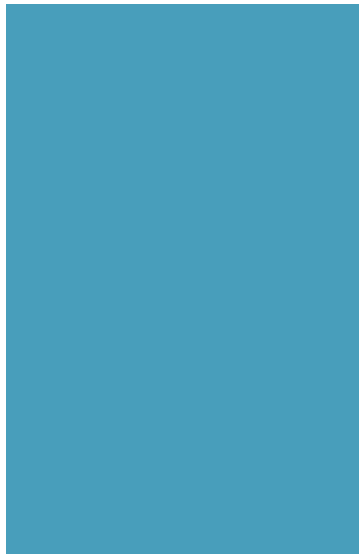


Origami

Paris, France

- Office building:
Headquarters of a bank.
- The building is certified HQE. HQE is a French certification standing for High Environmental Performance.
- The building was completed in 2011.

Credits: Manuelle Gautrand (architect)
Vincent Fillon (photography)





Home for Life Lystrup, Denmark

Home for Life fuses comfort and design to create an exceptional living environment, thanks to a high glazed surface which provides plenty of daylight and helps maximize energy efficiency. The window area is equivalent to 40 % of the floor area, well above normal practice for family homes in Europe. The building is built according to the Active House principles.

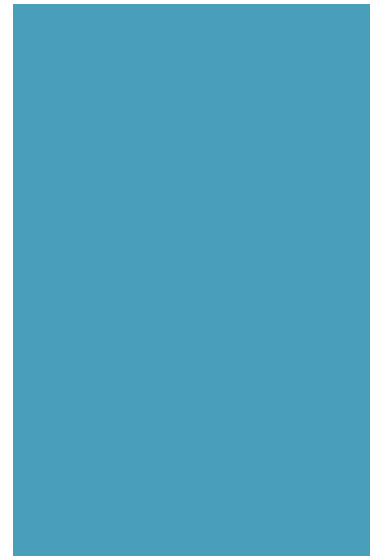
- Single family home.
- The building meets 2020 NZEB requirements and won the Green Good Design Award 2010.
- New building completed in 2008.

Credits: Adam Mark (photography)
Architect: Aart Arkitekter.
Source: The VELUX Group





Crown Square Warsaw, Poland



- Office building.
- The building obtained the BREEAM Very good certification.
- New building completed in 2010.

Source: AGC Glass Europe
Credits: Konior & Partners (architect)





Amera Tower

Cluj Napoca, Romania

Although Amera Tower is not as glazed as many other high-rise buildings, its glazed surface to floor ratio is relatively high. The rather traditional design of the building (i.e. almost a square shape on the ground) allows a good penetration of daylight inside office space.



- Office building.
 - The building obtained the LEED Platinum certification.
- It also won the MIPIM Award 2012 for the Best Office and Business Development.
- New building completed in August 2011.

Source: AGC Glass Europe
Credits: DaM Architects
Hubert Hesoun (photography)



American Heart Institute Nicosia, Cyprus



- Hospital.
- The building won the 2011 EU Green Building Award.
- New building completed in 2011.

Credits: Obrist Partner AG,
St. Moritz (architects)
Charalambos Artemis (photography)
Source: American Medical Center



Family home

Polva, Estonia



- Single family house.
- The building was built in accordance with the Passive House and Energy Plus standards.
- New building completed in 2013.

Credits: Georg W. Reinberg
Martha Enriquez Reinberg (architects)
Margus Valge (project management
and supervision)



Manchester Metropolitan Business School

Manchester, UK



- University Library.
- The building obtained the BREEAM Excellent certification.
- New building completed in 2011.

Source: AGC Glass Europe
Credits: Feilden Clegg Bradley Studios
(architect)



Gymnasium Nitescent

St Martin-en-Haut, France



The largely glazed south facade enhances the passive solar gain. Coupled with the solid wood walls, residual heating needs are minimized.

Additional glazing and openings on the North façade ensure that the gymnasium remains very bright and full of daylight. The glazed opening frames motorized placed in opposition and height also ensure natural ventilation.

- Sports hall.
- The building is certified BBC. BBC is a French certification standing for very low energy consumption.
- New building completed in 2012.

Credits: Tekhnê Architectes
Renaud Araud (photography)





Nereus

Malmö, Sweden

- Office building.
- The building obtained the LEED Platinum certification.
- New building completed in 2012.

Credits: White (architect)
Source: Vasakronan





Fonsanja HQ

Vitoria, Spain



- Office building.
- The building was granted an A-level certificate for its high energy performance.
- New building completed in 2011.

Credits: Estudio Beldarrain (architects)
Jesús Martín Ruiz (photography)



D10 Ulm, Germany

- Single family house.
- The building was designed as triple zero building: zero energy, zero emissions and zero waste.
- New building completed in 2011.

Credits: Werner Sobek (architect)
Zoëy Braun (photography)



Zero energy – the building does not consume more energy than it can generate from renewable sources. Zero emissions – the building does not emit CO₂ or any other detrimental emissions. Zero waste – 100% of the building can be recycled and it does not leave any waste.



Schukowitzgasse Vienna, Austria



- Nursery.
- The building was built in accordance with the Passive House standard.
- New building completed in 2006.

Credits: Georg W. Reinberg (architect)
Rupert Steiner (photography)





Green lighthouse Copenhagen, Denmark

- Faculty offices and student services, Copenhagen University.
- The building meets 2020 NZEB requirements and is CO₂ neutral (BE06).
- New building completed in 2009.

Credits: Adam Mørk (photography)
Source: The VELUX Group

Green Lighthouse is the first public CO₂-neutral building in Denmark. It is a cooperation between public and private partners, and is an example of a balance of energy efficiency, architectural quality, a healthy indoor climate and optimal daylight conditions.





Maison Air et Lumière

Verrières-le-Buisson, France



The house has been built in accordance with the Active House specifications to create healthier and more comfortable lives for the occupants without negative impacts on the climate. www.activehouse.info

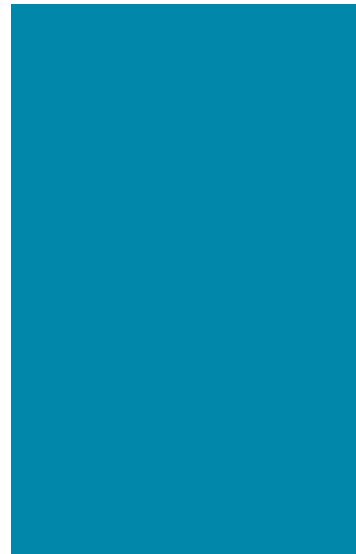
The energy concept of Maison Air et Lumière is based on the maximum use of renewable resources (solar energy, natural light, fresh air) in order to minimize the need for air-conditioning in summer, to reduce heating in winter and to reduce artificial lighting. The combination means a neutral environmental impact and maximum comfort for the residents.

- Single family house.
- The building meets the 2020 NZEB requirements and was built in accordance with Active House principles.
- New building completed in 2011.

Credits: Nomade Architectes
Adam Mork (photography)
Source: The VELUX Group

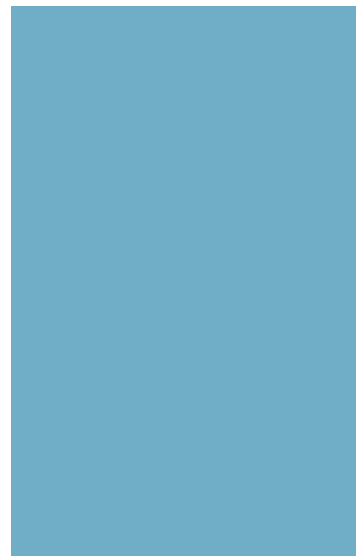


Uniqa Konzernzentrale Vienna, Austria



- Office building.
- The building won the 2007 EU Green Building Award.
- New building completed in 2004.

Credits: Heinz Neumann (architect)
©UNIQA-Bisutti (photography)
Source: Fachverband der Glasindustrie





KfW Westarkaden Frankfurt, Germany



- Office building.
- The building was built in accordance with KfW 40 and KfW 60 energy standards.
- New building completed in 2010.

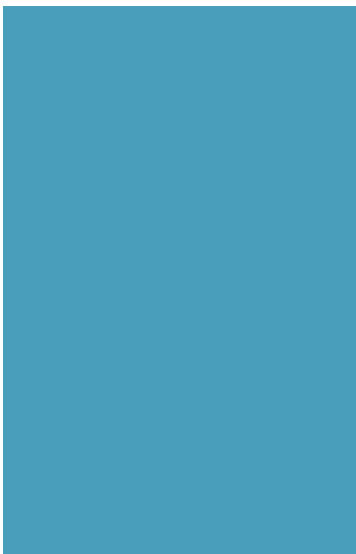
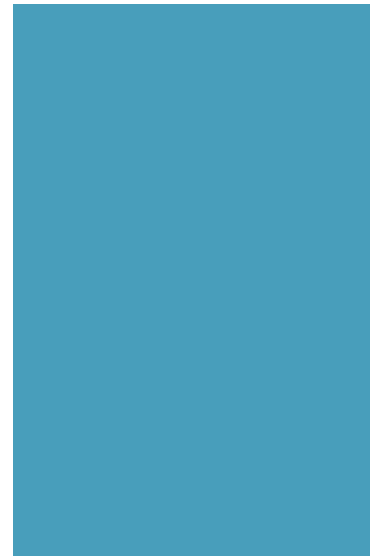
Credits: Sauerbruch Hutton (architects)
Jan Bitter (photography)





ETSAV campus

Sant Cugat del Vallès, Spain



- University halls of residence.
- The building was granted an A-level certificate for its high energy performance.
- New building completed in 2011.

Credits: H. Arquitectes dataAE
(architects)
Adrià Goula Sarda (photography)





Tour Oxygène

Lyon, France

- Office building.
- The building obtained the BREEAM Very Good certification.
- New building completed in 2010.

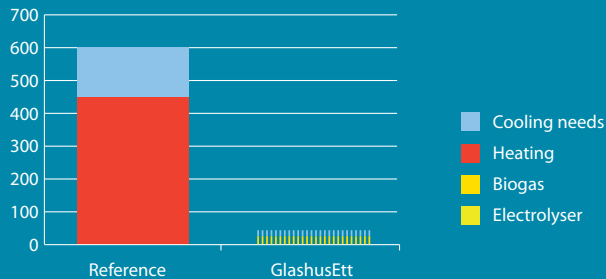
Credits: Arte-Charpentier (architect)





GlashusEtt, Hammarby Sjöstad Stockholm, Sweden

- Centre for Environmental Information.
- The aim throughout the construction of GlashusEtt was to achieve a good indoor climate with low energy consumption. The graph shows how well the aim has been met with nearly zero heating needs and considerably reduced cooling needs.



Credits: Björn Lofterud (photography)

The double-glazed facades, linked to an advanced control system cuts the energy consumption to 50% of that of an equivalent building. The double-glazed facades reduce the need for artificial light and the energy requirement for heating, cooling and ventilation.

This environmental information centre finds its heart in the middle of Hammarby Sjöstad, a new and 'green' urban development in the city of Stockholm. All buildings of this neighborhood were built to consume nearly zero energy. Glass is largely used on all building types: apartment blocks and offices.



Glossary of terms and acronyms

Active House: Active House is a vision of buildings that create healthier and more comfortable lives for their occupants without negative impact on the climate. To be considered an 'Active House' construction, the building has to respect a set of strict specifications including requirements to achieve nearly zero-energy standards, to include renewable energy, to achieve good levels of daylight availability and to ensure a good indoor environment.
www.activehouse.info

BBC ~ Bâtiment Basse Consommation: Low (energy) consumption building. According to the French thermal regulation 2012, the norm BBC can be granted to buildings whose primary energy needs for heating, cooling, ventilation, water heating and lighting are drastically reduced compared to similar types of buildings, i.e. 80% lower than that of regulatory requirements.

BREEAM ~ Building Research Establishment's Environmental Assessment Method: BREEAM is an environmental assessment method and rating system for buildings. BREEAM rewards performance above regulation which delivers environmental, comfort or health benefits to achieve sustainable buildings. BREEAM awards points or 'credits' for different indicators such as operational energy needs and carbon impact, resource efficiency of construc-

tion materials, waste management, health and wellbeing, etc. Based on the overall score, buildings are then ranked for their performance.
www.breeam.org

DGNB ~ Deutsche Gesellschaft für Nachhaltiges Bauen: Germany's Sustainable Building Council. The aim of DGNB is to promote sustainable and economically efficient buildings. It operates its own certification system for assessing the sustainability of buildings. The rating is based on around 50 indicators covering environmental, economic, socio-cultural and functional aspects. Based on the overall building's score, the DGNB Certificate is awarded in gold, silver or bronze.
www.dgnb.de

EU Green Building: The EU Green Building Award is managed by the Green Building Programme. This voluntary programme was launched and is supported by the European Commission and aims at improving the energy efficiency of non-residential buildings in Europe.
<http://iet.jrc.ec.europa.eu/energyefficiency/greenbuilding>

HQE ~ Haute Qualité Environnementale: High Environmental Quality. The French voluntary label HQE is granted to buildings whose construction or renovation works were carried so that the building meets certain sustainability objectives in

14 different areas including energy performance, indoor air quality, visual comfort, etc. The building must also be accompanied with an environmental management plan to ensure that objectives are effectively achieved throughout the building's lifetime.
www.assohqe.org

KfW ~ Kreditanstalt für Wiederaufbau: Credit Bank for reconstruction. KfW is a German bank, which has always been very active in the financing of real estate. Because it engaged in innovative models for the financing of energy efficient renovation works, it has established levels of energy performance, which are now widely used in Germany and are still called after the bank, e.g. KfW 40, KfW 60.
www.kfw.de

LEED ~ Leadership in Energy and Environmental Design: LEED is a green building tool that addresses the entire building lifecycle and offers a certification scheme for sustainable buildings. Building projects must satisfy prerequisites and earn points to achieve different levels of certification. Prerequisites and credits differ for each building type but always address the energy performance of the building, its environmental impacts and the human benefits of the building-related impacts.
www.usgbc.org/leed

NZEB(s) ~ Nearly Zero-Energy Building(s): Nearly zero-energy building is the minimum standard to be achieved for all new constructions in the European Union as of 2020, according to the recast Energy Performance of Buildings Directive 2010/31 EU. It is defined in the EU directive as 'a building that has a very high energy performance (...)'. The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby'.

Passive House Standards: Constructions meeting the Passive House standards require very little energy to achieve a comfortable temperature year round, making conventional heating and air conditioning systems obsolete. While delivering superior levels of comfort, the Passive House Standard requires that the building envelope is extremely well insulated and utilizes high performing glazing in order to modulate solar heat gains and to minimize the need for artificial lighting. The criteria for the certification of Passive Houses are set by the German Passive House Institute.
www.passiv.de/en/index.php

About Glass for Europe

Glass for Europe is the trade association for Europe's manufacturers of flat glass. Flat glass is the material that goes into a variety of end-products and primarily in windows and façades for **buildings**, windscreens and windows for **automotive and transport** as well as glass covers, connectors and mirrors for **solar-energy** equipments. It is also used in smaller quantities for other applications such as furniture, appliances, electronics, etc.

Glass for Europe has four members: **AGC Glass Europe**, **NSG Group**, **Saint-Gobain Glass** and **Sisecam-Trakya Cam** and works in association with **Guardian**. Altogether, these five companies represent 90% of Europe's flat glass production.

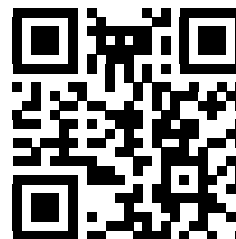
Glass products not only provide light, comfort, style, security and safety, they are also **essential to energy-efficient buildings, houses and transport**. Windows containing high-performance glass such as low-e insulating glass, which helps keep warmth in, and solar-control glass, which reflects unwanted heat away, help reduce energy consumption. Solar-energy glass helps enhance the production of a renewable sources of energy. Better use of building glass alone could help reduce Europe's CO₂ – emissions by 100 million tonnes annually hence Glass for Europe's plea for an ambitious and robust European energy-efficiency policy.

www.glassforeurope.com



This booklet has been produced and researched by Glass for Europe.

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