PU europe
EXCELLENCE IN INSULATION

PU and Very Low Energy Buildings

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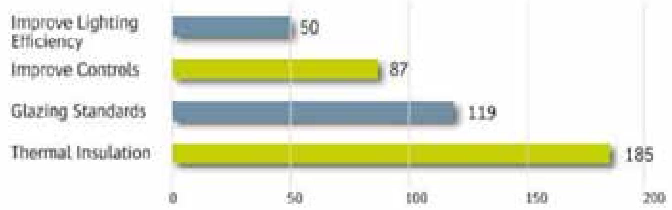
Contents:



Potential savings in EU - Mt CO_2 per annum

Source: Insulation for Sustainability - a Guide (CXO2 Conisbee Ltd. 2006)

Potential savings in EU – Mt CO_2 per annum[1]

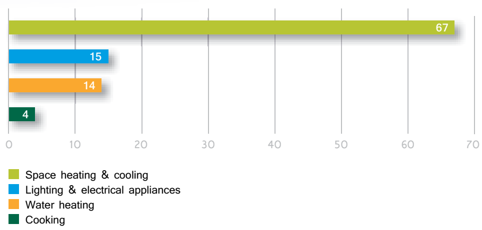
Executive summary

Our buildings account for almost 40 % of our overall energy consumption, yet offer the highest potential for cost effective savings. With Europe's dependency on energy imports rapidly growing and energy bills rising across the continent, reducing the energy demand of our buildings has become a crucial condition for maintaining our standard of living in the future.

Investment in energy efficient buildings offers multiple micro- and macro-economic benefits. The Energy Performance of Buildings Directive (EPBD) has therefore determined that all new public buildings must achieve nearly zero energy demand from 2019 onwards. The target date for all other buildings is 2021, but a number of Member States have adopted more ambitious deadlines.

Very low or nearly zero energy buildings can only be achieved if a holistic approach is adopted. This is described in the principle of trias energetica, which first requires that the energy demand of buildings is reduced by improving building envelope performance. Energy demand should then be covered by renewable sources of energy as far as possible. Any remaining demand should be met through the efficient use of fossil fuels.

Share in total building energy consumption



Despite an increase in the construction of low or zero energy buildings, there is still a wide-spread perception that these are costly to build and utilitarian in appearance. However, thanks to the use of high performance products such as PU insulation, highly efficient buildings can be constructed which combine high levels of comfort with attractive architecture and affordable prices.

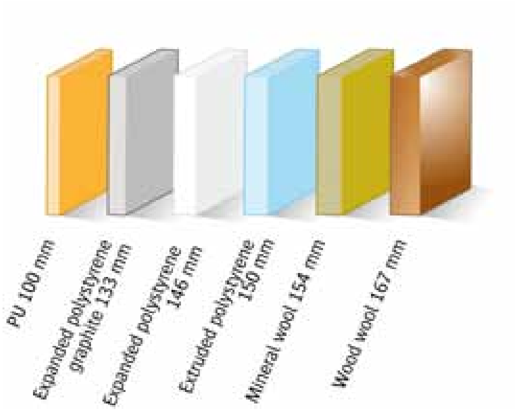
Renovation is another important aspect to consider if Europe is to meet the 2050 target of reducing CO_2 emissions by 80-95 % compared to 1990 levels. Because of its thin, lightweight properties and levels of thermal efficiency, PU insulation can also be used very effectively to upgrade the performance of existing buildings

[1] *Insulation for Sustainability – a Guide* (CXO2 Conisbee Ltd., 2006)

What is PU?

PU insulation stands for a group of insulation materials based on PUR (polyurethane) or PIR (polyisocyanurate). Their closed cell structure and high cross-linking density give them the characteristics of good heat stability, high compressive strength and excellent insulation properties. PU insulation has a very low thermal conductivity, starting from as low as 0.022 W/(m²·K), making it one of the most effective insulants available today for a wide range of applications.

Insulation thickness for U-value 0.022 W/(m²·K) – insulation only



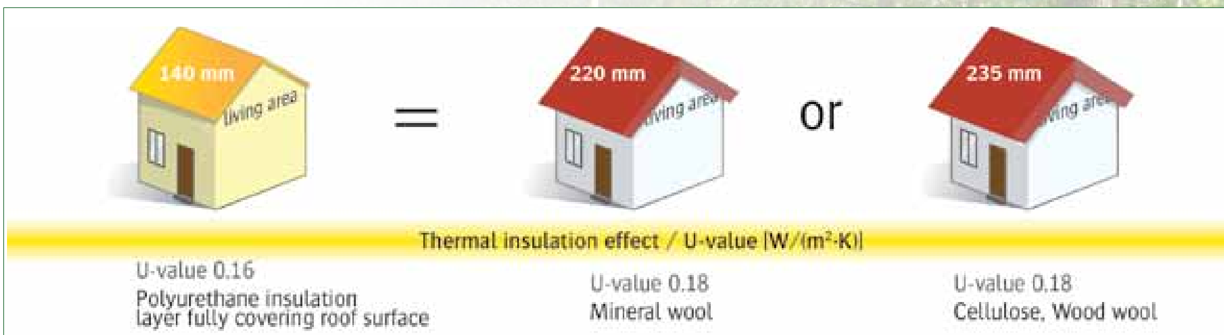
Why is PU the insulation material of choice for very low energy buildings?

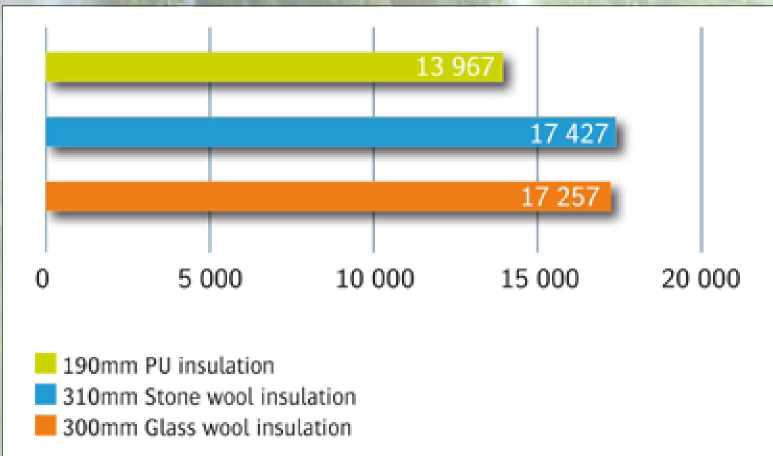
Not only is polyurethane (PU) insulation capable of achieving very high levels of energy efficiency, but because it can do so with minimal thickness there are fewer adjustments to be made to the design of buildings in order to accommodate the necessary depth of insulation.

This in turn saves on costs, as it minimises the impact on elements such as the depth of eaves, joists, rafters or studs, lengths of fixings and the size and strength of overall structure. It also maximises the available space, making the most of building land and living space.

Air tightness is a vital component of very low energy buildings. Design solutions using PU insulation can achieve high levels of air tightness with relative ease and reduced material use when compared to solutions using other insulation materials.

The durability of polyurethane insulation means that the energy efficiency it provides will last over the lifetime of the building, continuing to make savings long after the payback period.





Case study: new pitched roof insulation (3.5 % discount rate, temperature oceanic climate, U-value: $0.13\,W/(m^2 \cdot K)$, cumulative cost over a 50 year life cycle)

PU and sustainability

In a number of low energy building designs, PU insulation shows the lowest life cycle costs thanks to higher energy savings or, in the case of equal R-values, reduced material use and lower knock-on effects on the building.[2]

It is estimated that the use of PU insulation rather than other lower performing insulation materials can make an average saving of 5 % on each building element. With the residential construction and renovation market for Europe valued at 550€ billion in 2009, the savings can be very significant even when very cautious assumptions are used. This brings substantial economic benefits to the community.[3]

Research has shown that the life cycle environmental performance of PU insulation in low energy building designs is comparable to that of other common materials such as mineral fibre, EPS[4] and natural insulants[5]. In some applications, it can be better.

Lesser insulation thicknesses also allow walls to be thinner, and maximises available space; for example, the use of PU insulation can reduce the footprint of a detached house by up to $4\,m^2$ [6]

[2] PU Europe factsheet n° 15: *Life Cycle Environmental and Economic analysis of Polyurethane Insulation in Low Energy Buildings*, 2010

[3] Buildecon for Euroconstruct: Country reports – 70th issue (2010)

[4] See reference 1

[5] Centre Scientifique et Technique de la Construction (B): *Impact environnemental des toits à versants* (CSTC-Contact n° 28 (4-2010))

[6] See reference 1

What are the benefits of energy efficient societies?

Building an energy efficient society carries many benefits:

- It provides the most cost-effective and fastest way to reduce annual greenhouse gas emissions by 740 million tons.
- Tackles fuel poverty – between 50 and 125 million Europeans are currently considered to be in fuel poverty, and this figure is likely to increase[7].
- Increases security of supply. For example, achieving the 20 % energy savings target would save as much energy as fifteen Nabucco pipelines could deliver[8].
- Creates jobs and increases disposable income. Up to 2 million jobs could be created by 2020 and energy benefits per year could amount up to 1 000 € per household[9].
- Encourages individuals to make improvements in building infrastructure and long term changes in behaviour.
- The payback period for investments in energy efficiency is relatively short.
- Prepares homes for climate change and the effects of extreme temperatures in both the summer and the winter months. It is estimated that over 15 % of homes in Italy, Latvia, Poland, Cyprus and 50 % in Portugal are unsuited to current temperature levels in the winter.
- Improves existing building stock

[7] European Parliament, *Report on Revision of the Energy Efficiency Action Plan* (2010/2107(INI)), Committee on Industry, Research and Energy, Rapporteur: Bendt Bendtsen

[8] Idem

[9] European Commission, SEC(2011) 277: *Impact Assessment accompanying the Energy Efficiency Plan*

		Ratio primary energy / final energy for electricity	
DK Low energy class 1	< 35 + 1100/A kWh/m²/yr = energy consumption for heating, cooling, ventilation and hot water	2.5	Primary Energy
MINERGIE®	< 42 kWh/m²/yr = energy consumption for heating, cooling, ventilation and hot water	2	Primary Energy
effinergie	< 50 kWh/m²/yr = energy consumption for heating, cooling, ventilation and hot water + Lighting	2.58	Primary Energy
German Passive House	< 120 kWh/m²/yr = energy consumption for heating, cooling, ventilation, hot water and lighting + electrical domestic appliances	2.70	Primary Energy
&			
German Passive House	< 15 kWh/m²/yr = energy need for heating	2.70	Final Energy

Different scopes, calculation methods and norms for low energy and passive houses in selected countries[10]

What is a very low energy building?

There is no global definition for low energy buildings, but it is generally accepted that they have a better level of energy performance than the standard energy efficiency requirements in current building codes. Low energy buildings typically use high levels of insulation, energy efficient windows, low levels of air leakage and heat recovery ventilation in order to lower space heating and cooling energy requirements. Passive solar building design techniques or active solar technologies, and hot water heat recycling technologies to recover heat from showers and dishwashers may also be used.

Not only is there no clear universally accepted definition of what a low energy building is, there are also variations as to what energy use should be included to assess demand. Often, only space heating is included, but ideally the minimum performance requirements should take into account all types of energy use, including cooling and water heating, lighting and consumption of electricity for appliances. The image illustrates the different scopes and calculation methods on selected low energy performance standards.

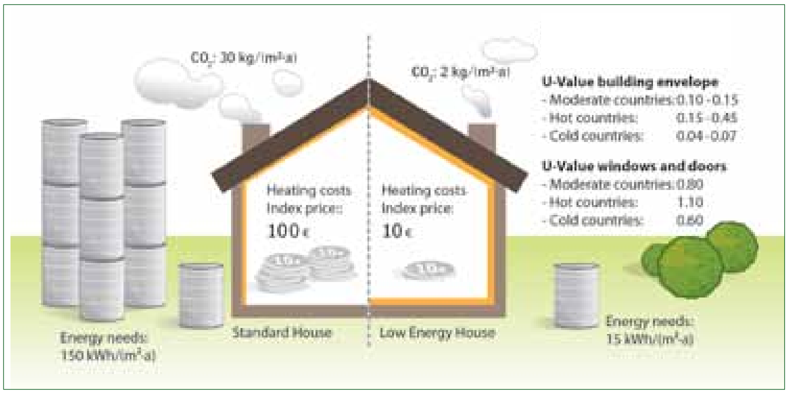
To date, about a third of the EU Member States have defined low energy building, and a few more plan to do so. Definitions apply in almost all cases to both residential and non-residential buildings and mostly focus on new buildings, but in some cases also cover existing buildings. A typical requirement is a reduction in energy consumption of between 30 and 50 % over current new building standards. This generally corresponds to an annual energy demand of ≤ 40-60 kWh/m² in Central European countries. In some countries labels have been introduced (MINERGIE in Switzerland and Effinergie in France) to help consumers to identify nationally standardised low energy buildings. ***Table 1*** gives an overview of the definitions for low energy buildings across Europe[11]

Table 1: Examples of definitions for low energy building standards (Source: SBI, *European Strategies to move towards very low energy buildings*, 2008)

Country	Official definition
Austria	► Low energy building = annual heating energy consumption below 60-40 KWh/m² gross area 30 % above standard performance ► Passive building = Feist Passivhaus standard (15 kWh/m² per useful area (Styria) and per heated area (Tyrol)
Belgium (Flanders)	► Low energy class 1 for houses: 40 % lower than standard levels, 30 % lower for office and school buildings ► Very low energy class: 60 % reduction for houses, 45 % for schools and office buildings
Czech Republic	► Low energy class: 51-97 kWh/m² p.a. ► Very low energy class: below 51 kWh/m² p.a., also Passivhaus standard of 15 kWh/m² is used
Denmark	► Low energy class 1 = calculated energy performance is 50 % lower than the minimum requirement for new buildings ► Low energy class 2 = calculated energy performance is 25 % lower than the minimum requirement for new buildings (i.e. for residential buildings = 70 + 2 200/A kWh/m² per year where A is the heated gross floor area, and for other buildings = 95 + 2 200/A kWh/m² per year (includes electricity for building-integrated lighting))
Finland	► Low energy standard: 40 % better than standard buildings
France	► New dwellings: the average annual requirement for heating, cooling, ventilation, hot water and lighting must be lower than 50 kWh/m² (in primary energy). This ranges from 40 kWh/m² to 65 kWh/m² depending on the climatic area and altitude ► Other buildings: the average annual requirement for heating, cooling, ventilation, hot water and lighting must be 50 % lower than current Building Regulation requirements for new buildings ► For renovation: 80 kWh/m² as of 2009
Germany	► Residential low energy building requirements = kfW60 (60 kWh/(m²·a) or KfW40 (40 kWh/(m²·a)) maximum energy consumption ► The thresholds for existing buildings are 40 % higher ► Passivhaus = KfW-40 buildings with an annual heat demand lower than 15 kWh/m² and total consumption lower than 120 kWh/m²
England and Wales	► Zero carbon definition: zero carbon dioxide emissions from space heating, cooling, hot water and lighting

[10] Thomsen/Wittchen, *European national strategies to move towards very low energy buildings*, SBI (Danish Building Research

[11] European Commission, *Low energy buildings in Europe: current state of play, definitions and best practice*, 2009



Recommended U-values for low energy houses

Are low energy buildings affordable?

Although constructing low energy buildings can incur additional capital costs, such as increased levels of insulation or better performing windows, they have increasingly become more affordable. The important question is how to achieve the optimum balance between energy saving and increased capital costs. The introduction of new technologies, for example, can also lead to hidden costs such as increased investment in planning, education and quality assurance, which are difficult to define in real terms, particularly for countries with less developed low energy markets. This chapter gives an overview of the current situation in several countries and some relevant studies.[12]

Increasing competition in the supply of specifically designed and standardised Passivhaus building products has brought costs down in Germany, Austria and Sweden. For these countries the extra cost of constructing at Passivhaus level is generally in the range of 0-14 % more than for the standard alternative. The cost difference between a low energy and the more ambitious Passivhaus standard is indicated at 8 % (around 15 000 Euro) for Germany.[13]

For Switzerland, a range of 2-6 % of additional upfront cost is given for the Minergie® low energy standard and, depending on the design chosen, a range of 4-10 % for the Minergie® P Passivhaus standard. The HQE association in France, reports an additional cost of only 5 % if the 'High Environmental Quality' parameters are taken into account early enough.

Payback periods can vary but should be around ten years based on current energy prices. With increasing energy prices the additional investment will pay off even faster in the future.

To put these costs into context, it should be noted that a substantial reduction of total costs can be achieved when the space heating energy requirements are reduced to around 15 kWh/m² p.a. – the point at which a traditional heating system is no longer needed. At this level of energy efficiency, the gains from energy savings will also be significant

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[12] Idem

[13] Sources: Passivhaus Centre Sweden, www.cipra.org, www.passive-on.org, www.ig-passivhaus.de

Legal Framework in Europe and the Member States[14]

The European framework is defined in the Energy Performance of Buildings Directive (2010/31/EU – EPBD)[15]. It stipulates that all new public buildings must achieve nearly zero energy demand from 2019 onwards. The target date for all other buildings is 2021.

Several Member States have already set up long-term strategies and targets for achieving low energy standards for new houses (see ***Table 2***). For example, in the Netherlands there is a voluntary agreement with industry to reduce energy consumption compared to the present building codes by 25 % in 2011, 50 % in 2015 (close to Passivhaus) and to have energy neutral buildings in 2020. In the UK the ambition is to have zero carbon homes by 2016. In France by 2012 all new buildings should comply with the "low consumption" standard, and by 2020 be energy positive, i.e. produce energy. Several regions and municipalities (in Italy for example) are also looking beyond current targets

Table 2: National roadmaps towards nearly zero energy buildings (Source: SBI, *Ecofys: principles for nearly zero energy buildings*, 2011)

Country/year	Existing	2010-2011	2012-2013	2014-2015	2016	2020
Austria	66.5 kWh/m²/year (final energy)	-15 %		Passivhaus		
Belgium	119-136 kWh/m²/year (primary energy)	-25 %				
Denmark	2010: 52.5-60 kWh/m²/year (primary energy)	-25 %		-50 %		-75 %
Finland	65 kWh/m²/year (heating demand)	-15-30 %	-20 %	Passivhaus for public		
France	Until 2012: Fossil fuels: 80-130 kWh/m²/year Electricity: 130-250 kWh/m²/year (primary energy)		LEB Effinergie 50 kWh/m²/year			Positive E+
Germany	2009: 70 kWh/m²/year (primary energy)		-30 %			NFFB
Ireland	2011: 64 kWh/m²/year (primary energy)	-60 %	CO_2 neutral			
Netherlands	Regulated through EPC factor 2008: ~100-130 kWh/m²/year (primary energy)	-25 %	Climate neutral public building	-50 %		ENB
Norway	2010: 150 kWh/m²/year (net heating demand)			Passivhaus		ZEB
Sweden	2009: 110-150 kWh/m²/year (delivered energy)	-20 %		-25 % of all new is ZEB		ZEB
Switzerland	2011: 60 kWh/m²/year (primary energy)			Minergie-P 30 kWh/m²/year (delivered energy)		
United Kingdom	Regulated through CO_2 demands 2010: ~100 kWh/m²/year (primary energy)	-25 %	-44 %		Zero Carbon	

[14] Idem 11
[15] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0013:0035:EN:PDF

Refurbishment of an old farm (XVIII) by Renaud Laverdure, Belgium

The case for refurbishment

Very low or near zero carbon new building is relatively simple with the latest technological advances and construction methods. The real issue that lies ahead is the deep renovation of the existing building stock, which is only insufficiently addressed in the recast EPBD.

Although largely cost-effective over its life time, deep energy renovation is technically demanding, requires tailor-made solutions and the price per kWh saved is therefore higher than for new build. However, without tackling the existing building stock, all efforts to achieve our CO_2 reduction targets will be in vain.

It is estimated that there are about 210 million buildings in the European Union, with a demolition rate of just 210 000 buildings per year – only 0.1% of the existing stock. Around 2.1 million new buildings a year are being constructed, so even if all of these are built to the necessary low carbon standards, that still only represents a small percentage of the current stock. The big challenge for the European Union therefore is existing buildings, as they account for such a high proportion of EU energy consumption, and will be with us for many decades to come.

The current rate of energy renovation of buildings is between 1.2% and 1.4% – a figure that needs to be increased by up to 3 times in order to achieve the EU targets of reducing CO_2 emissions by 80-95% by 2050 compared to 1990 levels.[16] However, if we follow the current business as usual scenario, it will take around 90 years before all existing buildings are of a sufficient standard!

It is also worth considering that the normal renovation cycle of a building is 30 years, so if inadequate measures are

Return on investment

Case study: Annual savings and return on investment of PU insulation[17]

A pitched roof was renovated and insulated with 140 mm of PU in Germany.

Heat losses through the roof before renovation:	17 250 kWh/a
Heat losses through the roof after renovation:	1 970 kWh/a
Heating oil prices 2010 (incl. auxiliary energy):	0.073 €/kWh
Annual heating oil savings:	1 520 l/a
Cost savings for energy:	1 115 €/a

The upper line of the following table shows possible scenarios for energy price developments (in % terms compared to the year before). The investment of 7 100 € includes all costs relating to the installation of the PU insulation layer. As it is assumed that the insulation works take place at a moment when the roof is renovated anyway, the roofing costs do not have to be taken into account. This will lead to the following returns on investment for different energy price scenarios:

Increase in oil price p.a.	0 %	4 %	8 %
Investment 2010	-7 100 €	-7 100 €	-7 100 €
Return on investment p.a.	12.46 %	16.34 %	22.22 %

being taken now they are unlikely to be rectified for some considerable time.

This challenge can only be effectively tackled through binding national renovation targets which provide a long-term prospective to both industry and end-users, allow the development of appropriate political tools and incentive schemes, and ensure the measurement of progress.

In times of strict budgetary rigour, authorities need to develop new financing tools to allow the greatest possible take up of the opportunities to improve building performance. Subsidised loans, pay-as-you-save schemes, etc. overcome the barrier of upfront financing and limit impact on public budgets. Any financial support should be proportionate to the level of energy savings that will be made, providing an incentive to take stronger measures.

The full realisation of the energy savings potential of existing buildings will offer a win-win situation: lower energy bills for energy consumers, more skilled jobs in the construction industry and higher revenues from increased economic activities for public budgets.

The PU insulation industry is willing, ready and able to provide high performance products and sustainable solutions for Europe's low energy future

[16] *The Fundamental Importance of Buildings in Future EU Energy Saving Policies*, a paper prepared by a Taskforce of Actors and Stakeholders from the European Construction Sector, July 2010 (www.ace-cae.eu/public/contents/getdocument/content_id/868)

[17] Institut für Vorsorge und Finanzplanung GmbH, Gutachten Energieeinsparung – der renditestarke Baustein für die finanzielle Zukunftssicherung (2011)

Apartment building in Bad Mergentheim

Category / year

Renovation – Large residential (multi-family house) / 2009

Address

Herrenwiesenstrasse 42, Bad Mergentheim (Germany)

Contact details

Owner:
Kreisbau Main-Tauber AG, Bad Mergentheim
www.kreisbau-mt.de

Architect:
Architekturbüro Jochen Elsner

For further questions:
Linzmeier Bauelemente GmbH
Project management
Tel.: +49 7371 180 649
Fax: +49 7371 180 67 749
Karin.frick@linitherm.de

Pictures




Description of the building

Detailed description:
A six-story apartment building in Bad Mergentheim, originally built in 1961, was renovated with a view to enhancing the appearance of the building and reducing energy consumption to 30 % below the level of a new building (to EnEV 2007).

By insulating and sealing the building envelope, installing new windows and modernizing the heating system, the primary energy demand of the building was dramatically reduced by over 70 %.

Building envelope:

- *Roof:* the building's hip roof was fitted with PUR/PIR insulation LINITHERM PAL N+F (140 mm, lambda 0.023) on the rafters to avoid thermal bridges. With a bulk density of 33 kg/m³, PUR/PIR adds only little weight to the roof structure and only slightly increases its thickness.
- *Roof windows:* the newly installed roof windows incorporated LITEC DDZ insulation frames. Because the frames made of recycled PUR/PIR rigid foam are supplied in standard lengths and cut on site to fit the window frame, they can easily be adapted to different window shapes and sizes.
- *Facade:* the facade was insulated with PUR/PIR boards (80 mm, lambda 0.027). The decision to use a high performance insulant was particularly important for the balcony recesses, as their surface was already small before renovation. Thanks to its low thermal conductivity, the surface was only marginally reduced.

Energy efficient technologies:

- Heating system: gas burner and mini block heating station

Renewables:

- None

Energy consumption

Energy values:

- *External wall (U-value):*
  Before renovation 1.13 W/(m²·K) — After renovation 0.19 W/(m²·K)
- *Roof (U-value):*
  Before renovation 2.63 W/(m²·K) — After renovation 0.16 W/(m²·K)
- *Windows (U-value):*
  After renovation: 1.00 W/(m²·K)
- *Total primary energy demand:*
  Before renovation 201 kWh/(m²·a) — After renovation 53.60 kWh/(m²·a)

Use of renewables:

- None

The BASF House

Category / year

New construction: nearly zero energy building or better – Small residential (1-2 family houses) / 2007-2008

Address

Creative Homes Project, University of Nottingham, Nottingham, United Kingdom

Contact details

Developer:
BASF plc, Deryn Gilbey
Tel.: +44 (0)161 488 5481
deryn.gilbey@basf.com

For further questions:
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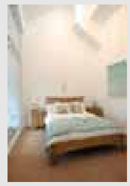
Tel.: +44 (0)161 488 5481
deryn.gilbey@basf.com

Pictures




Description of the building

Detailed description:
The BASF House is an 82 m² 1-family-home which can be extended to a row of terraces on demand. It is currently inhabited by 2 people. A low carbon emissions target was set for the house. Heat requirement reduction was essential; renewables are being used to heat the house and water. The house complies with the Passivhaus standards of 15 kWh/m² and can be called a 1.5 litre house. Materials were selected to balance the cost of building an energy efficient house against the requirement to make the house affordable to a first time buyer, based on whole life performance cost and energy use. Alternative methods of construction instead of traditional brick and block work reduced building time and the need for expensive skilled labour.

The house can achieve comfortable temperatures naturally by combining solar gains, natural ventilation and thermal mass provided by a new Phase Change Material (PCM).

Facing south there is a fully glazed, adjustable two-layer sunspace. The sun warms the air in the sunspace and acts as the primary heating source for the house. Windows between the solar area and the main part of the house can then be opened to enable the warm air to flow around the rest of the house.

Building envelope:
First floor and roof: structural Insulated Panels (SIPs) with PU core. The low carbon roof is made of lightweight steel and coated with a BASF Coatings' coil coating infused with specially-selected heat management pigments which have solar heat reflectant properties. These materials resulted in a U-Value of 0.15 for walls and roof.

Renewables:
An affordable Ground Air Heat and Cooling Exchange system and a biomass boiler to provide an effective, affordable heat and cooling source were incorporated.

Energy consumption

Energy values:
- *Heating demand:* ca. 12.5 kWh/m²/year
- *Cooling demand:* 0 kWh/m²/year
- *Final energy demand:* 12.5 kWh/m²/year (incl. hot water)

Use of renewables:
- 100 % RES fraction of the energy used for hot water
- 100 % RES fraction of the energy used for cooling
- 100 % RES fraction of the total final energy demand (electricity not considered as renewable, even if from renewable supply)

Awards won

- Finalist of the Sustainability Awards 2008, Category: Sustainability Innovation Award

Links

Websites illustrating the building:
- http://www.energyefficiency.basf.com/ecp1/EnergyEfficiency/en_GB/portal/_/content/show_houses/show_houses_uk

Bayer Administrative Building, Diegem

Category / year

Destruction and new construction: low energy building or better – Office building (250-400 employees) / 2009

Address

J. E. Mommaertslaan, 14 - 1831 Diegem (Belgium)

Contact details

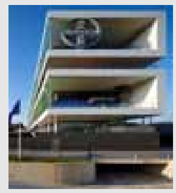
Owner:
Bayer

Architect:
Schellen Architecten

Construction:
Van Roey

For further questions:
Christoph Kohlen
Head of the EcoCommercial Building Program
Region Benelux
Mobile: +32 478 37 33 65
christoph.kohlen@bayer.com

Pictures



Description of the building

Detailed description:
The Bayer Diegem Administrative building combines the marketing & sales activities of Bayer HealthCare, Bayer CropScience and Bayer MaterialScience and the corporate services of Bayer in Belgium.
L / W / H = 94 / 13/ 26 m. Total surface 12 930 m² of which parking: 4 711 m², office: 7 697 m² and technical space: 522 m².

The total concept allows the reduction of the primary energy consumption for heating and cooling by 83 % which means 19 000 kg less of CO_2 emissions. The building that was on the site before was demolished and entirely recycled.

Building envelope:
- *Walls:* 10 cm polyurethane insulation (U=0.26 W/(m²·K))
- Facade covered with lamellas for optimal light / heat management (20 % savings on cooling)
- High performance glazing
- Optimal acoustics

Energy efficient technologies:
- Heating with activated concrete floors
- HVAC including rotating wheel heat recovery system
- Presence detectors and adaptive LED lighting
- Building automation

Renewables:
- Geothermal field (60 boreholes of 100 m deep)
- 3 heat pumps (16 kW, COP of 4.3)
- Ground-air heat exchanger (18 underground ducts of 55 m)
- Use of rain-water and recycling of grey water for sanitary purposes (reduces flush up to 90 000 l per year)

Energy consumption

Energy values:
- *Energy consumption:* less than E65 (144 kWh/m²/year) vs. Flemish E100 (222 kWh/m²/year) but in reality it should be E57 or lower since this official calculation method does not include the geothermal field and ground-air heat exchanger
- *Thermal heat loss coefficient:* U = 0.58 W/(m²·K) (K30 vs. Flemish required K45)

Energy demand:
- Heating: 35 %
- Hot water: 15 %
- Lighting: 16 %
- Ventilation: 16 %
- Kitchen: 11 %

- Excess: 1 %
- Geothermic: 25 %
- Heat exchange: 24 %
- Gas: 4 %
- Electricity: 47 %

Awards won

- Energy Award 2009
- Certificate of Partner in the GreenBuilding Programme for enhanced energy efficiency in buildings (EU Commission)
- Pilot project of the Flemish energy agency (VEA)
- Amongst the 5 finalists of the ORI 2020 Challenge 2009

Links

Websites illustrating the building:
- http://www.archello.com/en/project/bayer-diegem
- http://www.energymag.be/nl/home/item/235-case-study-bayer-diegem
- http://www.climate.bayer.com/en/ecocommercial-building.aspx

Promotional material online:
- Visits possible during BBL Open Door Days
- Detail of materials / technologies used available
- Movie of the construction

Cork Institute of Technology

Category / year
Renovation – Research facility / 2012

Address
Cork Institute of Technology's (C.I.T) main campus in Bishopstown (Ireland)

Contact details

Owner:
C.I.T

Architect:
Henry J. Lyons

For further questions:
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Carrickmacross Road, Kingscourt, Co. Cavan, Ireland
Tel.: +353 42 969 85 40
Fax: +353 42 969 85 72

Pictures

Description of the building

Detailed description:
Cork Institute of Technology's (C.I.T) main campus in Bishopstown is being refurbished using Kingspan Benchmark's Ceramic Granite Façade and Karrier Panel System to help transform both the aesthetics and the performance of their 1970's building stock. The retrofit was developed by the C.I.T Zero2020 research team in partnership with Kingspan and Architectural Metal Systems (AMS), and forms the first stage of an ambitious target to achieve Net Zero Energy, whereby the building would generate as much energy as it uses, by 2020.

The 1974 building which served as the project test bed featured precast concrete walls with external envelope U-value of 2.4 W/(m²·K) and air loss of 14.77 $m^3/hr/m^2$@50Pa. The key priority on the first stage of the project was therefore to reduce this heat loss and minimise the building's overall energy requirements.

This project has attracted significant funding from the Department of Education and Skills and will house both the Centre for Advanced Manufacturing and Management Systems (CAMMS) and the Medical Engineering Design and Innovation Centre (MEDIC) including research space, training rooms, offices and meeting rooms.

Only the upper floor part of the envelope forms the Zero2020 test bed.

Building envelope:

- *External walls:* an Architectural Metal Systems's (AMS) renovate curtain wall was installed around the building's original façade. A modular system, combining Benchmark's Karrier Panel with AMS's triple glazed Thermstrip Window System, was then constructed offsite and installed in stages onto the curtain wall. Finally, Ceramic Granite Panels were installed onto the Karrier Panels.

  Natural ventilation is provided by manual control of insulated openable panels behind a louvered section incorporated into the window system. A BMS controlled insulated panel, also located behind the louver, is used for night purging. Solar control is achieved by manually controlled interstitial blinds situated behind the triple glazed unit and a fourth pane of glass.

Renewables:

- An air to water heat pump coupled to high efficiency radiators was incorporated into Phase 1 of the project. C.I.T are currently reviewing a wide variety of energy generating technologies including PV solar technologies, Micro CHP and wind energy to be used as part of Phase 2 of the project. To assist this process current energy usage is already being carefully monitored allowing the energy burden to be properly assessed.

Energy consumption

Energy values:

- *External envelope average U-value before renovation, Ua:* 2.4 W/(m²·K)
- *Air permeability before renovation:* 14.77 $m^3/hr/m^2$@50Pa
- *External envelope average U-value after renovation, Ua:* 0.31 W/(m²·K)
- *Air permeability after renovation:* 1.76 $m^3/hr/m^2$@50Pa
- *Total delivered energy demand before renovation:* 210 kWh/m^2/year
- *Total delivered energy demand after renovation (Phase 1):* 70 kWh/m^2/year

Use of renewables:

- An air to water heat pump used in Phase 1
- PV solar technologies, Micro CHP and wind energy to be used as part of Phase 2 of the project
- The building should generate as much energy as it uses in/or before 2020

Covestro Zukunftshaus Bottrop

Category / year

Renovation - Commercial (supermarket, shopping centre, offices) / Built in 1964, latest renovation in 2014

Address

Hansastr. 15, 46236 Bottrop (Germany)

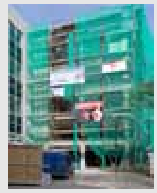
Contact details

Developer:
Oliver Helmke GmbH
Gerichtstr. 18, 46236 Bottrop (Germany)

For further questions:
Oliver Helmke GmbH
Gerichtstr. 18, 46236 Bottrop (Germany)

Pictures



Description of the building

Detailed description:
Mixed-use commercial building located in the city centre of Bottrop; five use units: public shops on ground level and offices in the levels above.

First commercial building renovation worldwide to reach a calculated plus-energy standard.

Building envelope:
- PU insulation (Linzmaier and Puren products) was used in the flat roof, wall and basement ceiling to achieve highest insulation values at low thickness:
  Roof: U value = 0.10 W/m²·K
  Walls: front side (cladded façade) and back side (ETICS), U value = 0.13 W/m²·K
  Cellar ceiling: U value = 0.32 W/m²·K
- Triple-glazed windows (U value = 0.89 W/m²·K, g = 0.49). Optimised use of daylight thanks to an in-window lamella

Energy efficient technologies:
- LED lighting incl. presence control and daylight control systems per office
- Glass fibre lighting technology using sunlight without additional energy supply
- Ceiling heating system (heating and cooling using activation of concrete ceiling core)
- District heating pumps and heating control devices
- Decentralised ventilation with min. 90 % heat recovery
- Energy efficient lifts with 75 % energy recovery

Renewables:
- Geothermal heat pump
- Photovoltaics (108 elements installed on roof and wall) incl. energy storage devices
- Wind plant of 300 W

Energy consumption

Energy values:
Values before renovation are unknown.
Final energy demand after renovation (excluding on-site production of renewables):
- *Heating demand:* 13.3 kWh/m²a
- *Cooling demand:* 0.8 kWh/m²a
- *Total final energy demand:* 34.1 kWH/m²a (excluding RES, incl. hot water, ventilation and lighting)

- *Total energy demand:* 29 kWh/m²a (primary energy)
- *Total demand:* 21 233 kWh/a
- *Total production:* 28 865 kWh/a
- *Energy fed into grid:* **7 632 kWh/a**

Use of renewables:
- RES fraction 100 % (excl. district heating energy peaks)

Awards won

- Zukunftshaus Bottrop (part of Innovation City Bottrop programme), KlimaEXPO.NRW - 1000 Schritte in die Zukunft (further info: http://www.klimaexpo.nrw/en/join-in/projects-pioneers/vorreitergefunden/covestro/)

Links

Websites illustrating the building:
- http://www.covestro.de/en/Projects-and-Cooperations/InnovationCity/Zukunftshaus.aspx

Daycare Center “Die Sprösslinge”, Monheim

Category / year

New construction: zero energy building or better – School building (60 children + staff) / 2009

Address

Alfred-Nobel-Str. 60, 40789 Monheim (Germany)

Contact details

Owner:
Bayer Real Estate

Architect:
tr. Architekten

Structural:
Ingenieurbüro für Baustatik Dipl.-Ing. Abed Isa

Energy concept:
IPJ Ingenieurbüro P. Jung GmbH

HVAC:
E + W Ingenieurgesellschaft mbH

For further questions:
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Bayer Real Estate GmbH
Tel.: +49 (0)214 30 75501
heinz-reiner.duenwald@bayer.com

Pictures

Description of the building

Detailed description:
The daycare center “Die Sprösslinge” in Monheim serves as an accommodation for children of Bayer employees. It contains offices, classrooms, and recreation areas and accommodates approx. 60 children + staff.

Enclosed space: 3556 m³ / floor space: 1064 m².

The building was designed as a zero energy building on the basis of a wooden frame construction. Thanks to the use of innovative technologies, the minimum energy savings vs. local standards are detected to be 91 %.

Building envelope:
- Optimized building envelope and cubature
- Polyurethane insulation boards (λ= 0.028 W/(m·K)), approx. 200 mm
- (Passivhaus) triple-glazed windows (approx. U= 0.70 to 0.90 W/(m²·K))
- Building envelope (mean value): U= 0.147 W/(m²·K)

Energy efficient technologies:
- Optimal, highly efficient HVAC technology
- Utilization of daylight & efficient lighting systems
- Highly efficient electrical equipment

Renewables:
- Geothermic energy (4 geothermal probes, approx. 100 m depth)
- Solar thermal energy (approx. 50 m²)
- Photovoltaic (approx. 412 m²)

Energy consumption

Energy values:
- *Primary energy demand:* 12 KWh/(m²·a) (the required max. value for this building type is according to German standards 134 KWh/(m²·a))

Energy demand:
- Heating + HW: 51 %
- Vent. + light: 15 %
- AC: 34 %
- *Total* = 60 MWh

- Geothermic energy: 41 %
- Solar energy: 10 %
- Photovoltaic: 49 %
- *Total* = 60 MWh

Awards won

- “Energy-Optimized Building” Award from the German Federal Ministry of Economics, 2009
- “Green Building Certification” of the European Union (application pending)

Links

Websites illustrating the building:
- http://www.energieportal24.de/pn_156785.htm
- http://www.ecocommercialbuilding.bayermaterialscience.com/
- internet/global_portal_cms.nsf/id/EN_Deutschland

Promotional material online:
- http://www.ecocommercialbuilding.com

Dorfwiesenstr. Friedrichshafen

Category / year

Renovation - Large residential (multi-family houses) / 2014-2015

Address

Dorfwiesenstr. 25, 88045 Friedrichshafen (Germany)

Contact details

Architect: Albrecht Weber, Büro für Baudenkmale, neuzeitlicher HolzlehmBau, Langenargen at Lake Constance, www.albrecht-weber.com
Property owner: private

TICS: Pfeiffer GbR - Stuckateurbetrieb (stucco plasterer), Tettnang, www.pfeiffer-tettnang.de
HVP planning: Planungsbüro Burr GmbH, Leutkirch, www.pb-burr.de

Heating (servers): Cloud & Heat, www.cloudandheat.com

HVP work: Franz Lohr GmbH, Ravensburg, www.franz-lohr.de

Consultants for pitched and flat roof insulation: Siegfried Hanßler, Area Manager puren gmbh

Consultants for heat insulation TICS: Alois Bärtle, Sales Manager ETICS puren gmbh

For further questions:
puren gmbh
Rengoldshauser Str. 4, 88662 Überlingen (Germany)
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Tel.: +49 (0) 7551 8099-147
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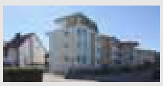
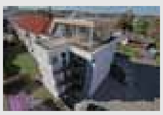
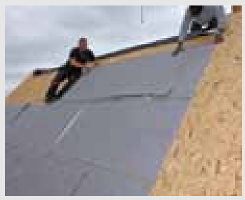
alois.baertle@puren.com

Pictures







Description of the building

Detailed description:
Built in 1968, the apartment building was transformed into a KfW "energy-efficient building 55". This was achieved mainly through the consistent use of PU insulation. Heating is provided via "Cloud & Heat" technology. Students are the main target group for this completely renovated and extended property in Friedrichshafen on Lake Constance. In the course of the renovation, the balconies were sawn off, new windows with triple glazing (Ug = 0.5 W/m²·K) were installed, the building was extended to the south in compliance with building regulations, new balconies were installed and a penthouse was built on the flat roof. As a result, the floor space was increased from 360 to 483 m². Instead of three tenants, the building now houses up to 16 people in five studio apartments, two flats and two shared flats.

In order to minimise the energy consumption, the owner installed high performance PU insulation and energy-efficient LED lamps throughout the building, as well as so-called "dead man's controls" in each flat. If residents leave their flats for a prolonged period, almost all power consumers are switched off (except refrigerators and PC sockets). When the flat is unoccupied, the ventilation and heating are turned down using a heat recovery system.

Building envelope:
The entire external walls are insulated with PU ETICS (External Thermal Insulation Composite System) using 16-cm-thick puren PU boards and a mineral render system of about 1 cm thickness from Schwenk Putztechnik. The basement is insulated with 16-cm-thick fleece-coated puren PD perimeter insulation. This insulation system runs seamlessly up to the flat roof, where it is connected to purenit (pressed board made of recycled PU foam) parapet elements. They have a Psi value of 0.005 W/m·K and are rated as thermal-bridge-free according to a check by the Passive House Institute.

With a lambda value of 0.026 W/m·K, puren PU insulation offers very good insulation properties allowing for streamlined insulated details. U-values of 0.1 W/m·K were achieved on walls and roofs.

Renewables:
The building is heated using the waste heat from computer servers of a decentralised data centre ("Cloud & Heat").

Energy consumption

Energy values:
Apartment building's primary energy consumption:
- *Before renovation:* 400 kWh/m²/year
- *After renovation:* 12 kWh/m²/year (-97 %)

Use of renewables:
- Waste heat from computer servers of a decentralised data centre ("Cloud & Heat")

Awards won

- EnEv-Award 2015 (Forumverlag) Builder & Engineer Awards - Energy Efficient Project of Year

Links

Websites illustrating the building:
- http://www.heinze.de/architekturobjekt/revitalisierung-wohnhaus-von-1968/12635625,1?q=friedrichshafen&f=601383034&s=7201&d=il&p=1&c=ao

Farmhouse (passive house), Trezzo Tinella

Category / year

New construction: nearly zero energy building or better – Small residential (1-2 family houses) / 2009-2010

Address

Trezzo Tinella (CN, Italy)

Contact details

Developer:
Edilio srl - Osio di Sotto (BG - I), Giovanni Cagnoli
Tel.: +39 338 243 5208
giovanni.cagnoli@libero.it

For further questions:
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Tel.: +39 338 243 5208
giovanni.cagnoli@libero.it

STIFERITE srl Padova (I), Massimiliano Stimamiglio
Tel.: +39 498 997 911
www.stiferite.it

Pictures

Description of the building

Detailed description:
Single family detached house (about 400 m² of net floor area) meeting Passivhaus standards. Built on the site of a demolished farmhouse, which was structurally compromised and had no historical or architectural value. The design goal was to build a residential building which is energy-independent, has zero CO_2 emissions and very low power requirements.

Building envelope:
The building consists of three linked parts. Each of these three parts uses different technologies / materials so as to test and compare them on the same site.

- *First part:* the main part uses the traditional double brick wall with cavity insulation. Insulation layer: 200 mm of STIFERITE GT PU boards to achieve a thermal transmittance (U-value) as low as 0.10 W/(m²·K)
- *Second part:* the bioclimatic pavilion was built as a timber frame construction insulated by structural insulating panels placed outside the frame to avoid thermal bridges. The U-value of these walls is 0.09 W/(m²·K) thanks to 250 mm of STIFERITE GT PU boards. The pavilion has a walkable green roof covered by a lawn. 200 mm STIFERITE GT polyurethane boards were used to achieve a U-value of 0.09 W/(m²·K)
- *Third part:* incorporating the staircase, this was built with a metal frame and curtain wall dry slabs and cement fibreboard layers alternating with three polyurethane layers to achieve a thermal transmission of 0.08 W/(m²·K). The outer timber is designed as a ventilated facade
- *Windows:* internorm EDITION series wood / aluminium with U-value = 0.74 W/(m²·K)

Renewables:
Two renewable energy systems are installed on the building roof: a photovoltaic electric plant and a vertical-axis wind turbine. Both systems are connected to the national electric grid and are sized to fulfil the energy requirements of all HVAC systems (auxiliary included).

Energy consumption

Energy values:
- *Heating demand:* 2 kWh/m²/year
- *Cooling demand:* 0 kWh/m²/year (passive cooling)
- *Final energy demand:* 30 kWh/m²/year

Use of renewables:
- 100 % RES fraction of the energy used for heating
- 100 % RES fraction of the energy used for hot water

Links

Websites illustrating the building:
- www.ediliosrl.it (work in progress)

Promotional material:
About 1 500 photos showing the building method will be made available on a CDrom.

ISOPA Polyurethanes Passive House

Category / year

New construction: nearly zero energy building or better – Small residential (1-2 family houses) / 2013

Address

Leemputgaarde 7, 1140 Evere (Belgium)

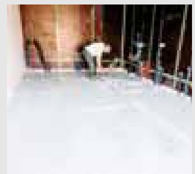
Contact details

Constructor:
Bostoen NV
Koninginnelaan 2-3, 9031 Drongen, Belgium

For further questions:
Jörg Palmersheim (ISOPA)
Av. E. Van Nieuwenhuyse 6, 1160 Brussels (Belgium)
joerg.palmersheim@isopa.org

Pictures






Description of the building

Detailed description:
The Polyurethanes Passive House project was undertaken by ISOPA with the help of Bostoen to demonstrate the advantages of PU insulation in very low energy buildings.

Total living surface: 235 m² (four floors).

Building envelope:

- *Ground floor:* two layers of PU insulation boards. In total, 180 mm on top of 70 mm chape to cover pipes on concrete slab (U-value: 0.124 W/(m²·K)).
- *First and upper floors:* on the first and second floors, PU spray foam (lambda 0.027 W/m·K) was applied between the concrete slab and floor finishing. As for the third floor, a special mortar made of 90 % recycled polyurethane granulates (lambda 0.046 W/m·K) was applied to cover the pipes on the concrete slab.
- *External walls:* in total, the brick walls are 450 mm thick with 180 mm thick PU boards in the cavity (U-value: 0.118 W/(m²·K)).
- *Partition walls:* to guarantee optimal acoustic separation between the PU Passive House tenants and their neighbours, the 40 mm cavity between the two houses was filled with open cell PU boards.
- *Pitched roof:* the wooden roof was prefabricated and includes PU boards of a total thickness of 400 mm (U-value: 0.073 W/(m²·K)).
- *Flat roof:* on the balcony above the room on the first floor, an insulation layer of 240 mm of PU boards (lambda 0.023 W/m·K; U-value of 0.093 W/(m²·K)) was installed on top of the slab.
- *Windows:* triple glazing (Ug-value: 0.5 W/(m²·K); g-value 50 %) and highly insulating PVC frame with PU core.

Energy efficient technologies:

- Ventilation system with heat recovery
- Modular bus-system for controlling building equipment

Renewables:

- Ground source heat pump feeding a floor climatisation system for heating/free cooling, and domestic hot water
- Photovoltaic panels: 15 panels of 250 Wp each, good for an estimated energy production of 3 187.5 kWh/year
- Solar panels: 2 panels for the production of hot water, good for an estimated 60 % of yearly demand

Energy consumption

Energy values:

- *Energy demand for heating/cooling and domestic hot water:* fully covered by renewables (zero energy building)
- *Airtightness:* below 0.6 at 50 Pa

Use of renewables:

- The combination of a ground source heat pump, the solar and the photovoltaic panels makes this building a zero energy building according to Passive House standards. All energy needs for heating and hot water are produced on site.

Awards won

- Passive House Certification

Links

Websites illustrating the building:

- http://www.polyurethanes.org/passivehouse/

Promotional material online:

- http://www.polyurethanes.org/passivehouse/media-room/news

Kingspan Lighthouse

Category / year
New construction: nearly zero energy building or better – Small residential (1-2 family houses) / 2007

Address
BRE Innovation Park, Bucknalls Lane, WD25 9XX (UK)

Contact details

Developer:
Kingspan Potton, Eltisley Road, Great Gransden, Sandy
Bedfordshire
SG19 3AR
Tel.: +44 (0) 1767 676 400

For further questions:
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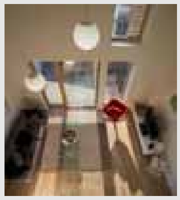
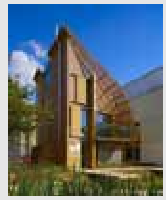
Tel.: +44 (0) 1268 597 252
dale.kaszycki@kingspan.com

Pictures

Description of the building

Detailed description:
The Kingspan Lighthouse was launched at the UK Building Research Establishment's (BRE) Innovation Park in 2007 and at the time was the most advanced house ever produced in the UK for mainstream construction. With annual fuel costs of just £30, Lighthouse pushed the boundaries of modern housing design and was the first house to achieve the highest level of the UK government's 2006 Code for Sustainable Homes (CSH), level 6.

A Mechanical Ventilation with Heat Recovery (MVHR) unit was installed to provide fresh air and maximise the thermal efficiency of the building's fabric. The house was designed to passively maximise solar gain in the winter and provide solar shading in the summer.

100 % low energy lighting is used throughout the house and all appliances are A++ rated (the most energy and water efficient). In addition all water dispensing units (shower, taps, etc.) are 'low flow', grey water recycling is used to flush the toilets and rain water harvesting is used for the washing machine and irrigation.

Building envelope:
The Kingspan Lighthouse adopted a 'fabric first' approach utilising the Kingspan TEK Building System which consists of SIP panels comprising a rigid urethane core with OSB autohesively bonded on either side. This created a construction with a highly insulated envelope (U-values of 0.11 W/(m^2·K) in the floors, walls and roof) with minimal thermal bridging and excellent air tightness (air leakage rates of approximately 1 m^3/h/m^2 at 50 Pa).

Renewables:
Photovoltaic panels provide all of the electricity needs while solar thermal panels and wood pellet fired boiler provide all of the hot water and space heating requirements.

Energy consumption

Energy values:
- *Lighting:* 4 kWh/m^2/year
- *Fans & Pumps:* 2 kWh/m^2/year
- *MVHR fans:* 4 kWh/m^2/year
- *Domestic hot water:* 29 kWh/m^2/year
- *Space heating:* 16 kWh/m^2/year
- *Catering:* 9 kWh/m^2/year
- *Occupant electricity use:* 20 kWh/m^2/year
- *Total* = 83kWh/m^2/year

Use of renewables:
- All electricity is provided by the photovoltaic panels
- Most of the hot water is provided by the solar thermal panels. The remainder is provided by the wood pellet fired boiler
- All space heating is provided by the wood pellet fired boiler

Awards won
- TTJ Awards – Achievement in Engineered Timber
- Builder & Engineer Awards – Energy Efficient Project of Year
- International Design Awards
- Building Services Awards
- Mail on Sunday – British Homes Awards

Links

Websites illustrating the building:
- www.kingspanlighthouse.com
- http://www.bre.co.uk/page.jsp?id=959

Promotional material online:
- http://www.kingspanlighthouse.com/pdf/lighthouse.pdf
- http://www.youtube.com/watch?v=aDqCdWnxmQc
- http://www.youtube.com/watch?v=Yj9b48iIvRI
- http://www.youtube.com/watch?v=Hfr2Xi1vzb0

Kuopas Apartment Building

Category / year

New construction: nearly zero energy building or better – Large residential (multi-family house) / 2010

Address

Finland, Kuopio, Suokatu 14

Contact details

Architect:
Arkkitehtistudio Kujala & Kolehmainen,
33200 Tampere

Developer:
Lujatalo Oy, Maaherrankatu 27, 70100 Kuopio
Tel.: +35820 789 5200, www.luja.fi

Owner:
Kuopas Oy, Torikatu 15, 70110 Kuopio
Tel.: +35820 710 9740, www.kuopas.fi

For further questions:
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Tel.: +35850 556 2032

Tuula Vartiainen, Kuopas Oy
tuula.vartiainen@kuopas.fi
Tel.: +35840 050 4534

Pictures

Description of the building

Detailed description:
5 story apartment building with 47 accessible apartments for students.

Building gross volume: 6 900 m^3, heated gross area 2 125 m^2 without garage.

Building envelope:

- *Walls:* polyurethane insulation (300 mm), concrete sandwich elements (U-value 0.08 W/(m^2·K))
- *Roof:* hollow slab, polyurethane insulation (270 mm) + 90-160 mm light gravel and 100 mm concrete
- *Total energy consumption of the building:* 107 100 kWh/a

Renewables:

- *Total renewable energy production* (solarheated water and solar electricity, geothermal heating and thermal energy created by use of the building): 85 600 KWh/a
- *Heating energy purchased from district heating grid:* 17 335 kWh/a
- *Electricity purchased from grid:* 4 230 kWh/a
- *Heating energy and electricity sold to district heating system and electricity grid:* 19 273 kWh/a

The example shows that zero energy buildings are feasible even in regions with harsh climatic conditions and low solar radiation.

Energy consumption

Energy values:

- *Heating demand:* 10.6 kWh/(m^2·a)
- *Cooling demand:* 12.9 kWh/a, cooling is completely produced by geocool i.e. the only energy consumed is the electricity for pumps
- *Final energy demand including onsite solar energy production:* 1.4 kWh/(m^2·a)
- *Total energy balance* = -2 292 KWh/a (electricity purchased from external sources)

Use of renewables:

- 100 % RES fraction of the energy used for heating
- 100 % RES fraction of the energy used for cooling
- Renewables – total energy demand 98 % total annual balance (building feeds energy to district heating grid as well as electricity grid)

Links

Websites illustrating the building:

- http://www.nollaenergia.fi/mediapankki.html

Promotional material:

- www.nollaenergia.fi

Loft in Cassà de la Selva, Girona

Category / year

New construction: nearly zero energy building or better - Small residential (1-2 family houses) / 2012

Address

Cassà de la Selva - Girona (Spain)

Contact details

Constructor:
Lluís Maymí

Thermical installation engineer:
Xavier Vilà i Pujolràs

Interior architect:
Manuel Sureda I Vila

For further questions:
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xgrabuleda@poliuretanos.com

Poliuretanos, Xavier Vila
xvila@poliuretanos.com

Pictures



Description of the building

Detailed description:
Detached house designed as an industrial-style loft following the most ambitious criteria of sustainable construction. The highest energy rating A was possible thanks to the use of an innovative thermal energy production system by aerogeneration (air-to-water) heat pump combined with floor heating and highly efficient PIR thermal insulation.

Building total surface: 126,45 m².

Building envelope:
PIR insulation boards covered on both sides with a multi-layered kraft-aluminium complex (thermal conductivity = lambda 0.023 W/m·K) in a continuous envelope without thermal bridges or condensation.

- *Heating system:* Poliuretanos PIR SL boards of 60 mm with a thermal resistance of 2.60 W/(m²·K).
- *Facade:* Poliuretanos PIR 7C boards of 100 mm with a thermal resistance of 4.35 W/(m²·K).
- *Roof:* Poliuretanos PIR CM boards of 120 mm with a thermal resistance of 5.20 W/(m²·K).
- *Windows:* aluminium with split of thermal bridge (U-value: 2.7 -2.8 W/(m²·K)).

Energy efficient technologies:
- *Roof:* aerothermal (air-to-water) heat pump that extracts heat from the outside air, generating at least 3 kW of free heating energy for every kW of electricity consumed and without direct emissions of CO_2.
- *Floor heating:* the heat is distributed throughout the loft via a low-temperature floor heating system.

Renewables:
- Aerothermal (air-to-water) heat pump

Energy consumption

Energy values:
- *Final energy demand:* 37.4 kWh/(m²·a)
- *Primary energy demand:* 51.3 kWh/(m²·a)
- *CO_2 emissions:* 12.7 kg/(m²·a)KWh/a (electricity purchased from external sources)

Use of renewables:
- Aerothermal (air-to-water) heat pump

Massive Passive House concept of Recticel Insulation

Category / year

New construction: nearly zero energy building or better – Small residential (1-2 family houses) / 2009

Address

Belgium, Bottelare (near Gent)

Contact details

Architect:
Kristof Cauchie, Eegene 32, 9200 Oudegem (Belgium)
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Owner:
Elie Verleyen

Initiators of the massive passive project:
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For further questions:
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Recticel Insulation, Valerie Deraedt (Marketing Manager Benelux)
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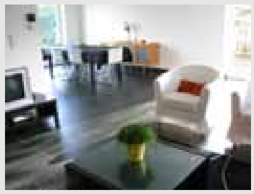
Pictures



Description of the building

Detailed description:
The massive passive house in Bottelare is a family house built for 6 people. The building has the official passive house certificate 'Passiefhuiscertificaat' ('Passiefhuis Platform vzw') and was the launch of many other massive passive house buildings in Belgium. For example, they are now building a massive passive hotel and a massive passive sports centre.

Building envelope:

- *Pitched roof insulation:* 160 mm PU insulation
- *Flat roof insulation:* 200 mm PU insulation
- *Cavity wall insulation:* 164 mm PU insulation
- *Ground floor insulation:* 200 mm PU insulation
- *Windows:* triple glazing

Renewables:
In the design of the massive passive house, 33 photovoltaic solar panels of 78 Wp and 36 photovoltaic solar panels of 81 Wp were installed.

- 33 x 78 Wp = 2 574 Wp – in Belgium (1 000 Wp - 850 kWh/year) – 2 188 kWh/year – according to the orientation (96 % of the optimal orientation) = 2100 kWh/year
- 36 x 81 Wp = 2 916 Wp – in Belgium (1 000 Wp - 850 kWh/year) – 2 487 kWh/year – according to the orientation (70 % of the optimal orientation) = 1 735 kWh/year

Energy consumption

Energy values:

- 15 kWh/m²/year heating demand
- 34 kWh/m²/year final energy demand

(Far below the required 42 kWh/m²/year instructed by the Belgian 'Passiefhuis-Platform')

Use of renewables:

- No RES for hot water production / no RES for cooling

Links

Websites illustrating the building:

- www.massiefpassief.be
- www.recticelinsulation.be
- www.passiefhuisplatform.be (Passiefhuis Platform vzw)
- www.maisonpassive.be (Plate-forme Maison Passive asbl)

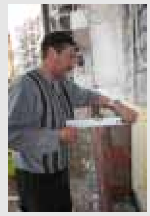
Promotional material online:

- http://www.recticelinsulation.be/topic/het-massief-passiefhuis (video available behind this link)

Multi-family dwelling, Lübeck

Category / year	Renovation - Large residential (multi-family house) / 2010
Address	Korvettenstr. 103-115, 23558 Lübeck (Germany)
Contact details	**Owner/Builder:** Bauverein Lübeck Tel.: +44 (0) 208 354 5665 Hannah.thompson@octaviahousing.co.uk **Consultant:** Fachhochschule Lübeck (University of Applied Science) **For further questions:** Tobias Schellenberger schellenberger@ivpu.de

Pictures

Description of the building

Detailed description:
This multi-family dwelling in Lübeck was renovated following the criteria of an energy efficiency retrofit (KfW Effizienzhaus 70 – EnEV 2007). The rehabilitation measures included the renovation of the façade (insulation of the outer façade), installation of new outside doors and windows and of a ventilation system (without heat recovery), the addition of one floor, the closing of the balconies and the addition of lifts.

The usable surface was 2942 m^2 before renovation and became 4424 m^2 after renovation.

Building envelope:
- *Walls:* 90 mm PUR/PIR and 20 mm glass fibre (cavity wall insulation). U-value of the walls before renovation: 1.35 W/(m²·K). U-value of the walls after renovation: 0.20 W/(m²·K). Reduction of about 84 % of the heat losses

Renewables:
- Solar thermal system for hot water production

Energy consumption

Energy values:
- *Heat losses before renovation:* 96.2 kWh/(m²·a)
  Ventilation: 25.3 % Roof: 3.1%
  Windows doors: 20.4 % Walls: 32.4 %
  Foundations: 5.3 % Thermal bridges: 6.7 %
- *Heat losses after renovation:* 15.6 kWh/(m²·a)
  Ventilation: 47.7 % Roof: 3.1 %
  Windows doors: 20.6 % Walls: 10.7 %
  Foundations: 12.3 % Thermal bridges: 6.7 %
- *Final energy demand/consumption:*
  before: 148.7 kWh/(m²·a); after: 61.5 kWh/(m²·a)
- *Heating energy demand:*
  before: 121.7 kWh/(m²·a); after: 35.7 kWh/(m²·a)
- *Average energy cost saving:* 5.72 €/(m²·a)
- *Pay-back period:* 5.7 years

Use of renewables:
- District heating
- Solar thermal system: energy production not known

Passive House Lac de Vouglans (Jura 39)

Category / year

Renovation and extension – Small residential (1-2 family houses) / 2014-2015

Address

90 Impasse Brillat, 39260 Maisod (France)

Contact details

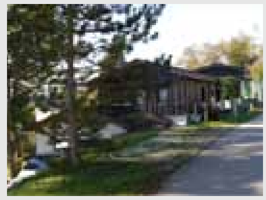
Construction:
Acquistapace SARL (Aquistapace got a twenty years expertise in the building sector. From design to realisation, a representative-coordinator trained to passive house is dedicated to each project)

Supervisor:
Peggy Vichot

For further questions:
Yves Acquistapace
yves@acquistapace.fr

Pictures



Description of the building

Detailed description:
The passive house at the Lac de Vouglans is a family house built for 4 people.

Total living surface: 150 m^2.

Building envelope:
- *Flat roof:* 24 cm (12 cm + 12 cm) of Utherm Roof PIR insulation boards (heavy protection – R=10.70 m^2·K/W)
- *Roof extension:* 28 cm (22 cm + 6 cm) of PIR roofing elements Rexotoit HPU Non Latté of 20.5 cm + wood wool 6 cm (R=10.30 m^2·K/W)
- *Walls:* concrete 20 cm + expanded polystyrene graphite 28 cm (R=9 m^2·K/W)
- *Floors:* Utherm Floor PIR insulation boards of 11.7 cm (R=5.20 m^2·K/W) in addition to an insulating concrete layer

Building envelope:
- Controlled mechanical ventilation with heat recovery up to 90 % combined with solar collectors
- Hydraulic Canadian well: geothermal heat exchanger using the relatively constant temperatures below the basement
- Heat collection from waste water
- Small heat pump for hot water and extra heating

Renewables:
- 16 solar panels of 4 kw in total (self-consumption and resale)
- 2 solar thermal panels for hot water production and extra heating

Energy consumption

Energy values:
- *Heating demand:* 15 kWh of energy per m^2 per year
- *Cooling demand:* 0 kWh/m^2/year
- *Final energy demand:* 60 kWh/m^2/year

Use of renewables:
- 60 % RES fraction in the heating energy demand
- 60 % RES fraction in the hot water energy demand
- 80 % RES fraction in the total final energy demand

Links

Websites illustrating the building:
- www.acquistapace-constructeur.fr
- http://www.unilininsulation.com/fr/Références/Maison-passive/

Princedale Road Passivhaus

Category / year

Renovation – Small residential (1-2 family houses) / 2011

Address

100 Princedale Road, London

Contact details

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Design:
Ryder Strategies

Architects:
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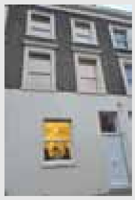
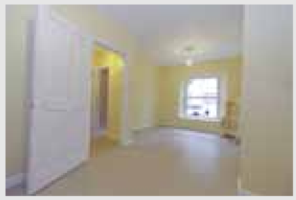
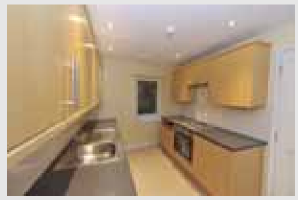
Pictures

Description of the building

Detailed description:
Built in the 1850's, 100 Princedale Road is the first retrofit to be awarded Passivhaus accreditation in the UK. The terrace's age, and its location within the Holland Park Conservation Area of London, led to several additional challenges as part of the build:

- This prevented the use of external insulation and meant that windows and doors had to be specially designed to match the period style.
- The property also features solid brick walls which prevent the use of cavity wall insulation.
- As a retrofit, the building featured more challenging junctions and room designs than would be found in a purpose built Passivhaus. This meant detailing had to be carefully planned and carried out.

Building envelope:

- *Pitched roof:* a 130 mm thickness of PU insulation Kingspan Thermawall TW55 was fitted between the rafters and followed by a 12 mm layer of OSB, which runs continuously throughout the property, and is sealed around windows, doors and other junctions using tape, forming an air tight seal. A further 50 mm layer of TW55 was then installed, followed by a layer of plasterboard (U-Value 0.15 W/m²·K)
- *External Walls:* 25 mm vented cavity was left between the brickwork and the insulation, preventing the accumulation of condensation within the wall. 150 mm of TW55 was then installed, followed by the air tight OSB layer. As with the roof a further 50 mm of TW55 was installed to allow for a service zone where sockets can be fitted without perforating the air tight layer, and then finally a layer of plasterboard was added. Junctions and surface penetrations were carefully designed and planned to minimise both heat-loss and air leakage (U-Value 0.10 W/m²·K)
- *Party Walls:* party walls were insulated with a build-up of 25 mm TW55 followed by the 12 mm OSB, then a further 25 mm thickness of TW55 finished with the plasterboard. The build-up was installed using adhesive rather than metal or plastic fixings, to further minimise thermal bridging (U-Value 0.27 W/m²·K)
- *Floors:* as part of the retrofit, the basement floor was first fitted with a ground-to-air heat exchanger. Above it an air tight layer of OSB was installed, followed by 150 mm of PU insulation Kingspan Thermafloor TF70 (U-Value 0.14 W/m²·K)

Renewables:

- Solar thermal system for hot water production

Energy consumption

Energy values:

- Air tightness of 0.5 m³/h/m² at 50 Pa
- 83 % reduction in CO_2 emissions and a 94 % cut in energy use
- The building's heating burden is now just 15 kWh of energy per m² per year (the UK average is 130 kWh per m² per year) – saving the tenants around £910 annually on fuel bills
- The house requires no gas boilers, radiators or conventional heating system, yet remains at a comfortable temperature with a healthy flow of air all year round

Use of renewables:

- Most of hot water is provided by a high efficiency solar thermal system

Awards won

- Passivhaus Certified

Links

Websites illustrating the building:

- www.greenoctavia.org.uk/ and www.pauldavisandpartners.com/projects/residential/retrofit/

Verwaltungsgebäude und Info-Center Linzmeier

Category / year

Renovation with renewables and energy efficiency / New construction: nearly zero energy building or better –
Administrative and educational building (offices and Info-Centre for customers)
Build in 1971 / renovated and new built (Info-Centre) 2008-2009

Address

Linzmeier Bauelemente GmbH, Industriestr. 21, 88499 Riedlingen (Germany)

Contact details

Architects:
Wahl & Wollmann Architekten, Gerhart Wollmann, Liststraße 57, D - 70180 Stuttgart

Owner:
Linzmeier Baustoffe GmbH & Co.KG, Industriestr. 21, D - 88499 Riedlingen

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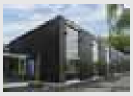
Pictures







Description of the building

Detailed description:
Administrative building and educational building (new building Info-Centre). Administrative part contains offices, meeting rooms and social rooms.

Net size is 1 475.55 m^2 (4 storeys) (renovated building) with 45 people working there. New built Info-Centre contains training centre (for customers), social rooms for production workers, and few offices with a total surface net of 734.30 m^2 (2 storeys).

Renewables:
- *Heating system for both buildings:* new heating system with a groundwater heat pump
- *Photovoltaic system:* on both roofs with a total energy production of 38.7 kWp

Energy consumption

Energy values:
- *Primary energy demand of administrative building before renovation:* 288.4 kWh/(m²·a)
- *Primary energy demand after renovation:* 76 kWh/(m²·a)
- *Primary energy demand of new built Info-Centre:* 86 kWh/(m²·a)

Use of renewables:
- 100 % RES fraction of the energy used for heating
- 100 % RES fraction of the energy used for hot water
- 100 % RES fraction of the energy used for cooling
- Energy produced by photovoltaic system: 38.7 kWp, fed to 100 % into official electricity grid
- Energy produced by groundwater heat pump, consumed by company Linzmeier Bauelemente GmbH

Links

Websites illustrating the building:
- www.linzmeier.de
- http://www.zukunft-haus.info/de/verbraucher/effizienzhaeuser-zum-anschauen/effizienzhaeuser-suchen/einzelansicht.html?projektId= 3348

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For more details on PU and Very Low Energy Buildings, see:

www.excellence-in-insulation.eu

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