United Kingdom

The Passive House

National Publication

What is a Passive House?

*In this age of **increased energy prices** and **emission excesses**, efficient energy use is becoming more and more important. This is no longer solely an environmental consideration, but increasingly also a financial one. Some **40% of our annual energy consumption** is used in buildings. The Passive House concept primarily focuses on residential buildings, though these principles are applicable in other building types as well. As the numbers show, **energy-wise**, there is **much to be gained in buildings**. For this reason, more and more building professionals have recognized the Passive House approach as the sensible way forward.*

The Passive House is a residence that has been optimally designed to retain energy. Much attention is paid to performance of the materials and components with respect to **indoor climate**. The advantage being that temperatures inside the residence have very few fluctuations, resulting in **notably higher indoor comfort.**

The **Passive House concept** applies **established techniques** and **solid design principles** to realize a residence that utilizes it's energy optimally.

By **reducing heat losses** to a minimum through optimal insulation and heat recovery techniques and **maximizing passive heat gains**, the Passive House is so efficient that it no longer requires a conventional heating system.

This means that the **cost savings** for the heating system can, in part, compensate for the higher cost of high performance building components.

Moreover, by using less energy over its lifetime, a Passive House not only generates a **smaller environmental impact**, it also incurs **lower energy costs** during use. In addition, a Passive House decreases the financial impact on occupants that rising energy prises may bring.

Introduction

What is PEP?

PEP, which stands for **'Promotion of European Passive Houses'** is a consortium of European partners, supported by the **European Commission**, Dictorate General for Energy and Transport.

Why Promotion of European Passive Houses?

It is generally recognized that, within the housing sector in Europe, **many building activities** can be expected over the coming decades. The old building stock will need to be refurbished or, in many cases, even demolished and new buildings erected. The existing housing stock is responsible for a **large share of our total energy consumption**, and therefore many **energy savings** can be accomplished in these upcoming reconstruction activities. As previous demonstration projects (such as CEPHEUS) have demonstrated, the **reduction of non-renewable energy demand** by a **factor 4** (compared to contemporary national standards) is not only **possible** but also **realistic**. The Passive House concept is a **sound** and relatively **low-cost method** to achieve these energy savings. To spread this knowledge throughout the professional building community, beyond the select group of specialists, PEP has set out to spread the experience gained throughout Europe on the Passive House concept.

What does PEP do?

Goal of P.E.P. is to promote regional economic activities, especially for SMEs (which perform a significant part of the work in the housing industry) in order to induce a substitution of expenses for energy use during the lifetime of houses with investment in the building envelope.

To achieve this goal, the consortium intends to:

- communicate the passive house concept and specific solutions in different European regions and climates

Introduction

- adapt the existing Passive House design tool (PHPP, Passive House Planning Package) to meet the demand of architects and planners in different countries
- develop practical information packages, such as building product documentation, design guides, research results, calculation methods and quality assurance activities to assist building professionals throughout Europe in the development of Passive Houses
- set up a certification program for Passive House buildings and technologies and a link to the national Energy Performance Certification system according to the EU building directive
- organize national workshops and the annual international Passive House Conference
- Create national Passive House websites for continuous up-to-date information provision

How can I find out more?

For more information, please contact:

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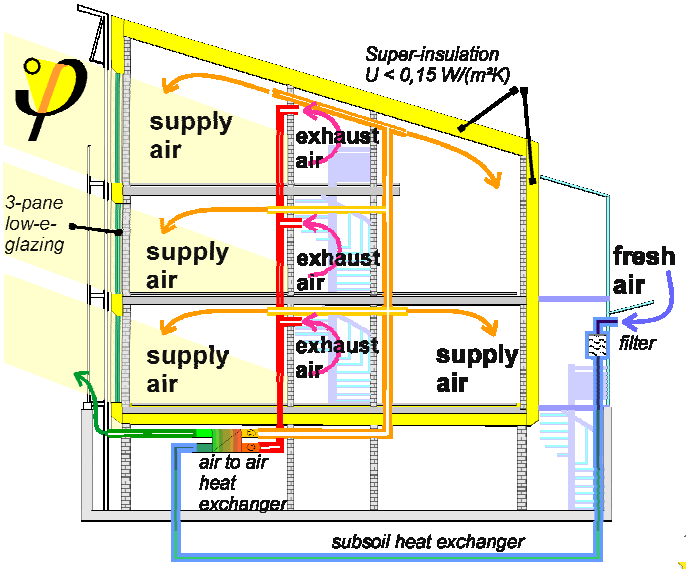


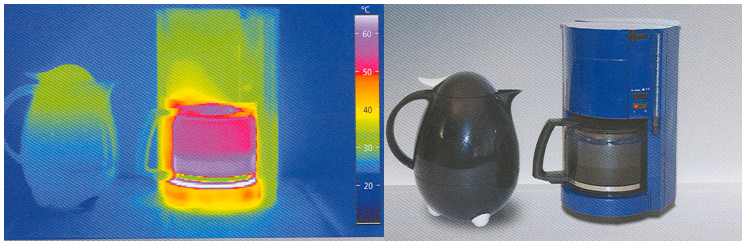
Passive House a definition

The term **Passive House** refers to a specific construction standard for residential buildings with good interior comfort conditions during winter and summer, without traditional heating systems and without active cooling. Typically this includes very good insulation levels, very good air- tightness of the building, whilst a good indoor air quality is guaranteed by a mechanical ventilation system with highly efficient heat recovery.

Thereby the design heat load is limited to the load that can be transported by the minimum required ventilation air. However space heating does not have to be carried through the ventilation system. For 40° - 60° Northern latitudes, under conditions specified in the PHPP calculation model[1]:

- the total energy demand for **space heating and cooling** is limited to **15 kWh/m² treated floor area**[2];
- the total **primary energy use** for all appliances, domestic hot water and space heating and cooling is limited to **120 kWh/m² treated floor area**[2]

A passive house has a **high level of insulation** with **minimal thermal bridges**, **low infiltration**, and utilizes **passive solar gains** and **heat recovery** to accomplish these characteristics. Consequently **renewable energy** sources can be used to meet the resulting energy demand.



The Passive House Concept illustrated: Passive (thermos) versus Active (stove)
Source:Informations-Gemeinschaft Passivhaus Deutschland

1 *Passive House Planning Package, Passiv Haus Institut*
2 *This is the total floor area, in m², of all of the individual storeys of the dwelling added together which are 'treated' i.e. are heated, air-conditioned or a combination of both.*
Dimensions refer to the inner surfaces of the elements bounding the dwelling. Thus floor dimensions are obtained by measuring between the inner surfaces of the external or party walls, disregarding the presence of any internal walls.

Passive House measures

Measure/ solution	*Passive House standard*
1. Super Insulation	
Insulation walls	U ≤ 0,15 W/(m^{2}K)
Insulation roof	U ≤ 0,15 W/(m^{2}K)
Insulation floor	U ≤ 0,15 W/(m^{2}K)
Window casing, doors	U ≤ 0,8 W/(m^{2}K)
Window glazing	U ≤ 0,8 W/(m^{2}K)
Thermal bridges	linear heat coeff ψ ≤ 0,01W/(mK)
Air tightness	n50 ≤ 0,6 h-1
Minimal Shape Factor (Area TFA/ Volume TV)	
2. Heat Recovery/ IAQ	
Ventilation counter flow air to air heat exchanger	heat recovery ηHR ≥ 75 %
Ventilation air sub-soil heat exchanger	air outlet after sub-soil heat exchanger above frost temperature
Ventilation ducts insulated	
Other heat recovery (e.g. ventilation & DHW return pipes)	
DHW heat recovery	
DHW pipes insulated	
Minimal space heating	postheater ventilation air/ low temperature heating
Efficient small capacity heating syst.	biomass, heat pump, gas, co-generation (e.g. district heating), etc.
Air Quality through ventilation rate	min. 0,4 ach^{-1} or 30 m^3/pers/h or national regulation if higher
3. Passive (Solar) Gain	
Window glazing	solar energy transmittance g ≥ 50 %
DHW (solar) heater	
Thermal mass within envelope	
Solar orientation	
Night-time shutters	
Shading factor [%] (East & West)	

Measure/ solution	*Passive House standard*
4. Electric Efficiency	
Energy labeled household appliances [Labeling A - G]	Energy reduction 50% of common practice
Hot water connections washing machines/ dishwashers	
Compact Fluorescent lighting	
Regular maintenance ventilation filters	
Direct Current motor ventilation	
Efficient fans: SFP (Specific Fan Power)	≤ 0,45 W/(m3/h) (transported air)
5. On-site Renewables	
Wind turbine	
Photo Voltaics	
Solar thermal energy	
Biomass system	
Other	
	=basic measure/ solution
	=often applied optional measure/solution
	=other optional measure/ solution

Barriers to build passive houses

- Planning and conservation
- Existing standards
- Build quality and skills
- Style of building
- Availability of building products
- Calculation methodologies
- Embodied energy vs. energy efficiency
- Heating systems to meet lower heating demand
- Consumer aspirations – they expect central heating and want fireplaces
- Previous voluntary certification schemes have failed.

On positive side:

- UK government is 100% behind reducing the UK's environmental impact

National publications

No publications are available yet.

United Kingdom climate

The United Kingdom consists of England, Scotland, Wales, and Northern Ireland. Situated off of the northwest coast of Europe, these islands extend between 50° and 60°N. The climate of Britain is notoriously variable and changeable from day to day. Weather is generally cool to mild with frequent cloud and rain, but occasional settled spells of weather occur in all seasons.

The frequent changes of weather affect all parts of the country in very much the same way; there are no great differences from one part of the country to another.

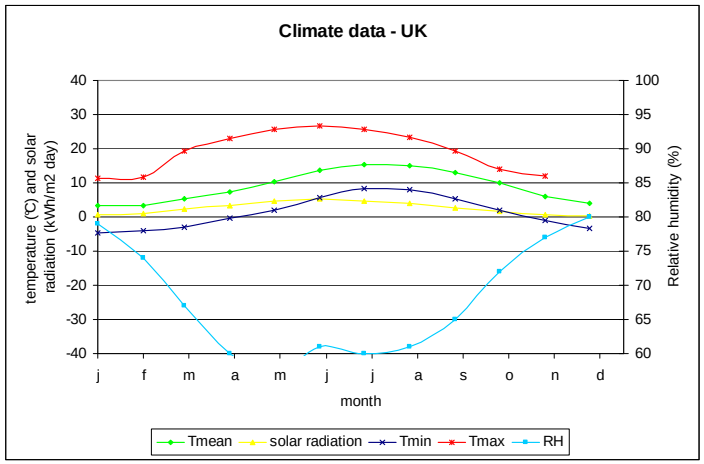
While the south is usually a little warmer than the north and the west wetter than the east, the continual changes of British weather mean that, on occasions, these differences may be reversed. Extremes of weather are rare in Britain but they do occur.

The average number of hours of sunshine is greatest in the south and southeast of England and least in the north and west. Western Scotland, Wales, and Northern Ireland have rather less sunshine than most of England.

In Britain daily sunshine hours range from between one and two in midwinter to between five and seven in midsummer. Winter sunshine is much reduced in Britain because of frequent fogs and low cloud.

Snow may occur anywhere in Britain in winter or even spring but, except on the hills, it rarely lies for more than a few days.

Quoted from BBC's Weather Centre.



longitude	1°29'
latitude	53°23'
altitude	+131m

Overview building stock

The growth of the housing stock has been subject to increasingly strict building regulation thermal requirements. Demolition tends to be of older, less well insulated dwellings. This tends to improve efficiency over time.

There has been small growth in the proportion of detached dwellings, tending to increase the average heat loss per dwelling. Equally, however, the proportion of flats has increased which tends to reduce the average heat loss per dwelling.

The number of households has increased, while the number of occupants per household has decreased. The trend to smaller households would result, all other things being equal, in a higher energy consumption per capita.

Owner occupier has become an increasingly common form of tenure over time, making more occupiers directly responsible for the thermal performance of dwellings.

Some housing statistics from 2003:

- GB population = approximately 60 million
- Number of households = approximately 25
- million (of which about 18 million dwellings are pre-1975 with relatively poor thermal performance)
- Average number of people per household = 2.4 (and this figure is shrinking, in 1970 there was an average of 3 people per household)
- Housing accounts for approximately 30% of national energy consumption
- 90% of households have central heating, the most common being a gas fired wet central heating system
- 32% of the housing is in the South East

Type of house	Existing building stock
Single family, row house	28 %
Semi-detached	29 %
Detached	16 %
Apartment/flat	19 %
Bungalow	8 %
# Passive houses/ year	..

Passive House characteristics

Thermal mass: No information is available regarding thermal mass of the Passive House equivalent in the UK.

Typical construction UK

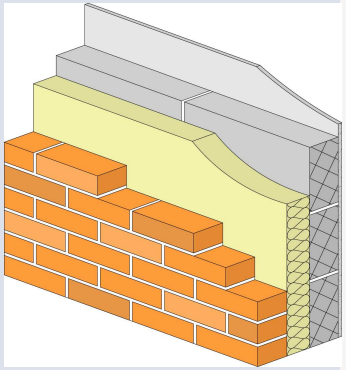
Air tightness Passive House Std.	$n_{50} \leq 0{,}6\ h^{-1}$
Air tightness typical UK	*$n_{50} \sim 4\ h^{-1}$*

Thermal insulation

	Passive House Standard	*Typical House UK*
Envelope component	**U-value [W/m²K]**	
Facade	0,15	*0,35*
Roof	0,15	*0,16*
Floor	0,15	*0,25*
Doors		*2*
Window frame	0,8	
Windows	0,8	*- Dual Pane*

Compared to typical construction:

The typical British house has a medium—high thermal mass, as this figure of the exterior wall illustrates.



Equipment/ installations

No information is available regarding equipment and installations of the Passive House equivalent in the UK.

Heating	Heat generator Heating fluid Heating system	N/A
Domestic hot water	Heating Energy source	N/A
Ventilation	System Heat recovery Supply- and exhaust air flow per apartment	N/A

Compared to typical construction:

In England, Wales and Scotland the most prevalent form of heating is a gas boiler with hot water cylinder.

For Northern Ireland oil is the most popular fuel, with solid fuel use becoming rarer (as a mains gas supply is made available).

It is typically only flats which are specified with electric heating.

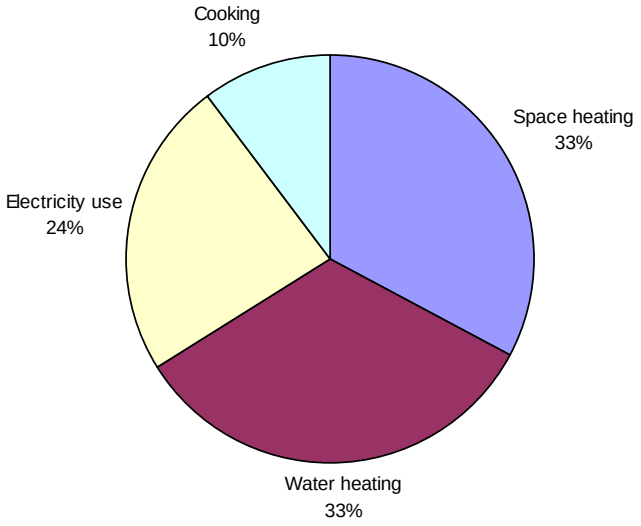
Heating	Gas condensing boiler with a seasonal efficiency of >86%
Domestic hot water	Hot water cylinder with >37.5mm of spray foam insulation, and medium duty coil (typically a 15-25min recovery period)
Ventilation	Either, a combination of trickle vents and local extract fans; or passive stack ventilation. >70% of dwellings are naturally ventilated.

Energy Use

No information is available regarding energy use of Passive House equivalent houses in the UK. However, according to the Passive House standard the space heating energy demand of a passive house is limited to a maximum of 15 kWh/m^2 treated floor area (excluding interior walls). And the total energy demand for heating, ventilation, electricity for fans and pumps and household electricity is limited to around 42 kWh/m^{2}a or 120 kWh$_{primary}$/m^{2}a treated floor area.

Compared to typical new build construction:
For the typical new build semi-detached house the energy use for space heating per square meter floor area is around 48 kWh. For domestic hot water also approximately 48 kWh.

Total energy use around 150 kWh per year based on standard occupancy patterns of use.



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Intelligent Energy Europe

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