HOUSES WITH FACTOR X

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From 0 to 100 in 4 seconds? Why not, in a 'one-litre car'. Moreover, it saves 70% of energy. *(see www.hypercar.com)*

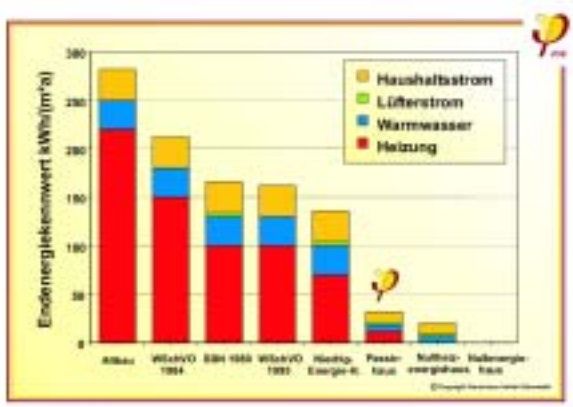
A screen that is clear, sharp, totally flat, and light? The TFT monitor, which also saves 65% energy. *(Thin-film transistor, technology for controlling the LCD layer, see www.pctechguide.com/07panels.htm)*

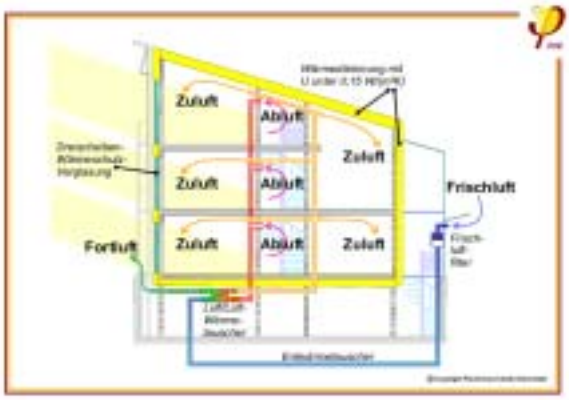
A modern cosy house, full of light and sun, warm in winter, cool in summer, with a permanent supply of fresh air? A passive house that also saves 75% of energy.

(Wolfgang Feist, 2003)

Passive houses

The concept of the passive house was first created by Dr. Feist around the beginning of the 1990s, a milestone in the development of environmental construction. The first house was built under his supervision in Darmstadt in 1991, and it fully confirmed theoretical expectations. Over the following years, many hundreds of such buildings were built in Europe, containing thousands of flats. Their inhabitants appreciate the comfort and negligible running costs, which are not achievable in houses of lower quality.





Ventilation for comfort: heating (or cooling) gain is ten times the electric input

An obvious pre-condition of a good house is a very well thermally insulated outer area, including windows, and also a high level of air-tightness. The building's ventilation is not affected by the amount of wind or whether it is freezing outside. It is aired so that the inside is as pleasant as possible.

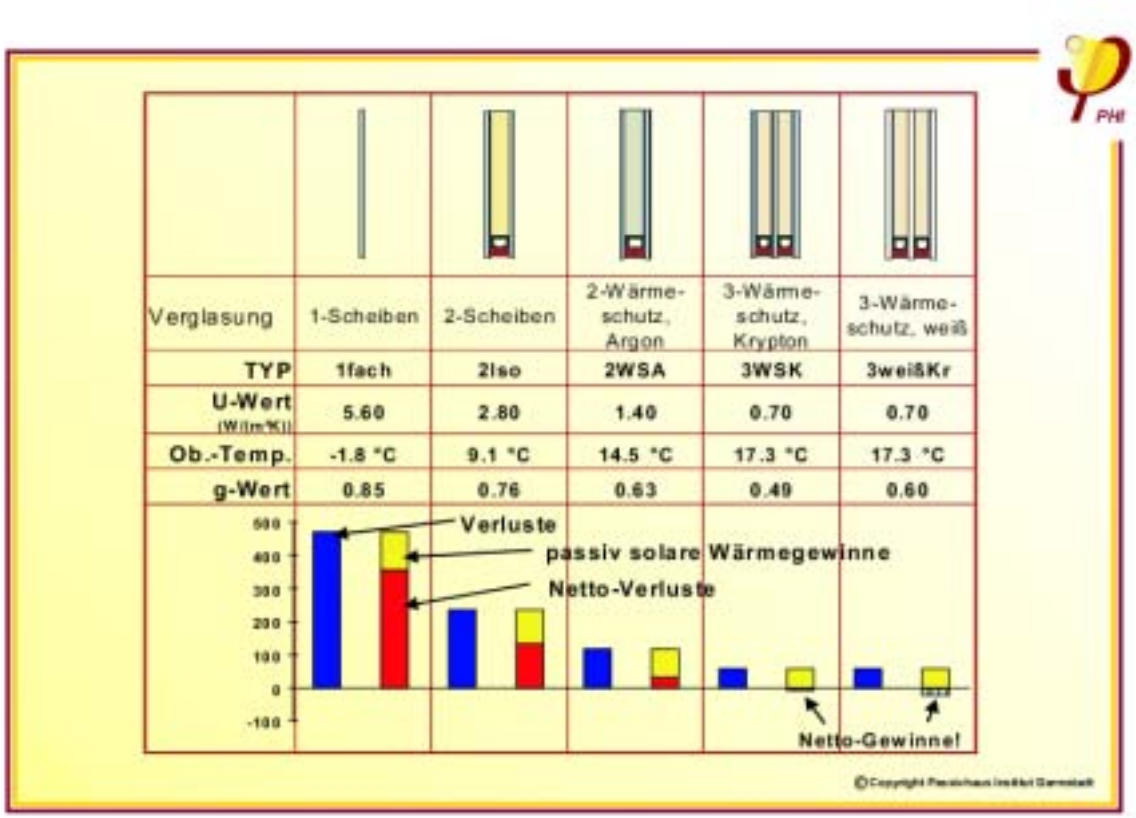
Such comfortable ventilation, ensured by quiet ventilators, is something quite different than air-conditioning. It does not guzzle energy, but uses it very effectively. For comfort it is essential that the fresh air that comes inside is not ice-cold; this can be ensured by warming it up with the 'used' air that is being released. This way the heat does not escape, on the contrary, at least eight (or better nine) tenths of the heat returns inside with the warmed-up fresh air.

In order to keep the heat recovery device from freezing, in winter the fresh air first comes through underground pipelines, where it is preheated above the freezing point. In summer the

cool ground serves for cooling, so it is possible to ventilate even in the hottest days without warming the house but rather cooling it down.

Highest permissible specific values for a passive house	
heating input (-12ºC outside)	10 W/m^2
annual heating consumption	15 kWh/(m^2.a)
yearly supply to the house	42 kWh/(m^2.a)
energy release to achieve it	120 kWh/(m^2.a)

Windows instead of radiators



Another key technology in good houses is excellent window insulation. Windows consist of three layers, so there are two spaces between them. The hollows are specially treated on one side so that heat is not transmitted to the other side by means of radiation. Heat conduction within each space is suppressed by filling the space with a less conductive gas, ideally krypton.

Although such a triple-glazed window lets in less solar heat than a common one, but up to one half of it still gets through. On the other hand, four times less heat than usual escapes from the interior in winter. Even on winter days, unless it is constantly overcast and below zero, such windows let more heat in than out. They insulate so well that it is not cold around them even at night, and therefore no radiator is needed below them.

In summer, triple-glazed southern windows exposed to very high sun let in very little solar radiation, and therefore the house does not overheat even if the glazed area is large.

Hi-tech glazing deserves window frames which insulate equally well. This is achieved by dedicating most of their thickness to the insulation layer. Appropriate joining to the wall also helps.

The market has developed to the point that perfectly insulating and durable windows can be purchased for the same price as inferior ones.

Using more expensive components is to a great degree compensated by the fact that the house does not require independent heating, i.e. pipelines and radiators (or floor or wall heating) with a heat pump, boiler etc. It is precisely the absence of a ‘classical’ active heating system that gives the house the predicate ‘passive’.

Not that heating would not be needed at all. On sunny winter days heating is not necessary, but during cloudy weeks it is. However, additional heating of the pre-warmed fresh air by a single heating register suffices. Or one stove located anywhere in the house, regardless whether a classical or small pellet stove.

Sustainable building principles

- Compact and well-insulated building ($U < 0.15$) without heat bridges
- Main side facing south and not shaded in winter
- Super-window glazing with $U \leq 0.8$ and permeability for sunlight $g \geq 0.5$
- Ventilation with efficient recuperation, retaining at least 85 % heat
- Using as effective appliances as possible
- Heating potable water with solar panels or a thermal heat pump from waste air

- Winter pre-warming (and summer cooling) by means of underground pipelines

Classical examples

A passive house can look very futuristic but also rather inconspicuous. To each his own. Of course, a house with generous south-facing glazing is more pleasant, thanks to the winter sunlight. As for construction materials, there are no limitations, although most customers and architects try to avoid using too expensive materials like steel and aluminium and prefer natural materials.

House in Breitenfeld: wood, straw, clay

The house in Breitenfeld violates the principles of the passive house a little bit; the builder decided to use cheaper windows. What is interesting, though, is the construction, in which straw bales were pressed into the wooden frame. Straw insulates as well as styrofoam, but is much cheaper and nobody needs to worry about waste. On the contrary; the more straw is deposited within the walls, the better, as the straw stores carbon dioxide taken from the air.

Passive prefabricated house from the Buhl company, Perchtoldsdorf

A pioneering project which developed a ‘puzzle system’ for assembling the house’s raw construction from six pieces (floor, four walls and roof) for the price of a regular prefabricated house, plus the quality of a passive house. The visible material of the house is wood, which was used also for the load-bearing elements. The main component of the walls are straw bales. The picture shows a close-up of the insulation of the interior panelling of the house.

The best apartment buildingx in the Czech Republic: concrete blocks in Nový Lískovec!


There is not much of a difference between the two pictures. Perhaps the repaired block is a little neater. You cannot see that the insulation is at least 16 centimetres thick. That is not much, but it is more than usual in Czechia. Another specific thing about the two already repaired buildings is the fact that they were equipped with central ventilation with heat recovery. In both respects they are the first Czech apartment buildings of such quality, with the lowest achieved heat consumption and unusual comfort.

This was just the beginning of the regeneration of the concrete apartment blocks in Nový Lískovec. This Brno neighborhood will see an even more ambitious project, a Czech-Austrian collaboration which will renovate a building to reach the parameters of new passive houses. Considering the size of the building and the fact that it will be a renovation, this looks like a world achievement. A large solar panel is to be installed on the southern side of the building, with an area of 150-300 square metres.

Repairs of buildings for centuries to come

- If not fully passive standard, then at least to 30 kWh/(m^2.a) for heating: three-litre house (1 litre of diesel or 1 m^3 of natural gas = 10 kWh)
- Increased comfort and fully usable area
- Very long physical and moral service life
- Huge interest in such high-quality houses
- A real decrease in Europe’s heating needs to one fifth of the current level
- Covering this consumption exclusively with non-fossil resources