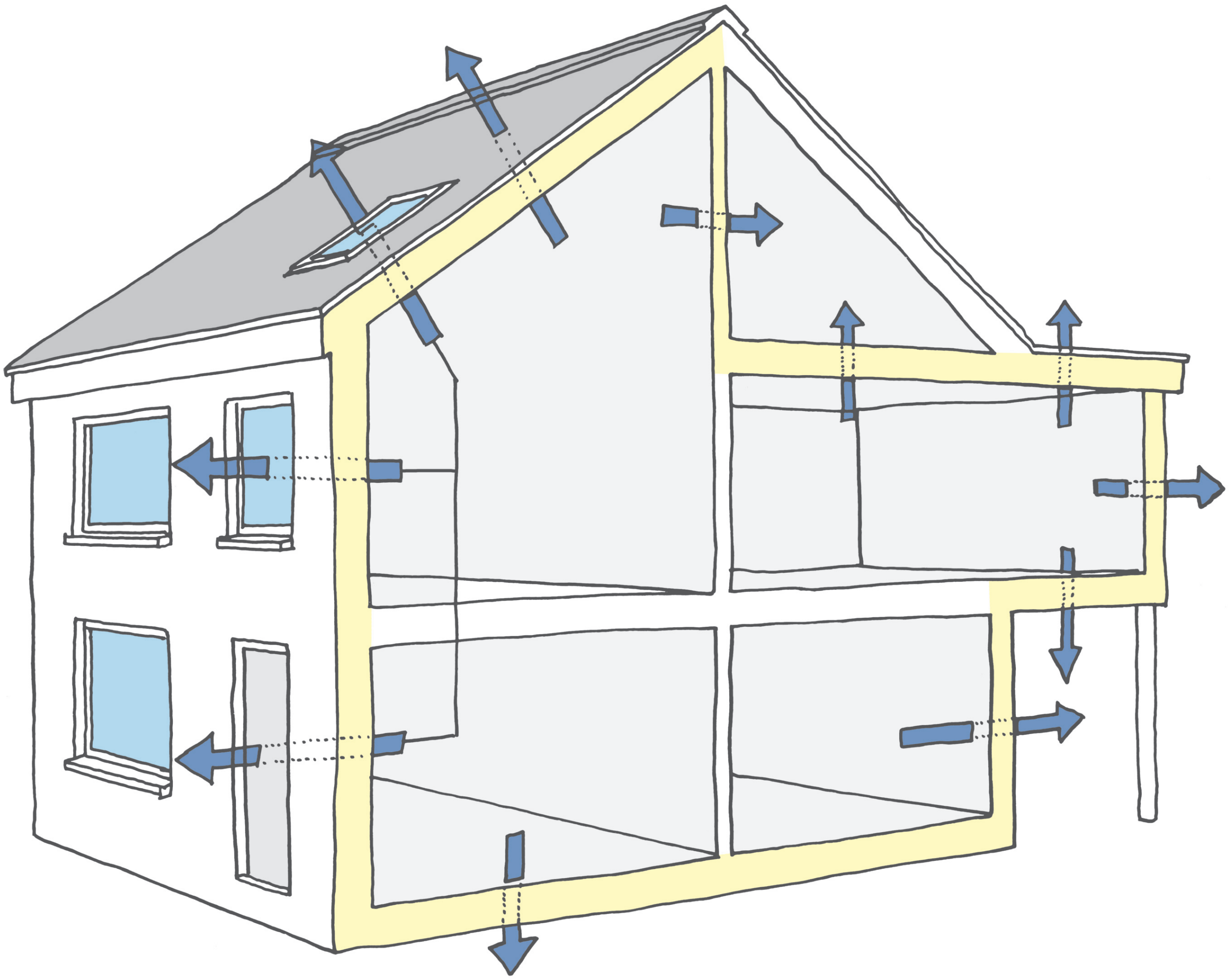
CHAPTER 24

Energy Standards



There are several key facts driving change in the standards to which homes are built:

- over 90% of Ireland's energy supply comes from non-renewable sources (e.g. oil, natural gas, solid fuels)
- almost 30% of Ireland's energy supply is consumed by the residential sector (houses, flats, apartments)
- approximately 30% of Ireland's carbon emissions come from the residential sector:
  - almost every home (98.4%) in Ireland has central heating
  - almost four out of five homes (78%) consume oil or natural gas
- carbon emissions are causing global warming, which is leading to climate change
- energy costs are rising and more people are experiencing energy poverty.

In response to these facts the government has increased the energy efficiency requirements for newly built houses. This means that a home built today must be significantly more energy efficient than one built ten or twenty years ago. These changes are expected to continue with regular updates to the building regulations until new homes are at a net zero energy standard.

Design and performance standards

Regulatory authorities all over the world are trying to tackle these same problems. Some countries have introduced standards that promote a higher quality of sustainable design above the minimum standards set out in their building regulations. The idea is to encourage the construction industry to build sustainable homes.

Some standards are very broad and take into account all aspects of the building's impact. Examples include:

- Code for Sustainable Homes (CSH) – a voluntary standard for England, Wales and Northern Ireland that examines 34 issues related to how a home is designed, constructed and used
- Leadership in Energy and Environmental Design for Homes (LEED for Homes) – a voluntary standard for the USA and Canada that comprises a suite of rating systems for the design, construction and operation of homes.

Other standards are more specific and focus on energy in use. Examples of these include:

- Passivhaus standard – a voluntary standard developed in Germany and used all over the world
- Minergie – a voluntary standard developed in Switzerland
- Effinergie – a voluntary standard developed in France.

The fundamental difference between the broad standards (e.g. CSH) and the 'energy in use' standards (e.g. Passivhaus) is that the broad standards look at everything – from construction materials to recycling of household waste, to whether the home has storage space for bicycles; whereas the 'energy in use' standards focus on the energy consumed in the home on a day-to-day basis.

To achieve this, 'energy in use' standards focus on building fabric (i.e. thermal insulation and airtightness) and services (i.e. ventilation). The energy in use standards are not concerned with whether a house is built using materials from renewable resources (e.g. timber) or how the home contributes to sustainable transport in the community; they look only at how energy efficient the home is and how comfortable an indoor environment is provided.

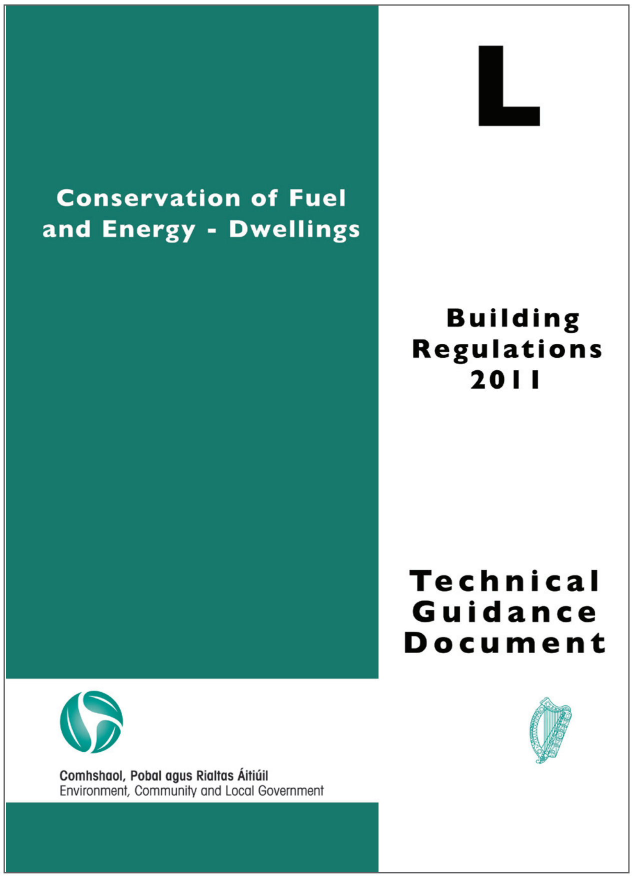
This is not a question of which type of standard is 'better'; it is simply a case of recognising that different standards measure different things and that they all have a role to play. The most important fact to realise is that a home built to any of these voluntary standards will be more sustainable than one built to the minimum building regulations requirements.

Categories	Issue
Energy and CO_2 emissions	Dwelling emission rate (M) Fabric energy efficiency (M) Energy display devices Drying space Energy labelled white goods External lighting Low and zero carbon technologies Cycle storage Home office
Water	Indoor water use (M) External water use
Materials	Environmental impact of materials (M) Responsible sourcing of materials – basic building elements Responsible sourcing of materials – finishing elements
Surface Water Run-off	Management of surface water run-off from developments (M) Flood risk
Waste	Storage of non-recyclable and recyclable household waste (M) Construction site waste management Composting
Pollution	Global warming potential (GWP) of insulants NO_X emissions
Health and Well-being	Daylighting Sound insultaion Private space Lifetime homes (M)
Management	Home user guide Considerate Constructors Scheme Construction site impacts Security
Ecology	Ecological value of site Ecological enhancement Protection of ecological features Change in ecological value of site Building footprint

24.01 Code for Sustainable Homes: assessment categories. (M) denotes issues with mandatory elements.

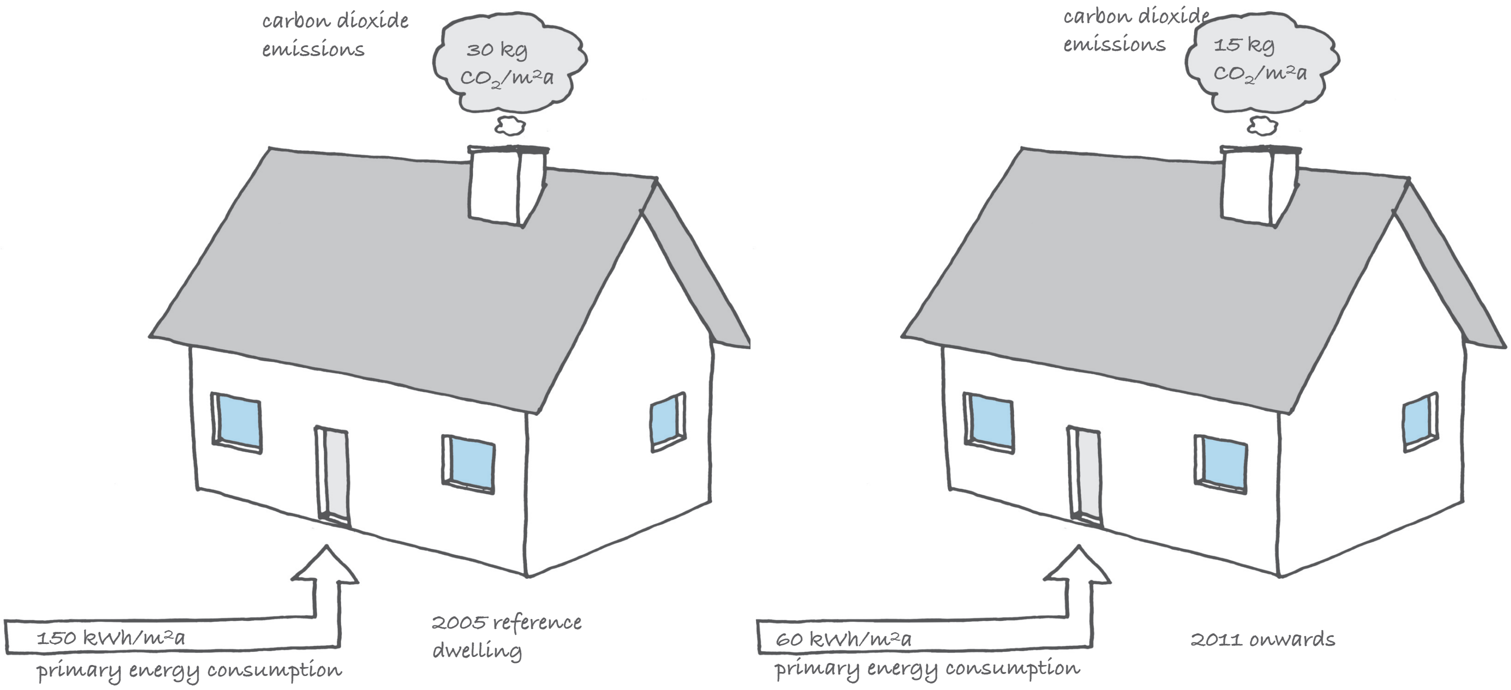
Building regulations (TGD L 2011)

The Technical Guidance Documents provide detailed information on the design features required to comply with the building regulations. Each document addresses a different area of building design. Technical Guidance Document L: Conservation of Fuel and Energy – Dwellings (TGD L) sets out the requirements for energy efficiency and carbon emissions.



24.02 Technical Guidance Document L: Conservation of Fuel and Energy – Dwellings (2011 edition).

Energy consumption and carbon emissions
The building regulations specify the requirements for energy consumption and carbon emissions that must be met by all newly constructed houses.



24.03 Baseline reference dwelling (2005) and proposed dwelling (2011 onwards) with 40% relative energy consumption and 49% relative carbon emissions.

Reference dwelling

The requirements for energy efficiency and carbon emissions are stated relative to a 'reference dwelling'. This is based on the idea that the proposed home must outperform a similar house (i.e. the reference dwelling) built in the past. There isn't a single reference dwelling; it is a notional version of the proposed house.

The reference dwelling complies with the building regulations that were in force in 2005. So the question becomes: How much better is the proposed house compared to the same house built to the 2005 standards?*

* The minimum acceptable performance is 40% relative energy consumption and 49% relative carbon dioxide emissions.

Energy consumption and carbon emission limits

The amount of energy consumption and carbon emissions permitted under the building regulations have reduced gradually in recent years.

Performance indicator	2005 (baseline reference dwelling)		2007		2011		2016	
Primary energy consumption	1.0	150	reduction factor 0.60	90	reduction factor 0.40	60	reduction factor 0.30	45
Carbon dioxide emissions	1.0	30	0.69	21	0.46	14	0.30	9
Building energy rating	1.0	B3		B1		A3		A2

24.04 Maximum permitted energy consumption and carbon emissions for an average dwelling.

The energy consumption rate (per square metre of floor area) of the proposed home is stated as the energy performance coefficient (EPC):

$$EPC = \frac{\text{primary energy consumption of the proposed dwelling (kWh/m}^2\text{a)}}{\text{primary energy consumption of the reference dwelling (kWh/m}^2\text{a)}}$$

The maximum permitted energy coefficient (MPEPC) is 0.4, or 40%.

The carbon emission rate (per square metre of floor area) of the proposed dwelling is stated as the carbon performance coefficient (CPC):

$$CPC = \frac{CO_2 \text{ emission rate of the proposed dwelling (kg}CO_2\text{/m}^2\text{a)}}{CO_2 \text{ emission rate of the reference dwelling (kg}CO_2\text{/m}^2\text{a)}}$$

The maximum permitted carbon performance coefficient (MPCPC) is 0.46, or 46%.

Both energy consumption and carbon dioxide (CO_2) emissions are calculated using the Dwelling Energy Assessment Procedure (DEAP) software tool.

Renewable energy requirement

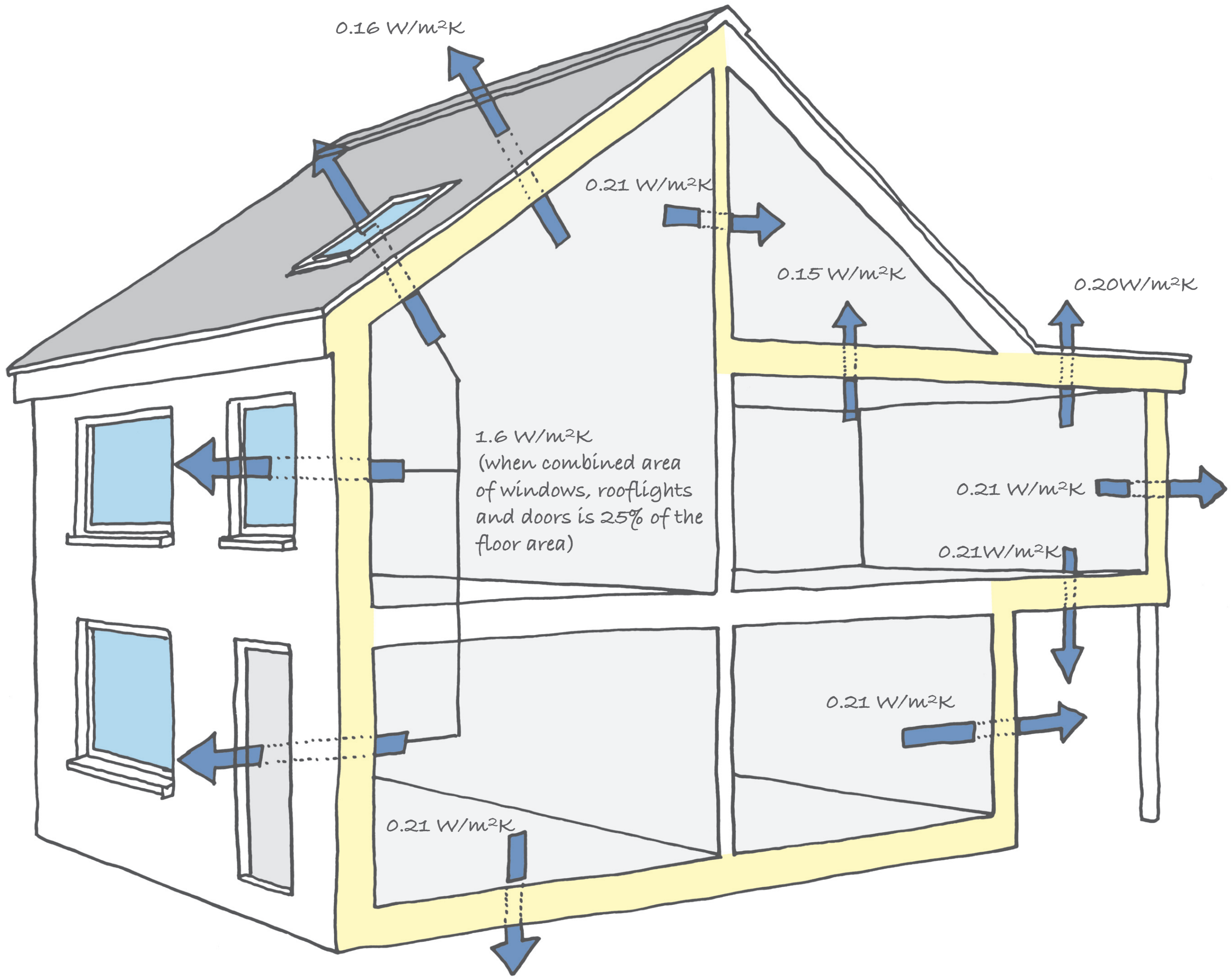
TGD L (2011) also requires that some of the energy consumed by a home is generated on site using renewable energy technologies. The minimum level of required is:

- 10 kWh/m^{2}a contributing to energy use for domestic hot water heating, space heating or cooling; or
- 4 kWh/m^{2}a of electrical energy; or
- a combination of these which would have an equivalent effect.

Renewable energy technologies means technology, products or equipment that supply energy derived from renewable energy sources, including:

- solar thermal systems
- solar photovoltaic systems
- biomass systems
- systems using biofuels
- heat pumps
- wind turbines
- other small-scale renewable systems.

Building fabric insulation: U-values



24.05 U-values: maximum permitted U-values for the building fabric (TGDL, 2011).

The maximum permitted rate of energy loss through the building fabric is outlined in TGD L (2011). The average U-value of U ≤ 1.60W/m²K for windows and doors assumes that the windows and doors comprise 25% of the area of the floor. A house that has a greater proportion of glazing is required to meet a higher building standard (i.e. a lower U-value).

Average U-value of windows, doors and rooflights (W/m^2K)	Maximum combined area of external doors, windows, rooflights and doors expressed as a percentage of floor area (A_1)
0.8	58.9
1.0	44.8
1.2	35.1
1.3	31.9
1.4	29.2
1.5	26.9
1.6	**25.0**
1.7	23.3
1.8	21.9
1.9	20.6
2.0	19.4
2.2	17.5
2.4	15.9
2.6	14.5

24.06 U-values: maximum permitted variation in U-values for windows, rooflights and doors.

Airtightness

TGD L (2011) suggests the following approach to airtightness:

- identify the primary air barrier elements (e.g. sheathing, plaster, vapour control layer, breather membrane) at early design stage
- develop appropriate details and performance requirements to ensure continuity of the air barrier
- communicate these to all those involved in the construction process
- provide on-site inspection regime and related quality control procedures to ensure that airtightness is achieved in practice.

While this procedure suggests that airtightness is important, the requirement is only <7 $m^3/h.m^2$ (less than 7 cubic metres of air per hour for every square metre of floor area). This is a very poor standard compared to the Passivhaus standard.

Building Energy Rating (BER)

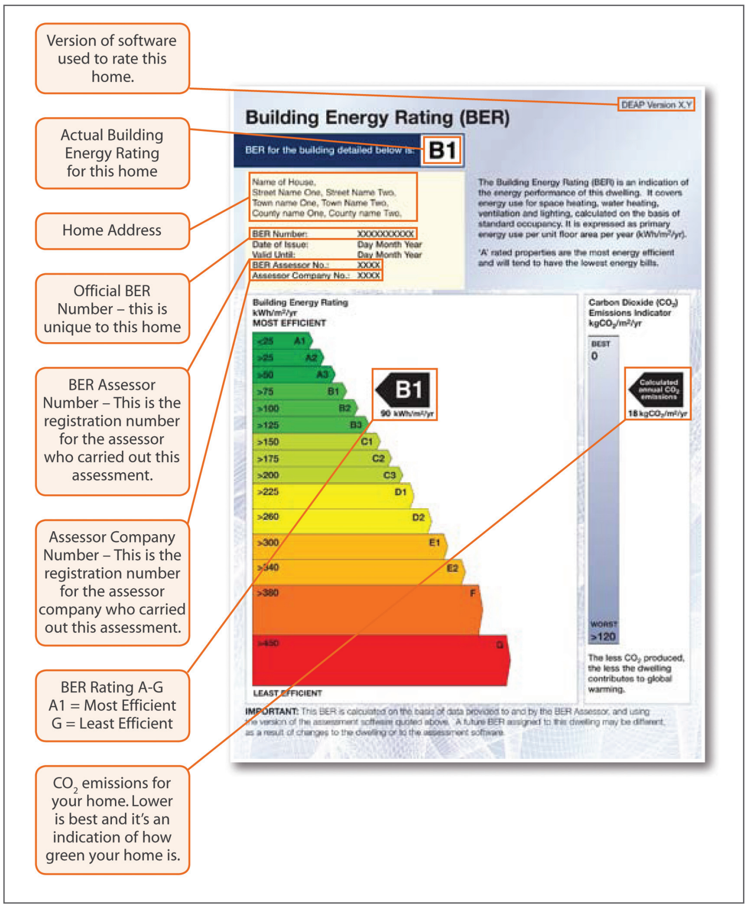
A Building Energy Rating (BER) is an approximate measure of how much energy a building consumes every year. When a BER assessment is completed a certificate is produced. This certificate is similar to the energy efficiency label for household electrical appliances (e.g. fridges, cookers) and it also states the annual amount of the greenhouse gas carbon dioxide (CO_2) that the home produces. By law, a BER certificate must be available for every home rented or sold in Ireland.

BER certificates are useful for comparing the performance of homes built to building regulations standards. However, they lack the accuracy and scientific methodology to provide a true picture of the energy performance of a home.

KEY PRINCIPLES

The benefits of having a BER system include:

- increases awareness – labelling every home will allow consumers to make an informed decision when renting or buying a home and should encourage people to buy/rent more energy-efficient homes
- changes behaviour – making people more aware of the energy performance of buildings will encourage them to reduce their energy consumption
- encourages better design – architects, builders and developers will build more energy-efficient homes to make their houses more attractive to buyers
- fights climate change – improving the energy performance of homes will lower energy consumption and reduce CO_2 emissions.



24.07 Building Energy Rating (BER) certificate (*Source:* Sustainable Energy Authority of Ireland).

To conduct a BER, the assessor follows the Dwelling Energy Assessment Procedure (DEAP). Carrying out an assessment on an existing building involves visiting the building, taking measurements and recording certain details. This information is then entered into the DEAP software tool and the calculations are combined to produce an overall estimation of annual primary energy demand and carbon dioxide (CO_2) emissions. The dwelling is then given a rating on a scale of A1 (best) to G (worst). As well as the certificate, the homeowner is also given an advisory report. The report explains the changes that could be made to the home to improve its energy performance and reduce CO_2 emissions.

Year of construction	Pre-1972	1972–1978	1979–1981	1982–1991	1992–2001	2002–2008
Typical rating	E2–G	E1–E2	D1–D2	C3–D1	C2	C1

24.08 Existing houses: typical BER ratings prior to retrofitting insulation.

ACTIVITIES

Find out the BER for your home or a similar home nearby. Hint: Whenever a home is sold/rented a BER must be provided to the new owner/tenant.

SUPPLEMENTARY INFORMATION

The information gathered during the assessment visit includes:

- dwelling type and age – detached, semi-detached, terraced, ground floor apartment, etc.
- structural details – wall, roof and floor construction
- room-by-room survey – dimensions, openings (doors, windows), chimneys, fans, vents, radiators, lighting
- ventilation system – natural ventilation, mechanical ventilation, etc.
- space heating system – type (radiators, storage heaters, underfloor, etc.), fuel type (gas, oil, electricity, etc.), boiler type
- water heating system – heat source, fuel type, insulation (e.g. water cylinder insulation), solar water heating system, controls (e.g. thermostats, timers, etc.).

Passivhaus standard

The Passivhaus standard is the world's leading 'energy in use' standard. It is the most reliable and scientifically rigorous methodology available. Unlike the other standards, the Passivhaus standard is not merely an assessment tool; it is a design tool. Using the PHPP (Passivhaus Planning Package) software, the designer can adapt the design of the building and receive immediate feedback on how the changes will affect the energy performance of the building. For example, the designer can extend the depth of the roof overhang to see how this will impact on solar gain and contribute to the control of overheating. When one variable is changed, the software recalculates the entire design to assess how the building will perform.

Similarly, if the homeowner requests a change to the design during construction, the designer can enter the proposed change into the PHPP and see precisely what impact it will have on the energy performance of the building.

Critics of the Passivhaus standard dismiss it as a brand. While there is some truth in this, it is important to acknowledge that the Passivhaus standard is 'open source'. The PHPP is simply a series of spreadsheets. The formulae within the spreadsheets are not hidden and can be manipulated to suit the end user.

Also, it is possible to design and build a home to the Passivhaus standard without going through the certification process. In other words, somebody who wants an energy-efficient home but isn't interested in achieving certification can adopt the principles and methods of the Passivhaus standard without ever contacting the Passivhaus Institute.

DEFINITION

Passivhaus
A Passivhaus building is a building in which thermal comfort can be maintaines by post-heating the fresh air, supplied to maintain acceptable indoor air quality, without the need for additional re-circulation of air.

In fact, many architects who are certified Passivhaus designers are bringing their Passivhaus knowledge and techniques to non-Passivhaus projects.


Passive House Institute

Passive House Institute
Dr. Wolfgang Feist
Rheinstr. 44/46
D-64283 Darmstadt

Certificate

The Passive House Institute awards the seal "Certified Passive House" to the following building

Passive House, Passivestreet 100, 12345 Passivecity, Passivecountry

Certified Passive House
Passive House Institute

Client: ...
Passivestr. 100, 12345 Passivecity, Passivecountry

Architect: ...
Passivestr. 101, 12345 Passivecity, Passivecountry

Building Services: ...
Passivestr. 102, 12345 Passivecity, Passivecountry

This building was designed to meet Passive House criteria as defined by the Passive House Institute. With appropriate on-site implementation, this building will have the following characteristics:

- Excellent thermal insulation and optimised connection details with respect to building physics. The heating demand or heating load will be limited to
  15 kWh per m² of living area and year or a heating load of 10 W/m², respectively
- When outdoor temperatures are high, thermal comfort can be ensured with passive solutions or with minimal energy demand for cooling and dehumidification according to the location-specific Passive House requirements.
- A highly airtight building envelope, which eliminates draughts and reduces the heating energy demand: The air change rate through the envelope at a 50 Pascal pressure difference, as verified in accordance with ISO 9972, is less than
  0.6 air changes per hour with respect to the building's volume
- A controlled ventilation system with high quality filters, highly efficient heat recovery and low electricity consumption, ensuring excellent indoor air quality with low energy consumption
- A total primary energy demand for heating, domestic hot water, ventilation and all other electric appliances during normal use of less than
  120 kWh per m² of living area and year

This certificate is to be used only in combination with the associated certification documents, which describe the exact characteristics of the building.

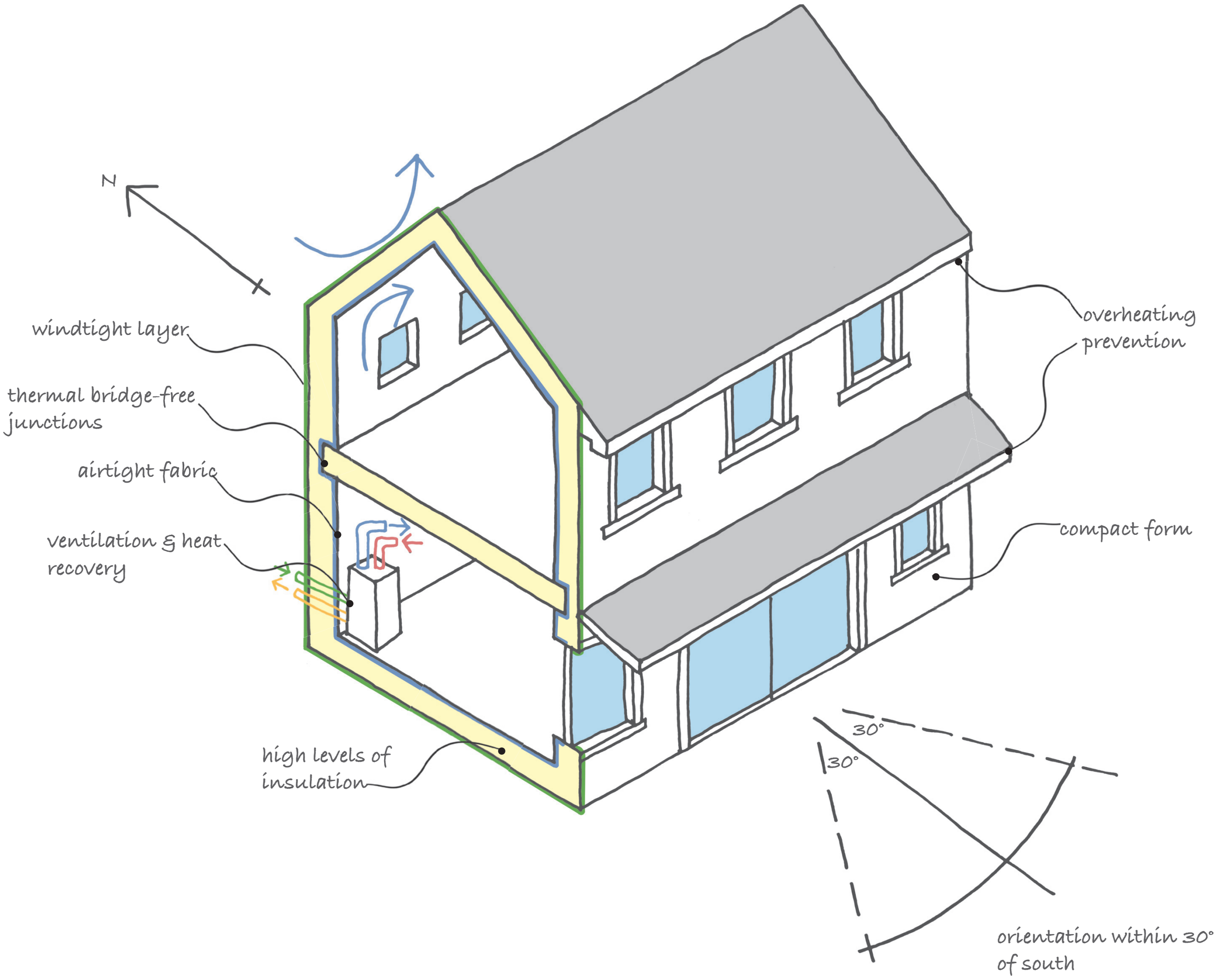
Passive Houses offer high comfort throughout the year and can be heated or cooled with little effort, for example, by heating/cooling the supply air. Even in times of cold outdoor temperatures the building envelope of a Passive House is evenly warm on the inside and the internal surface temperatures hardly differ from indoor air temperatures. Due to the highly airtight envelope, draughts are eliminated during normal use. The ventilation system constantly provides fresh air of excellent quality. Energy costs for ensuring excellent thermal comfort in a Passive House are very low. Thanks to this, Passive Houses offer security against energy scarcity and future rises in energy prices. Moreover, the climate impact of Passive Houses is low as they reduce energy use, thereby resulting in the emission of comparatively low levels of carbon dioxide (CO_2) and air pollutants.

issued:
Darmstadt, Date

Dr. Wolfgang Feist

24.09 Passivhaus Certificate. Each house is individually tested and assessed to ensure that it meets the Passivhaus standard and a certificate is issued by the Passivhaus Institute in Germany.

Principles



24.10 Passivhaus principles.

The Passivhaus approach to building design is based on seven simple principles:

1 orientation – using high-performance south-facing windows to capture the sun's energy
2 insulation – using very high levels of insulation throughout the structure
3 preventing thermal bridges – ensuring that there is no heat loss at joints
4 airtightness – sealing the entire structure to reduce heat loss caused by leakage of warm air
5 heat recovery ventilation – providing a constant supply of warm, clean, fresh air
6 compactness – having a low surface area to volume ratio
7 preventing overheating – the indoor temperature should not rise above 25°C for more than 10% of the year.

These design principles should inform the design of the building, but there is some flexibility in relation to their implementation. For example, it is possible to build a less compact house or on a site with poor solar exposure; it just means that other measures (e.g. extra insulation) will be needed to compensate.

ACTIVITIES

Visit the Passivhaus database (www.passivhausprojekte.de) to see examples of houses that have been built to the Passivhaus standard.

Criteria

There are two types of criteria set out in the Passivhaus standard:

1 evaluation criteria – absolute requirements that must be met
2 functional criteria – limiting backstop values that should not be exceeded to ensure thermal comfort.

Evaluation criteria

To achieve passive house standard a house must meet the following energy performance criteria:

- space heating demand ≤ 15 kWh/m^{2}a. The space heating demand is the energy required to maintain an indoor temperature of 20°C all year round. Space heating refers to the heating of the indoor rooms; it does not include hot water heating or other energy needs.

OR

- heating load ≤ 10 W/m^2. The heating load is the energy required to maintain an indoor temperature of 20°C on a given day. The heating load should not exceed the amount of heat that can be supplied to the house via the fresh air required for good indoor air quality (≤ 10W/m^2).

AND

- primary energy demand ≤ 120 kWh/m^{2}a. The primary energy demand is the total energy consumed for all requirements (i.e. space heating, water heating, ventilation and all electricity use).

AND

- building airtightness: air changes ≤ 0.6 h^{-1}@ n50

AND

- excess temperature frequency (above 25°C) ≤ 10% of the year.

Functional criteria

There are several functional criteria in relation to thermal performance:

- opaque elements (floors,walls, roofs):
  - U-value ≤ 0.15 W/m^{2}K

Windows:

- triple glazing with U-value glazing: Ug ≤ 0.70 W/m^{2}K
- solar transmittance value, g value > 0.55
- low conductivity glazing spacers
- thermal bridge-free window frame and sash/casement
- installed window U-value: $U_{window\ installed}$ ≤ 0.80 W/m^{2}K

Doors:

  - $U_{door\ installed}$ ≤ 0.80 W/m^{2}K

Thermal bridging:

  - linear thermal bridges (psi value)ψ < 0.01W/mK
  - point thermal bridges (chi value)$\sum\chi$ / A < 0.01W/K

The criteria for ventilation equipment include:

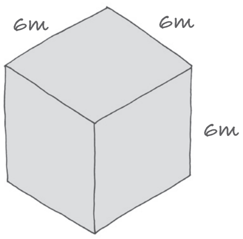
- heat recovery efficiency, η_{HR} > 75% – this refers to the ability of the heat exchanger to capture heat energy from the exhaust air leaving the building
- electricity efficiency, < 0.45Wh/m^2 – this is the maximum amount of energy (per square metre of floor area) that the ventilation unit can consume
- noise protection, < 25 dB(A) in living spaces.

Another criterion is compactness. This describes the relationship between the surface area of the home and its volume:

- a ratio of 0.7 or less (i.e. surface area ÷ volume ≤ 0 7).

Compactness

Heat is lost through external surfaces; the greater surface area, the greater the heat loss. A simple house design that has a minimum of extensions or additions is best. Despite what might seem intuitive, building small does not necessarily mean building compact.



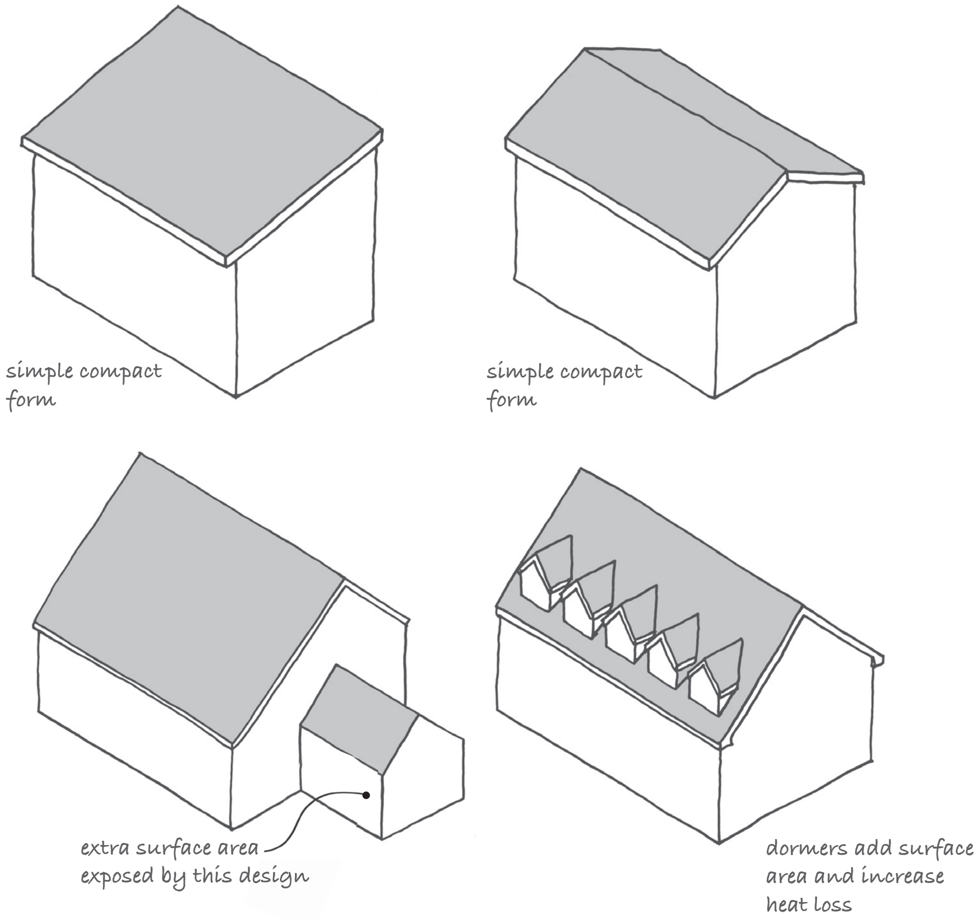
24.11 Compactness.

For example, taking a regular cube with a side length of 6m:

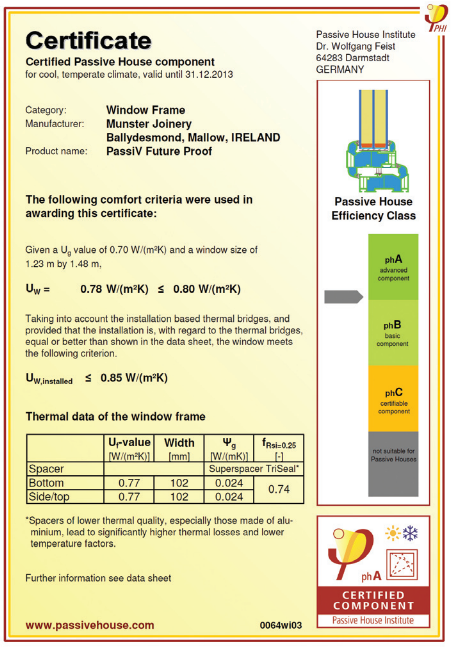
- area of one side = (6 x 6)
- total area = 6 x (6 x 6) = 216m^2
- volume = 6 x 6 x 6 =216 m^3
- compactness ratio = surface area ÷ volume = 216/216 = 1.0
- 1.0 > 0.7 – therefore does not meet Passivhaus recommendation.

For a regular cube with a side length of 10m:

- area of one side = (10 x 10)
- total area = 6 x (10 x 10) = 600m^2
- volume = 10 x 10 x 10 = 1,000m^3
- compactness ratio = surface area ÷ volume = 600/1,000 = 0.6
- 0.6 < 0.7 – therefore meets Passivhaus recommendation.



24.13 Compactness: a compact design reduces energy loss.



Certificate

Certified Passive House component
for cool, temperate climate, valid until 31.12.2013

Passive House Institute
Dr. Wolfgang Feist
64283 Darmstadt
GERMANY

Category: **Window Frame**
Manufacturer: **Munster Joinery**
Ballydesmond, Mallow, IRELAND
Product name: **PassiV Future Proof**

The following comfort criteria were used in awarding this certificate:

Given a U_g value of 0.70 W/(m²K) and a window size of 1.23 m by 1.48 m,

U_W = **0.78 W/(m²K) ≤ 0.80 W/(m²K)**

Taking into account the installation based thermal bridges, and provided that the installation is, with regard to the thermal bridges, equal or better than shown in the data sheet, the window meets the following criterion.

$U_{W,installed}$ **≤ 0.85 W/(m²K)**

Thermal data of the window frame

	U_f-value [W/(m²K)]	Width [mm]	Ψ_g [W/(mK)]	$f_{Rsi=0.25}$ [-]
Spacer			Superspacer TriSeal*	
Bottom	0.77	102	0.024	0.74
Side/top	0.77	102	0.024	

*Spacers of lower thermal quality, especially those made of aluminium, lead to significantly higher thermal losses and lower temperature factors.

Further information see data sheet

Passive House Efficiency Class

phA advanced component
phB basic component
phC certifiable component
not suitable for Passive Houses

phA
CERTIFIED COMPONENT
Passive House Institute

www.passivehouse.com 0064wi03

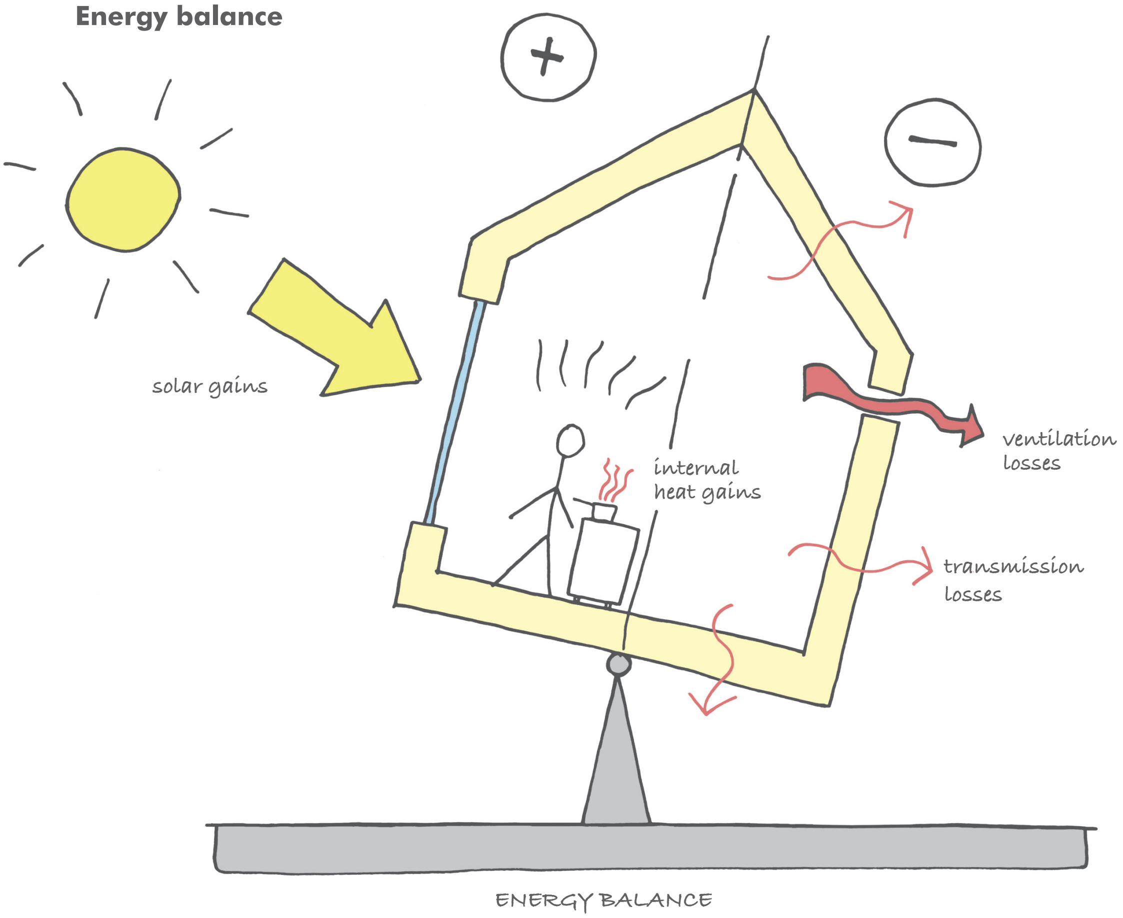
24.12 Certified component: certificate for a window.

Certified components

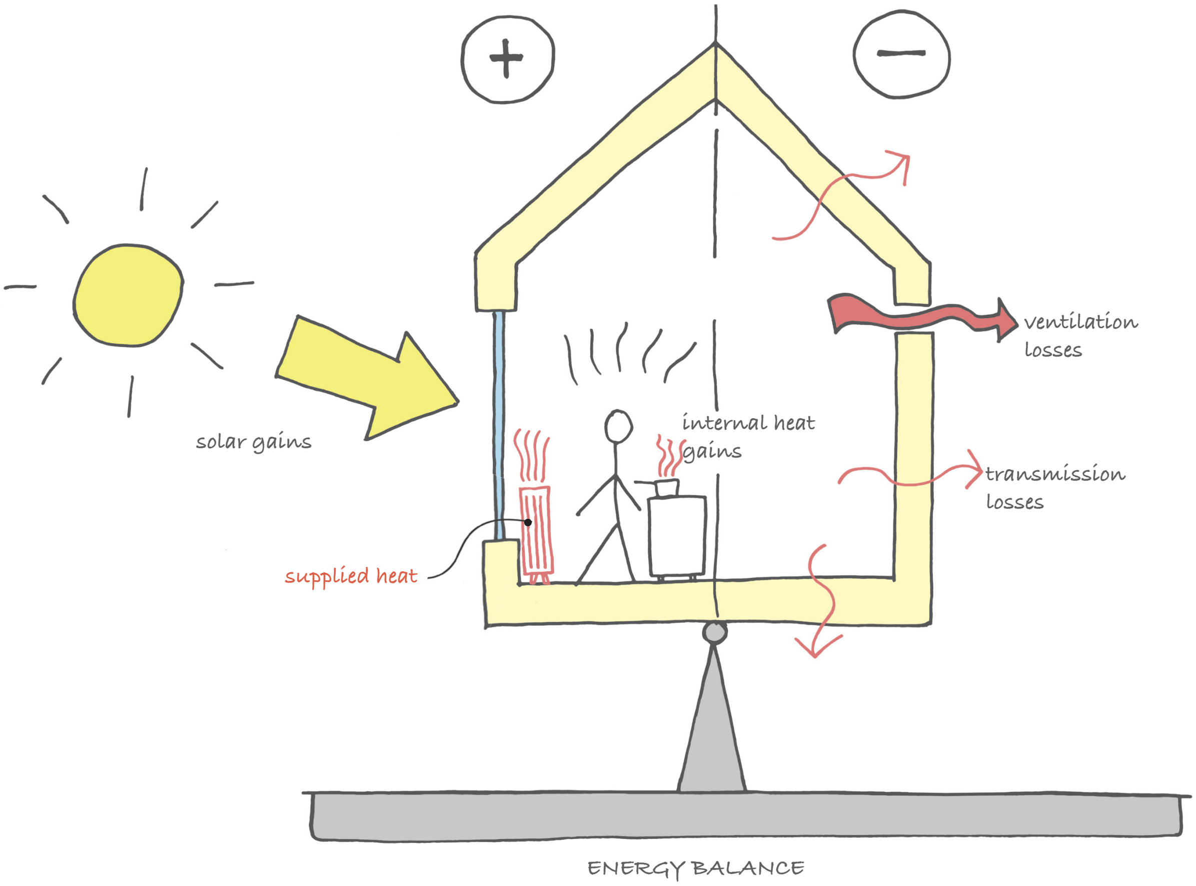
Components such as windows, doors and ventilation units that are used in passive houses can be submitted for certification to the Passivhaus Institute in Germany. Each product submitted is subjected to rigorous tests to ensure it performs as designed. For example, a window will only be certified as installed in a particular wall buildup. So the certificate will include detailed installation drawings showing precisely how the window is to be installed on site to ensure optimal performance.

Certified components do not have to be used in the construction of a passive house. However, when uncertified products are used, the Passivhaus Institute will only allow 75% of the manufacturer's claimed energy performance when entering figures in the passive house planning package for certification. This is to guard against exaggerated claims by manufacturers.

Energy balance



24.14 Energy balance: in cool climates the losses 'outweigh' the gains ... so we supply heat.



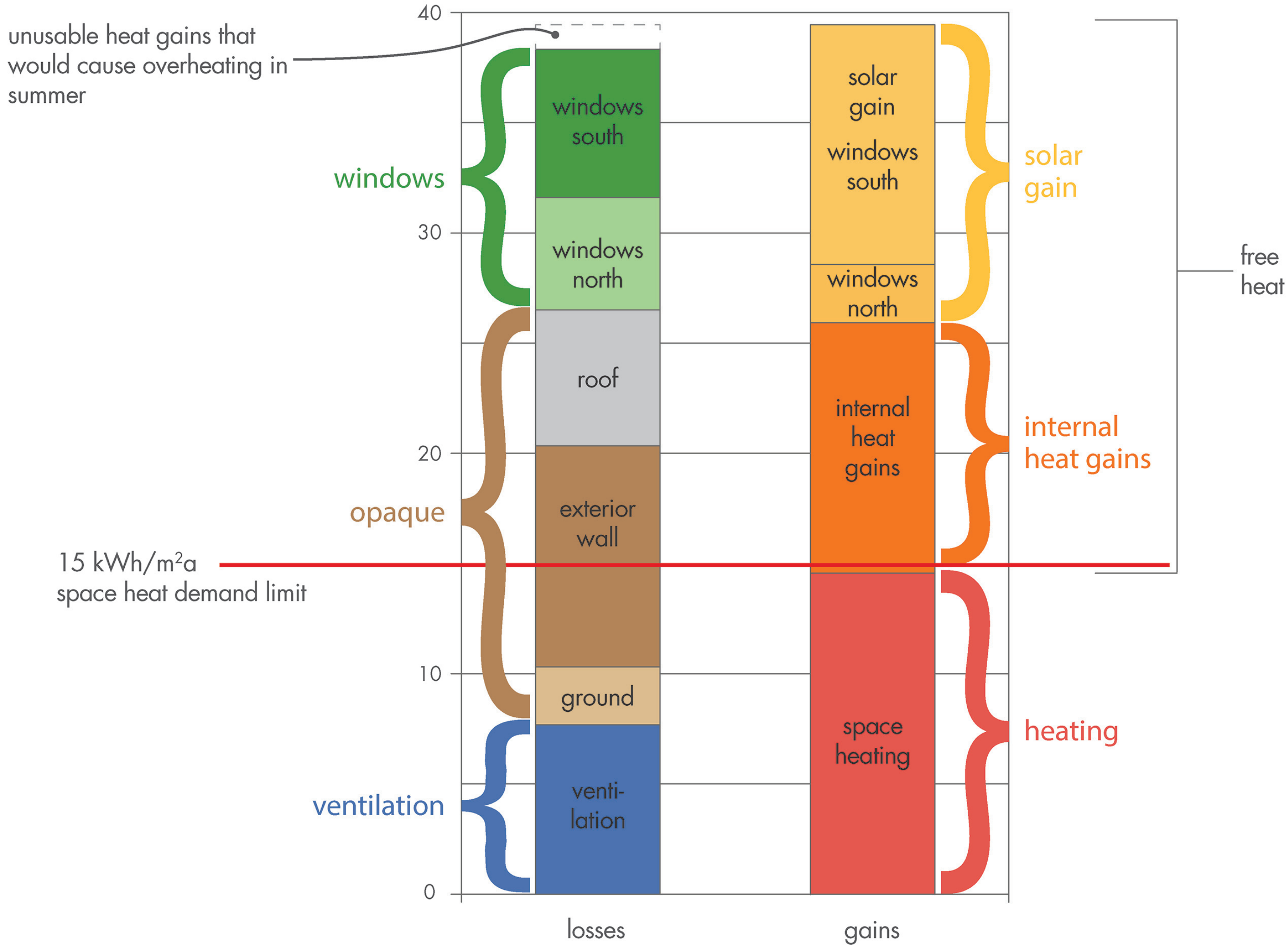
24.15 Energy balance: supplied heat brings the system into balance – the Passivhaus limit is 15 kWh/m^{2}a.

The law of energy conservation states that the sum of all heat losses must equal the sum of all heat gains. In a typical home energy is gained from the sun and from people and appliances inside the home. These are called 'solar heat gains' and 'internal heat gains'. Energy is lost through the building fabric and through air leaving the building. These are called 'transmission losses' and 'ventilation losses'. In cool climates the total losses exceed the total gains and the difference must be made up by the heating system so that the law of energy conservation is satisfied. In a Passivhaus, this heating demand is limited to 15 kWh/(m^2a).

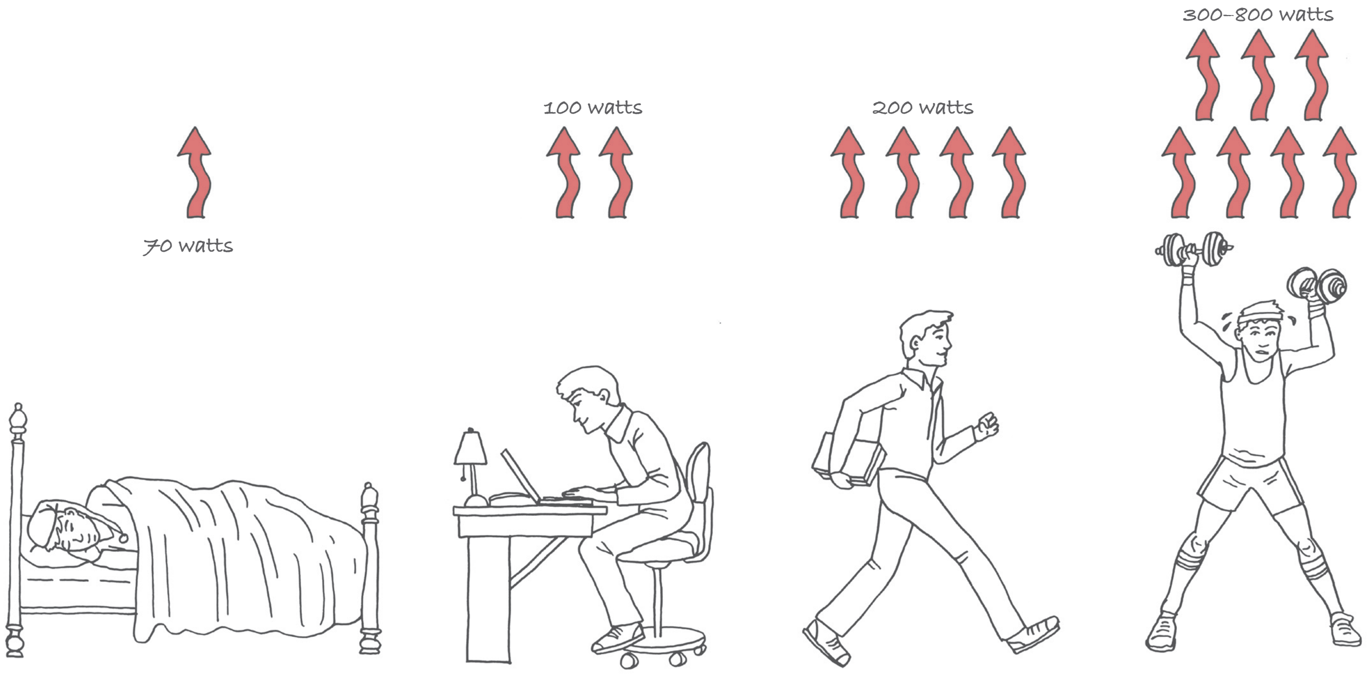
KEY PRINCIPLES

Energy balance: in a cool climate (e.g. Ireland) the losses always outweigh the gains over the course of a year. Heat energy must be supplied to bring the system into balance – this is the space heating demand.

space heat demand = (transmission losses + ventilation losses) – (solar gains + internal heat gains)



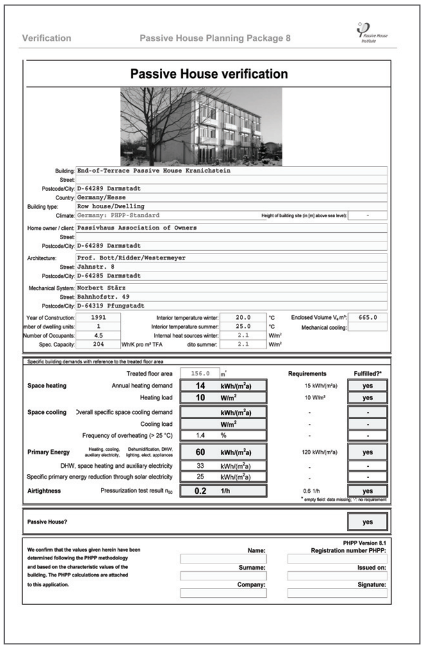
24.16 Energy balance: losses minus gains equal heating requirement.



24.17 Internal heat gains: the human body (core temperature 37°C) is constantly emitting heat energy.

Passivhaus planning package

While all the calculations required during the design phase of a Passivhaus project are completed automatically in the PHPP, it is important to have a basic understanding of what is being calculated and how this influences the design process.


Verification Passive House Planning Package 8

Passive House verification

Building: End-of-Terrace Passive House Kranichstein
Postcode/City: D-64289 Darmstadt
Country: Germany/Hesse
Building type: Row house/Dwelling
Climate: Germany: PHPP-Standard
Home owner / client: Passivhaus Association of Owners
Postcode/City: D-64289 Darmstadt
Architecture: Prof. Bott/Ridder/Westermeyer
Street: Jahnstr. 8
Postcode/City: D-64285 Darmstadt
Mechanical System: Norbert Stärz
Street: Bahnhofstr. 49
Postcode/City: D-64319 Pfungstadt

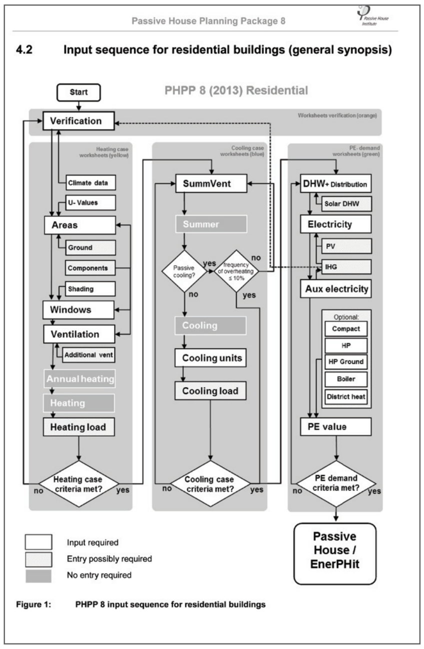
Year of Construction: 1991 | Interior temperature winter: 20.0 °C | Enclosed Volume: 665.0
Number of dwelling units: 1 | Interior temperature summer: 25.0 °C
Number of Occupants: 4.5 | Internal heat sources winter: 2.1 W/m²
Spec. Capacity: 204 Wh/K pro m² TFA | ditto summer: 2.1 W/m²

			Requirements	Fulfilled?
	Treated floor area	156.0 m²		
Space heating	Annual heating demand	14 kWh/(m²a)	15 kWh/(m²a)	yes
	Heating load	10 W/m²	10 W/m²	yes
Space cooling	Overall specific space cooling demand	kWh/(m²a)	-	-
	Cooling load	W/m²	-	-
	Frequency of overheating (> 25 °C)	1.4 %	-	-
Primary Energy	Heating, cooling, dehumidification, DHW, auxiliary electricity, lighting, electr. appliances	60 kWh/(m²a)	120 kWh/(m²a)	yes
	DHW, space heating and auxiliary electricity	33 kWh/(m²a)	-	-
	Specific primary energy reduction through solar electricity	25 kWh/(m²a)	-	-
Airtightness	Pressurization test result n_{50}	0.2 1/h	0.6 1/h	yes

Passive House? yes

We confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The PHPP calculations are attached to this application.

Name: | Surname: | Company: | PHPP Version 8.1 | Registration number PHPP: | Issued on: | Signature:



24.18 Passivhaus Planning Package (PHPP): summary page and workflow.

The PHPP allows a designer to calculate, during the design stage, the exact energy performance of the house. The designer has complete control over every aspect of the design and can accurately calculate how changes to the design will affect the energy performance of the home.

The information required for the PHPP is much more detailed than that required for DEAP. It is the greater amount and accuracy of the information used that makes the PHPP so much more accurate than DEAP. Practice has shown that the actual performance of a passive house in use in usually extremely close to the results calculated using the PHPP at the design stage.

When the PHPP process is complete the designer has several key indicators of energy performance, including space heating demand, heating load and primary energy demand.

KEY PRINCIPLES

The benefits of using the PHPP include:

- better design outcomes – the house design can be modified to optimise its energy efficiency
- different energy efficiency measures can be tested to establish which provide(s) the best result
- problems can be anticipated before they arise, which reduces costly errors on site
- changes to the design that are suggested on site can be tested to see what impact they might have on overall energy efficiency
- reduction in the amount of energy the home consumes
- reduction in CO_2 emissions.

REVISION EXERCISES

1 Explain the purpose of the building regulations.
2 Outline the improvement in energy and emissions standards that has occurred through revisions to TGD L.
3 Describe the requirement for renewable energy generation in TGD L and give one example of how this can be achieved.
4 Describe, using a neat annotated sketch, the seven principles of Passivhaus design.
5 Explain the concept of energy balance.