As described earlier, the energy performance of a building is calculated and compared with the requirements for the chosen Minergie system. The calculations are then sent to a Minergie administrator who has been authorised to handle the particular system that has been chosen. The administrator checks the calculations and sends a provisional Minergie certificate to the property owner. When a building has been completed, and sometimes even during construction, around one in every ten buildings is checked to verify that it meets the levels indicated by the calculations before the final certificate is sent to the property owner. In the case of Minergie-P certification an airtightness test is carried out on the climate shell/building envelope. The person carrying out the test certifies that the work has been carried out in accordance with the chosen Minergie system.

4.2.3 MINERGIE – ORIGIN AND ORGANISATION

The Minergie brand name is administered by the non-profit organisation Minergie. This organisation is primarily financed by certification fees, membership and partnership fees, sponsoring and by the Swiss state. Its head office is located in Bern.

Members and partners

Companies and organisations can choose to become Minergie members or partners. They are then mentioned on the Minergie website in the list of companies and organisations that are certified to carry out work according to the Minergie concept. Examples of such firms include architects, building contractors, painters, floor layers, etc. These companies are authorised to use the Minergie logotype in connection with their marketing activities.

4.3 Passive House

The following information is based on the content posted on the Passive House websites www.passiv.de and www.igpassivhus.se.

Passive House (Passivhaus) certification originated in Germany, where the system was created by Dr. Wolfgang Feist in 1998. Basically, the Passive House system is based on Passive House technology whereby heating losses (due to transmission and ventilation losses) are minimized. This leads to a low remaining heat demand that can be met by a relatively small heating system, often located in the supply air system. In short, the technology requires the construction of airtight and well-insulated climate shells/building envelopes as well as installing windows and doors with low transmission losses. The remaining heat demand is often supplied via the supply air,

which is heated using heat recovery from the extract air. Numerous buildings around the world have been built using passive building technology, although not all of these have chosen to be certified according to the Passive House certification system. At present, around 4,400 building units (one unit = 100 m^2) have been certified around the world.

4.3.1 PASSIVE HOUSE – THE BASICS

All types of buildings can be certified using the Passive House system as long as they fulfil the stipulated criteria.

Passive House certification can be used for new constructions, refurbished buildings and existing buildings, if the specific requirements are met. When a building is refurbished it is possible to gain a slightly different type of certification if the refurbishment has been carried out using 'Passive house components'. The two types of certification are called 'Quality-Approved Passive House' and 'Quality-Approved Modernisation with Passive House Components'.

It is not possible to certify individual flats in a block or individual premises in a multi-storey building and, when refurbishing a building the building must comprise at least an outer wall, a roof and a foundation slab or a suspended floor.

Passive House certification systems

As mentioned above, there are two ways in which a passive house can be certified and these are, in turn, divided into systems for dwellings and non-domestic buildings. Refurbishment criteria, however, are the same for all types of buildings. Passive House certification systems do not have a scale of ratings as in many other energy and environmental certifications systems. Either the building receives its certification or it doesn't.

4.3.2 WHAT DOES PASSIVE HOUSE ASSESS?

Passive House is a system that assesses a building's energy performance. The system does not, therefore, assess the other environmental questions described for the environmental certification systems described in Chapter 3. In order to be certified, data and calculations carried out in the PHPP (Passive House Planning Package) have to be reported, including U-values, the designing out of thermal bridges, types of windows and heat demands. In order to gain Passive House certification, the performance requirements in the following areas must be met:

1) Specific annual heat demand or design heat power demand

2) Total specific primary energy demand
3) Airtightness
4) Comfort cooling

Passive House requirements focus primarily on the heating performance of a building. The heating demand must first be minimized after which the heating system is chosen. As the choice of heating system and use of domestic hot water do not affect the quality of the building these are not included in the heat demand under point 1) above. On the other hand, the choice of system for production of heat and domestic hot water are taken into account in the primary energy demand in point 2) above.

The requirements that must be fulfilled to attain Passive House certification are the same for the whole world, and are independent of, for example, the indoor climate. This means that buildings must be designed differently depending on the prevailing outdoor climate conditions.

Table 4.8 lists the energy performance requirements for dwellings, non-residential buildings and refurbished buildings. The PHPP, Passive House Planning Package, contains a check list, a calculation program and handbook that can be used to check the criteria in Table 4.8.

Table 4.8 Criteria for Passive House certification. The area (m^2) corresponds to the usable area (net living area/usable area within the climate shell/building envelope).

Criteria	Dwellings	Non-residential	Refurbished*
Specific annual heating demand or heat power demand excluding domestic hot water	15 kWh/m^2 10 W/m^2	15 kWh/m^2 10 W/m^2	25 kWh/m^2
Total weighted specific primary energy demand** including all domestic, non-domestic and end-user electric power	120 kWh/m^2	120 kWh/m^2	120 kWh/m^2
Air change rate at testing pressure of 50 Pa (η_{50} measurement)	0,6/h	0,6/h	Limit value: 1.0/h Target value: 0.6/h
Specific energy demand for comfort cooling	–	15 kWh/m^2	–

*Refurbishment of both dwellings and non-residential buildings.
**According to type of energy.

Certification after refurbishing is called 'Quality-Approved Modernisation with Passive House Components', if the requirements in Table 4.8 are fulfilled or if Passive House technologies have been used for the relevant parts during refurbishment, so-called EnerPHit classified thermal bridge solutions. The certification 'Quality-Approved Passive House' can also be attained after refurbishing, provided that the requirements for dwellings or non-residential buildings have been fulfilled.

Passive House certification is associated with the term Passive House technology. At present (Spring 2012) there are around 37,000 buildings registered around the world that have been built using this technology. Most of the buildings have not been certified according to the Passive House system.

In addition to the criteria in Table 4.8 above, buildings that are built using Passive House technologies should, as far as possible, also follow the guidelines and recommendations in Table 4.9 below.

Table 4.9 Guidelines and recommendations to achieve Passive House certification.

Criteria	Dwellings	Non-residential	Refurbishment*
U-values for opaque building components	< 0,15 W/m²K	< 0,15 W/m²K	External insulation: < 0,15 W/m²K Internal insulation: < 0,35 W/m²K
U-values for Windows and external doors	U < 0,80 W/m²K (windows) U < 0,85 W/m²K (installed windows)	U < 0,80 W/m²K (windows) U < 0,85 W/m²K (installed windows)	U < 0,80 W/m²K (windows) U < 0,85 W/m²K (installed windows)
Thermal bridges	< 0,01 W/mK	< 0,01 W/mK	All thermal bridges must be accounted for and approved
Upper temperature in summer	Max 10% of the annual hours > 25°C	Max 10% of the annual hours > 25°C	Max 10% of the annual hours > 25°C
Ventilation Heat recovery Electric power	η> 75% SFP < 1,62 kW/(m³/s)	η> 75% SFP < 1,62 kW/(m³/s)	η> 75% SFP < 1,62 kW/(m³/s)
Noise	Max 25 dB(A) in living spaces, max 35 dB(A) in clothes closets, ventilation plant rooms, etc	Max 25 dB(A) in occupied spaces, max 35 dB(A) in plant rooms and secondary areas	Max 25 dB(A) in living spaces, max 35 dB(A) in clothes closets,ventilation plant rooms, etc

*Refurbishment of both dwellings and non-residential buildings.

PHPP includes tools for:

- Calculating transmission losses through windows and the solar heat contribution
- Calculating heat power demand
- Calculating heating demand (annual and monthly use)
- Calculating and assessing heating systems using primary energy factors
- Calculating airflows, different operating conditions and degrees of heat recovery
- Calculating heat distribution losses and domestic hot water use

4.3.3 PASSIVE HOUSE IN PRACTICE

When a building is certified using Passive House systems the planning and calculations used for the building are carried out using the PHPP. The national authorised Passive House certifier is then contacted. This person represents the Passive House Institute in Darmstadt, which is also responsible for the certification. In addition to the calculations, drawings and commissioning reports that have to be submitted, an airtightness test must also be carried out. Passive House certification can only be awarded when the building is ready for its tenants to move in and all the criteria have been verified and approved.

The PHPP software is required in order to carry out the certification work and this can be bought via the Passive House website. Three different criteria documents are available:

- 'Quality-Assured Passive House' – with certification criteria for dwellings
- 'Quality-Assured Passive House' – with certification criteria for non-domestic buildings
- 'Quality-Assured Modernisation using Passive House Components'– with certification criteria for components

All the assessment criteria can be found in the above mentioned criteria documents. Information and guidelines are also available to help the builder fulfil the requirements. There are also recommendations regarding the involvement of energy coordinators or trained passive house building experts who can help during the project. However, this is not a requirement.

As shown in Table 4.8 above, there are requirements regarding the airtightness of the climate shell/building envelope and an airtightness test must be carried out to verify that the building meets these requirements. Prefer-

ably the first test is carried out at a point in time when the airtight materials are still accessible, in case improvements have to be carried out. When the building is completed a final airtightness test is carried out. This final test is the one that is included in the certification and is recorded in the PHPP.

It is a good idea to follow the eleven steps in the following check list in order to gain Passive House certification. The check list functions as a guide when carrying out the work and can be purchased via the Passive House website. The steps are as follows:

Step 1. Site planning
Step 2. Pre-planning
Step 3. Building permission planning
Step 4. Planning for building elements
Step 5. Planning for ventilation systems
Step 6. Planning for other building services
Step 7. Design of the building structure
Step 8. Design of the ventilation system
Step 9. Design of other building services
Step 10. Introduction for owners and tenants
Step 11. Certification

4.3.4 PASSIVE HOUSE – ORIGIN AND ORGANISATION

Passive House certification was originally conceived in Germany where it was developed by Dr. Wolfgang Feist. The certificate for a Passive House includes the initials PHI, which stand for Passive House Institute, as part of the logotype.

In a similar way to the other certification systems described in this book, it is possible to become a member of the organisation behind the Passive House certification system. To become a member of an international or national Passive House organisation a manufacturer's products or a property owner's building must be quality assured and the steps for further training and information retrieval followed.