ACTIVE HOUSE - the specifications

for RESIDENTIAL BUILDINGS

2nd edition

The Specificat

Index – specifications

Creating Active Houses today

Today, the world is facing many environmental challenges. Natural resources are scarce, global warming needs to be tackled and well-known sources of energy are being depleted.

Meanwhile, there is a need to meet essential human needs for a healthy, comfortable indoor climate. Active House seeks to respond to these needs.

These specifications represent the next generation in sustainable buildings with a focus on user well-being.

This report outlines the specifications for designing an Active House, a building that combines energy efficiency with specific attention to user health and comfort, indoor climate and the environment. Its scope is residential buildings. This specification outlines the vision behind Active House, lays down the key principles that have influenced the evolution of the Active House concept and outlines the technical specifications of an Active House.

This definition and decription of an Active House is intended as a guideline at an international level. It seeks innovative technical approaches whilst introducing goals of architectural quality and environmental design – at the same time as providing energy efficiency.

Living in an Active House should be a step forward and not present any obstacles for the occupants, whether they be children, their parents or grandparents – or people with special needs and physical challenges.

Active House is a vision of how to create sustainable buildings anywhere in the world. It really comes to life and becomes a viable proposition in the second generation of Active House specifications. There are now three steps:

The first is The Principles, providing an overview of the vision, thinking and principles behind an Active House.

The second step is The Specification, gaining the insight and knowledge needed to draw up the requisite technical specifications and design concept for an Active House. They include the important issues to consider when creating an Active House. These issues are often processoriented, some provide guidance on how to achieve the performance levels described in the technical specifications, and some describe the holistic approach of the design (biodiversity, local culture and location).

The third step is The Guidelines, addressing the process of planning the construction of an Active House.

These specifications for building an Active House seek to provide an answer for the three main challenges facing the building industry today: comfort, energy and environment.



The specifications focus on providing guidelines to constructing an Active House: a building that creates healthier and more comfortable lives for its occupants without impacting negatively on the climate – moving us towards a cleaner, healthier and safer world.

Members of the Active House Alliance have shared knowledge, experiences and feedback on the first edition of the specifications to produce this second edition.

This edition, like the first, was developed using an open source model. It involved online debates and contributions as well as offline meetings and workshops with broad participation across the building industry globally.

This edition has been substantially improved, especially in terms of usability. Changes have been made to making the criteria/specification more concise and relevant. The content has also been changed, in Environment especially.

We are pleased to present these principles and specifications for Active House. And are looking forward to seeing more and more of them flourish around the world.

Brussels, 5 March 2013

Vision

BUILDINGS THAT GIVE MORE THAN THEY TAKE

Active House is a vision of buildings that create healthier and more comfortable lives for their occupants without impacting negatively on the climate – moving us towards a cleaner, healthier and safer world.

The Active House vision defines highly ambitious long-term goals for the future building stock. The purpose of the vision is to unite interested parties based on a balanced and holistic approach to building design and performance, and to facilitate cooperation on such activities as building projects, product development, research initiatives and performance targets that can move us further towards the vision.

The Active House principles propose a target framework for how to design and renovate buildings that contribute positively to human health and well-being by focusing on the indoor and outdoor environment and the use of renewable energy. An Active House is evaluated on the basis of the interaction between energy consumption, indoor climate conditions and impact on the environment.

Comfort – creates a healthier and more comfortable life
An Active House creates healthier and more comfortable indoor conditions for the occupants, ensuring a generous supply of daylight and fresh air. Materials used have a neutral impact on comfort and indoor climate.

Energy – contributes positively to the energy balance of the building
An Active House is energy efficient. All energy needed is supplied by renewable energy sources integrated in the building or from the nearby collective energy system and electricity grid.

Environment – has a positive impact on the environment
An Active House interacts positively with the environment through an optimised relationship with the local context, focused use of resources, and its overall environmental impact throughout its life cycle.

Photo by Adam Mørk

Key principles of Active House

BUILDINGS WITH UNIQUE COMBINATION

An Active House will always be a unique combination of the three principles: Comfort, Energy and Environment. It's precisely the combination, or 'integration', of these three factors that can tell the exact story of the building's architectural quality, energy efficiency, human health, comfort and well-being, and environmental benefits. This unique integration demonstrates the ambition of the Active House.

In an Active House, the integration should provide further value to:

- the integration of the demands of comfort, energy, environment and ecology into an attractive whole
- the architectural quality and human well-being
- the interactive systems and spaces adding to human enjoyment and supporting environmentally responsive family life.

THE ACTIVE HOUSE KEY PRINCIPLES ARE AS FOLLOWS:

COMFORT

- a building that provides an indoor climate that promotes health, comfort and sense of well-being
- a building that ensures good indoor air quality, adequate thermal climate and appropriate visual and acoustical comfort
- a building that provides an indoor climate that is easy for occupants to control and at the same time encourages responsible environmental behaviour.

ENERGY

- a building that is energy efficient and easy to operate
- a building that substantially exceeds the statutory minimum in terms of energy efficiency
- a building that exploits a variety of energy sources integrated in the overall design.

ENVIRONMENT

- a building that exerts the minimum impact on environmental and cultural resources
- a building that avoids ecological damage
- a building that is constructed of materials with focus on re-use.

Photo by Adam Mørk

Active House Radar

SHOW THE AMBITION WITH THE BUILDING

An Active House is the result of efforts to actively integrate the three main principles of Comfort, Energy and Environment in the design of a building and in the finished building.

The Active House Radar shows the level of ambition of each of the three main Active House principles.

The integration of each principle describes the level of ambition of how 'active' the building has become. For a building to be considered as an Active House, the level of ambition can be quantified into four levels where 1 is the highest level and 4 is the lowest.

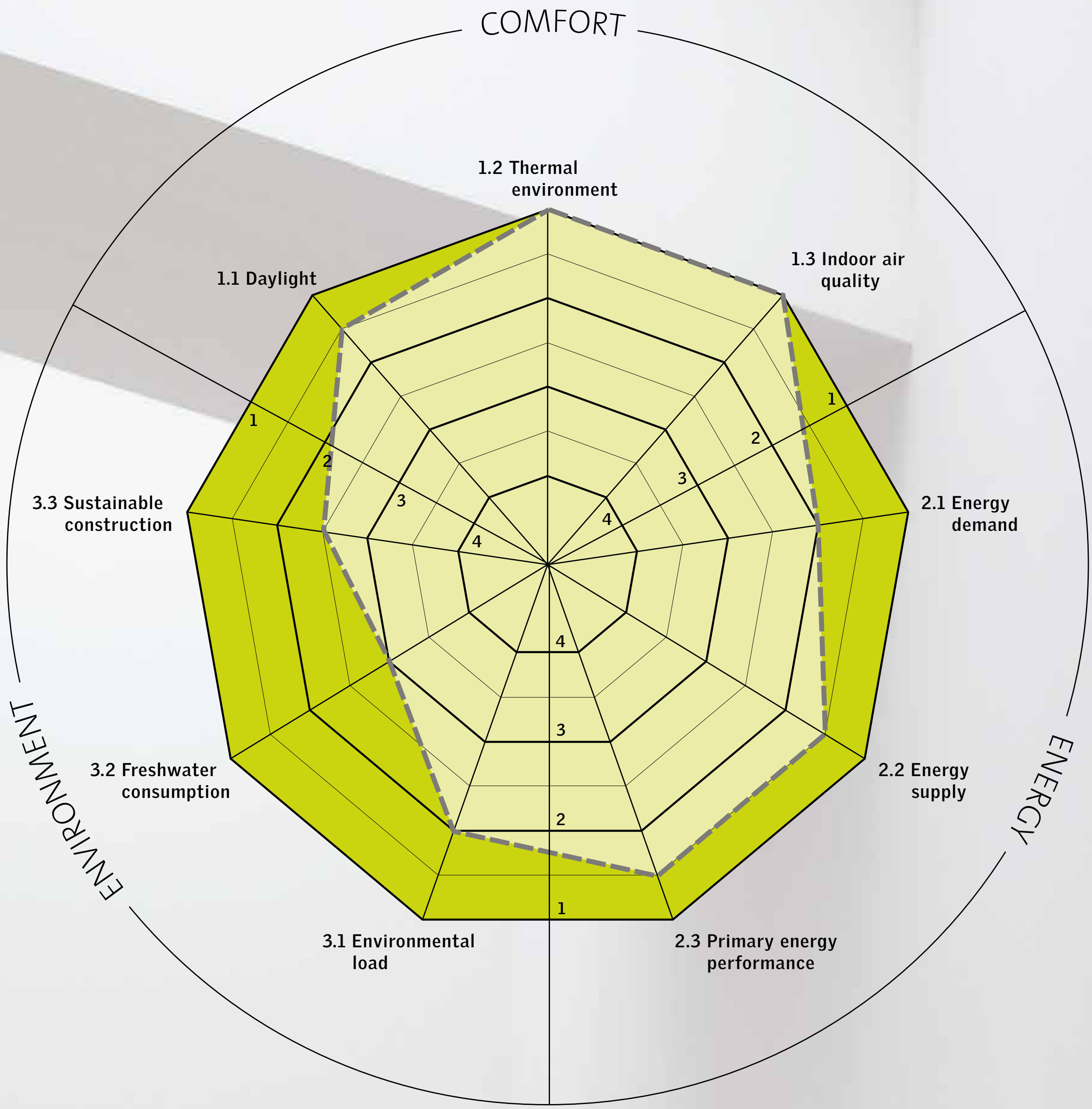
The ambitious requirement for Active House includes all nine parameters and recommends the lowest level for each of them. As long as the parameters are better or equal to the lowest level of ambition, it is an Active House within the specific parameter.

The Active House Radar to the right shows how all parameters and goals within each principle are dependent on each other.

When (re)designing a dwelling or housing complex, the basic idea is to select individual and ambitious requirements for each parameter.

The Active House Radar is a good tool for displaying the ambition reached with the building and the calculated values. When the building is inhabited, the Radar can also be a useful tool for monitoring, evaluating and improving the building. As a communication tool, it can provide clarity as to why the integration of parameters is important for creating Active Houses.

This figure shows how all parameters within each principle are balanced against each other. It also shows that the Active House parameters depend on active choice and prioritisation within each principle.



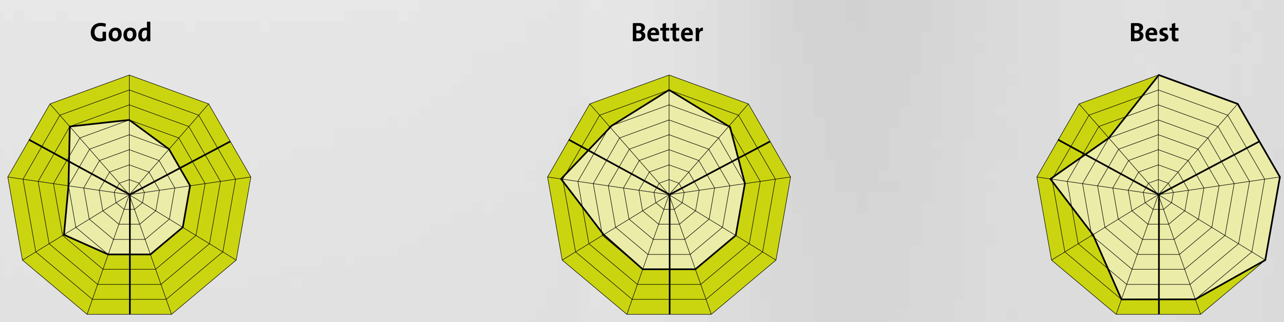


Photo by Adam Mørk

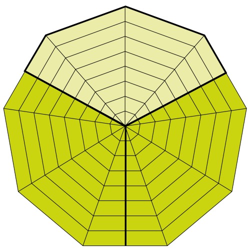
Comfort

1.0. AN ACTIVE HOUSE OFFERS EXCELLENT INDOOR COMFORT

An Active House is a building that lets in abundant daylight and fresh air, thereby improving the quality of the indoor climate. This also means that the thermal environment is of high quality.

We spend 90% of our time indoors; therefore the quality of the indoor climate has a considerable impact on our health and comfort. A good indoor climate is a key quality of an Active House. It must be an integrated part of the house design to ensure good daylight conditions, thermal environment and indoor air quality. To support this process, the parameters in the specifications must be considered.

In order to evaluate each building's indoor climate, we utilise the four levels of ambition mentioned under Active House Radar earlier. Architects and engineers can use these levels to work towards creating their own specific levels for a building.




We spend 90% of

Daylight

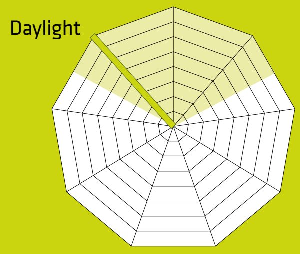
1.1. AN ACTIVE HOUSE OFFERS OPTIMAL DAYLIGHTING

Adequate lighting and especially well-designed daylight penetration provide an array of health benefits to people in buildings. High levels of daylight and an optimised view out positively influence people's mood and well-being.

In an Active House it is thus important that the building allows for optimal daylight and attractive views to the outside. Electric lighting during daytime should rarely be necessary, which should make it possible to reduce the overall energy consumption for lighting.

Evaluation method

- The amount of daylight in a room is evaluated using average daylight factor levels on a horizontal work plane (table height approx. 0.8 m). Daylight factors are calculated with a validated daylight simulation program.
- The daylight factor is assessed room by room. Each factor is weighted to give an average daylight factor for each room. The calculation should also take neighbouring buildings into account.
- The evaluation includes the living and activity zones (such as living room, work space, dining room, kitchen, bedroom or children's room).
- The room with the lowest daylight factor score sets the overall daylight factor for the building.



Daylight facto

QUANTITATIVE CRITERIA

PARAMETER	VALUE	CRITERIA	SCORE
1.1.1 Daylight factor		The amount of daylight in a room is evaluated through average daylight factor levels on a horizontal work plane: 1. DF > 5% on average 2. DF > 3% on average 3. DF > 2% on average 4. DF > 1% on average Daylight factors are calculated using a validated daylight simulation program.	
1.1.2 Direct sunlight availability		For minimum one of the main habitable rooms, sunlight provision should be available between autumn and spring equinox: 1. At least 10% of probable sunlight hours 2. At least 7.5% of probable sunlight hours 3. At least 5% of probable sunlight hours 4. At least 2.5% of probable sunlight hours The evaluation is made according to British Standard BS 8206-2:2008 “Lighting for buildings – Part 2: Code of practice for daylight”.	
		TOTAL AVERAGE:	

Thermal environment

1.2. AN ACTIVE HOUSE OFFERS AN OPTIMAL THERMAL ENVIRONMENT

A pleasant thermal environment is essential for a comfortable home. Adequate thermal comfort, both in summer and winter, enhances the mood, increases performance and, in some cases (e.g. in houses for the elderly), prevents and alleviates diseases.

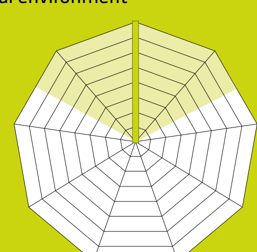
Active Houses should minimise overheating in summer and optimise indoor temperatures in winter without unnecessary energy use. Where possible, use simple, energy-efficient and easily maintained solutions.

There are no requirements for maximum temperature in the winter (heating period) and minimum temperature in the summer (cooling period), as these are related to the behaviour of the users of the building. This is a deviation from EN15251.

Evaluation method

- To objectify the risk of overheating, a dynamic thermal simulation tool is used to determine hourly values of indoor operative temperature at room level (e.g. in living rooms, kitchens and bedrooms). In dwellings without mechanical cooling systems (like central air conditioning), adaptive temperature limits are used in the summer months. This means that the maximum allowable temperature inside is linked to the weather outside: limits go up during warmer periods.
- Requirements should be met for a minimum of 95% of occupied time.
- The room with the lowest score determines the overall score for the individual parameter.

Thermal environment



QUANTITATIVE CRITERIA

PARAMETER	VALUE	CRITERIA	SCORE
1.2.1 Maximum operative temperature		The maximum indoor temperature limits apply in periods with an outside T_{rm} of 12°C or more. For living rooms, kitchens, study rooms, bedrooms etc. in dwellings without mechanical air conditioning and with adequate opportunities for natural (cross or stack) ventilation, the maximum indoor operative temperatures are: 1. $T_{i,o} < 0.33 \times T_{rm} + 20.8$°C 2. $T_{i,o} < 0.33 \times T_{rm} + 21.8$°C 3. $T_{i,o} < 0.33 \times T_{rm} + 22.8$°C 4. $T_{i,o} < 0.33 \times T_{rm} + 23.8$°C T_{rm} is the Running Mean outdoor temperature as defined in 'chapter 3.11 External temperature, running mean of EN 15251:2007'. For living rooms etc. in residential buildings with air conditioning, the maximum operative temperatures are: 1. $T_{i,o} < 25.5$°C 2. $T_{i,o} < 26$°C 3. $T_{i,o} < 27$°C 4. $T_{i,o} < 28$°C For bedrooms (especially at night time), a 2°C lower value should preferably be used than indicated above as people are more sensitive to high temperatures when sleeping or trying to fall asleep. Also, in kitchens higher temperatures than indicated can be allowed periodically, e.g. during cooking activities. The system should be designed to achieve the values, the users can however choose other settings. Reference: EN 15251:2007.	
1.2.2 Minimum operative temperature		The minimum indoor temperature limits apply in periods with an outside T_{rm} of 12°C or less. For living rooms, kitchens, study rooms, bedrooms etc. in dwellings, the minimum operative temperatures are: 1. $T_{i,o} > 21$°C 2. $T_{i,o} > 20$°C 3. $T_{i,o} > 19$°C 4. $T_{i,o} > 18$°C The system should be designed to achieve the values, the users can however choose other settings.	
		TOTAL AVERAGE:	

Indoor air quality

1.3. INDOOR AIR QUALITY SHOULD BE OPTIMAL IN AN ACTIVE HOUSE

Good indoor air quality can prevent humans from getting mucous membrane irritation, asthma and allergy. It can also contribute to prevent some cardiovascular diseases. High indoor air quality helps to avoid odour problems, which can positively affect the overall well-being of the building's occupants.

Active Houses should provide good air quality for the occupants while minimising energy use e.g. for ventilation. This means that natural ventilation should be used where possible, or so-called hybrid systems (combination of natural and mechanical ventilation) as these systems provide the best energy performance.

Humidity only has a small effect on thermal sensation and perceived air quality in the rooms of sedentary occupancy; however, long-term high humidity indoors will cause microbial growth.

Active Houses should provide good indoor humidity levels for occupied spaces and set maximum requirements for indoor humidity. To avoid problems related to dampness and mould, it shall be guaranteed that there is sufficient extraction in rooms with periodic damp-production peaks (especially kitchens, bathrooms and toilets). The minimum exhaust air flow in these 'wet rooms' should be achievable as specified in national building codes or guidelines and the exhaust systems shall secure that the daily limit value for relative humidity in wet rooms such as bathrooms is below 80%.

Requirements

- Fresh air supply can be evaluated by examining indoor CO_2 concentrations at room level during occupancy. CO_2 is a good indicator of the amount of bio-effluents, pollutants from humans, in the air.
- Hourly values of CO_2 concentrations should be determined with a dynamic simulation tool, using standard occupancy rates (e.g. two persons in a master bedroom) and standard CO_2 production per person.
- The requirements should be met for a minimum of 95% of occupied time.
- The classification of the air quality is determined as the use-time-weighted hourly average of all room scores.
- The minimum requirements as specified in national codes should always be followed.

QUANTITATIVE CRITERIA

PARAMETER	VALUE	CRITERIA	SCORE
1.3.1 Standard fresh air supply		The fresh air supply shall be established according to the below limit values for indoor CO_2 concentration in living rooms, bedrooms, study rooms and other rooms with people as the dominant source and that are occupied for prolonged periods: 1. 500 ppm above outdoor CO_2 concentration 2. 750 ppm above outdoor CO_2 concentration 3. 1000 ppm above outdoor CO_2 concentration 4. 1200 ppm above outdoor CO_2 concentration	

Energy

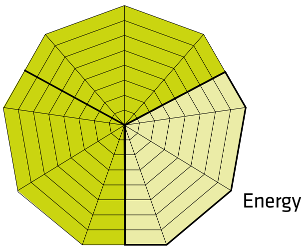
2.0. ACTIVE HOUSES REALISE THE GREAT POTENTIAL TO USE ENERGY MORE EFFICIENTLY IN BUILDINGS

An Active House is energy efficient and supplied by renewable energy sources integrated in the building or from the nearby collective energy system and electricity grid.

Globally, heating, cooling and electricity in buildings account for 40% of all energy consumption. Considering the total energy consumption throughout the whole life cycle of a building, the energy performance and energy supply are important issues in the concern about climate changes, reliability of supply and reduced global energy consumption.

The design, orientation and products for an Active House are optimised to use as little energy as possible and to utilise renewable energy sources.

The design of an Active House has to be based on the Trias Energetica approach to sustainable design. The main focus of the concept is the fact that the most sustainable energy source is saved energy.



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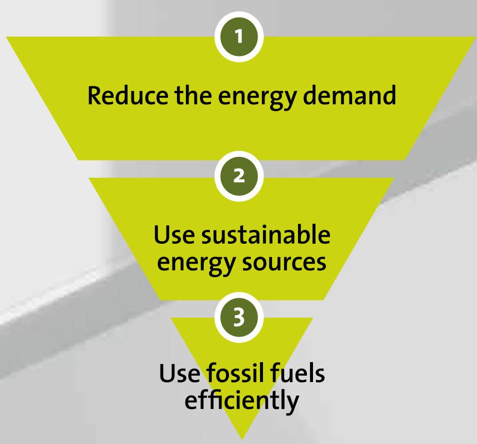

1. Minimise the energy demand of the building. To do so, use energy-efficient solutions and architectural measures, such as orientation, materialisation and shape of the building.

2. Source the remaining energy requirement as much as possible from renewable and CO_2-free energy sources, either on the building, the plot or from the nearby energy system.

3. Any remaining energy demand may be met by using fossil fuels through highly-efficient energy-conversion processes.

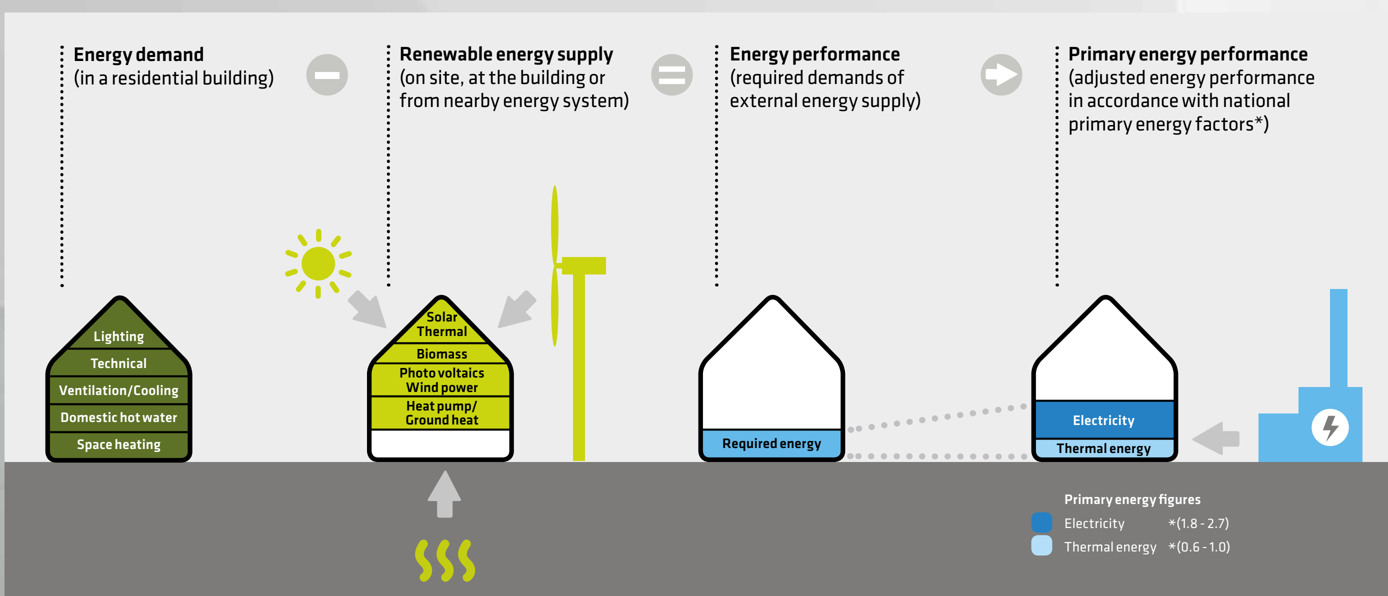

Photo by Adam Mørk

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Energy demand

2.1. ACTIVE HOUSES KEEP THE ENERGY DEMAND LOW

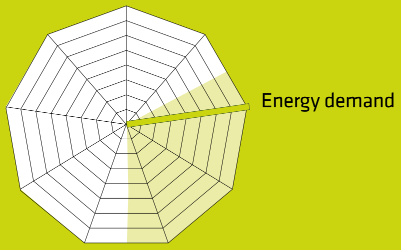
In an Active House, the energy demand is calculated by including all energy needed for the building (including space heating, water heating, ventilation, air conditioning including cooling, technical installations and electricity for lighting). New buildings will typically have a low energy demand, while renovated buildings allow for a higher demand.

In the design phase, it is important to focus on minimising the use of energy as well as heat loss from the building. This includes the transmission loss through constructions, thermal bridges etc.

It is crucial to adopt a holistic approach to the use of energy. This means, for example, that an Active House should be optimised with maximum use of solutions that are not energy intensive.

Such solutions could be solar gain, daylight, natural ventilation, ventilative cooling etc. This approach is also important in regards to the need for cooling of the building. Shading of exposed facades and windows shall be established either as permanent summer shading or dynamic shading, such as intelligent insulation of glazed facades.

The definition of the heated floor area shall follow the national definition.



Evaluation method

- The annual energy demand includes energy demand for space heating, water heating, ventilation, air conditioning including cooling, technical installations and electricity for lighting.
- The annual energy demand shall follow the national calculation methodology. The calculation of heated floor area shall follow the national method.
- The requirements to individual products and construction elements (i.e. minimum thermal resistances, maximum thermal bridge effects and airtightness) shall at least follow requirements set in national building regulations.

QUANTITATIVE CRITERIA

PARAMETER	VALUE	CRITERIA	SCORE
2.1 Annual energy demand		1. ≤ 40 kWh/m^2 2. ≤ 60 kWh/m^2 3. ≤ 80 kWh/m^2 4. ≤ 120 kWh/m^2	

Energy supply

100% of the energy

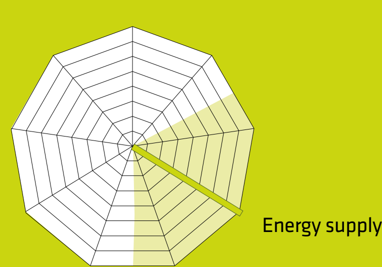
2.2. RENEWABLE ENERGIES SUPPLY AN ACTIVE HOUSE

The goal is that the energy supply to an Active House shall be based on renewable and CO_2-neutral energy sources in accordance with the energy performance classification chosen.

There are no specific requirements to where and how the renewable energy is produced. It must, however, be documented that the energy comes from renewable energy in the energy system.

Evaluation method

- The annual energy supply from renewable energy and CO_2-free energy sources shall be calculated and divided into the different sources (solar thermal, heat pumps, biomass, PV, wind etc).
- The definition of renewable energy sources follows the EU Directive on the promotion of the use of energy from renewable sources (2009/28/EC of 23 April 2009).
- Requirements to performance of the individual renewable source shall follow the requirements in national building legislation. As an alternative to national requirements, the requirement in the EU Directive on the promotion of the use of energy from renewable sources (2009/28/EC of 23 April 2009) can be used.
- Renewable energy sources can either be in the building, on the site, from a nearby energy system or electricity grid and can be a mix of these sources.
- The definition of nearby system and boundaries for renewable energy on the plot follows the national or European definitions.



QUANTITATIVE CRITERIA

PARAMETER	VALUE	CRITERIA	SCORE
2.2 Origin of energy supply		1. 100% or more of the energy used in the building is produced on the plot or in a nearby system 2. ≥ 75% of the energy used in the building is produced on the plot or in a nearby system 3. ≥ 50% of the energy used in the building is produced on the plot or in a nearby system 4. ≥ 25% of the energy used in the building is produced on the plot or in a nearby system	

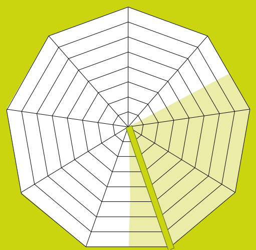
Primary energy performance

2.3. ACTIVE HOUSES INCLUDE ANNUAL PRIMARY ENERGY PERFORMANCE

The annual primary energy performance shall be based on national figures on primary energy. The calculation shall include energy demand for the building as well as the energy supply from renewable energy.

Evaluation method

- The primary energy performance = (energy used – renewable energy supply) x national primary energy factors.
- The energy demand and the energy produced by renewable sources must be monitored on a yearly basis. Metering devices are to be used for all types of energy production/consumption at the building level.
- The annual energy performance evaluation shall specify the supply from:
  - individual renewable energy sources integrated into the building
  - energy supply from local energy system and the share of renewable energy as well as the CO_2 emissions from the local energy system.
- Calculation of primary energy and CO_2-emissions shall be based on the national calculation methodology, using nationally-adopted efficiency/conversion and emission factors, as well as climate data.



QUANTITATIVE CRITERIA

PARAMETER	VALUE	CRITERIA	SCORE
2.3 Annual primary energy performance		1. < 0 kWh/m² for the building 2. 0-15 kWh/m² for the building 3. 15-30 kWh/m² for the building 4. ≥ 30 kWh/m² for the building	

Environment

3.0. ACTIVE HOUSES AIM TO HAVE A POSITIVE IMPACT ON THE ENVIRONMENT

An Active House will have an impact on the environment – it should be as positive as possible. This means that any harm to environment, soil, air and water should be minimised.

The challenges we face regarding the environment are a reality on a local, regional and global level. Global environmental resources are under pressure from over-consumption and pollution. The pressure is felt at a regional and a local level too.

When developing an Active House, it is important to ensure that such challenges are considered at both global, regional and local levels. This is important in order to ensure a new generation of buildings and products that aim to have a positive impact on the environment.

Consideration should be given in the design phase for how Active Houses use building materials and resources.

It is also possible to consider the local building culture and behaviour in and around the local buildings as well as traditions, climate and ecology. This is relevant when working on improving the building's exterior and interior relations to the cultural and ecological site-specific context.

The key parameters to consider within resource and emissions are:

- Consumption of non-renewable energy resources
- Environmental loads from emissions to air, soil and water
- Freshwater consumption

Active Houses need rigorous evaluation

When evaluating the performance of an Active House, it is important to consider the consumption of energy resources and the emissions to air, soil and water through a Life Cycle Assessment in accordance with the EN 15643 series on sustainable construction or with ISO 14040.


ultoral change

The building's life cycle is considered at the following stages:
- Production of building materials
- Construction processes
- Operation of the building and maintenance of the building construction and fabric
- End of life of building materials
- Transport and site processes may be omitted

At least, all major building components should be considered, that is
- Outside walls, roofs, slabs, foundations, windows and doors
- Inner walls, floors and ceilings
- Major technical components (heat generators etc.)

The estimated service life of the building should be in accordance with local standards. Active House suggests 50 years as benchmark. The estimated service life of all building components should be in accordance with local standards and experiences.

Environmental Product Declaration (EPD) and average data from public sources or software tools can be used as long as they are applicable to the country or region.

The following impact categories are to be evaluated:
- Resource consumption:
  – Primary energy consumption (non-renewable)
  – Primary energy consumption (renewable)

- Impact categories (emissions):
  – Global warming potential (GWP)
  – Ozone depletion potential (ODP)
  – Photochemical ozone creation potential (POCP)
  – Acidification potential (AP)
  – Eutrophication potential (EP)
  – Other impact categories

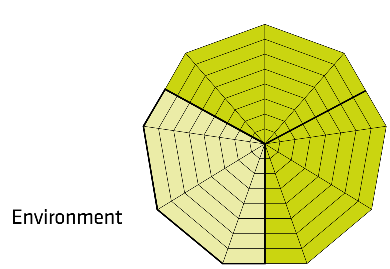


Photo by Adam Mørk

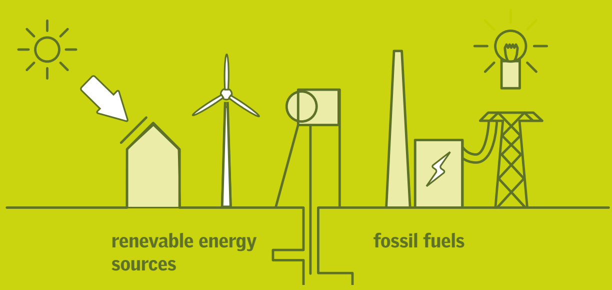
Environmental loads

3.1. ACTIVE HOUSES LIMIT THE ENVIRONMENTAL LOADS DURING THE WHOLE LIFE CYCLE OF THE BUILDING

The process of constructing a new building causes various emissions to air, soil and water, which have different impacts on the environment. When constructing an Active House and conducting a Life Cycle Assessment, it is important to know and consider the different impact categories of these emissions, which may have serious environmental effects. They are explained in the following:

Primary energy (PE)

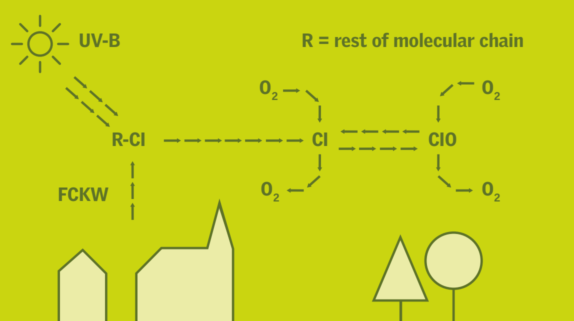
Primary energy (PE) measures the total amount of primary energy directly withdrawn from the hydrosphere, atmosphere, geosphere or energy source without any anthropogenic change, including both non-renewable and renewable resources. Primary energy is expressed in Mega Joules (MJ) and as net calorific value.



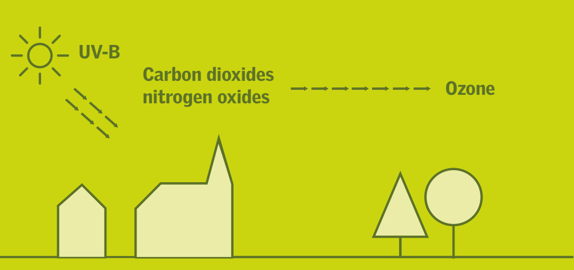
Global warming potential (GWP)

The accumulation of so-called greenhouse gases in the troposphere causes increased reflection of infrared radiation from the earth's surface. Consequently, the temperature on the earth's surface rises. This phenomenon is referred to as the 'greenhouse effect', affecting human health, ecosystems and society in general. The global warming potential groups together gases in relation to the impact of carbon dioxide (CO_2).

Ozone depletion potential (ODP)
Ozone (O_3) occurs as a trace gas in the stratosphere (10-50 km altitude) and absorbs solar UV radiation. However, human emissions induce the thinning of the stratospheric ozone layer since certain gases, such as halocarbons, work as catalysts degrading ozone to oxygen. Thus the transmission of UV-B radiation is increased, with potentially harmful impacts on human health, terrestrial and aquatic ecosystems, causing for example DNA-damage, cancer (especially skin cancer) and eye irritation, crop failures and the decrease of planktons. The ozone depletion potential groups together the impact of various ozone depleting gases.
The reference variable used is R11 (trichlorofluoromethane CCl_3F).



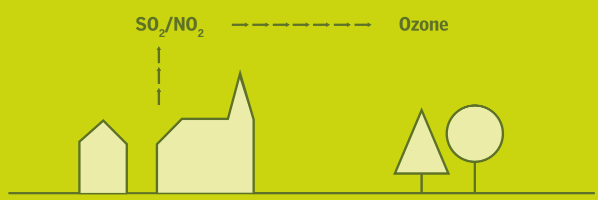
Photochemical ozone creation potential (POCP)
A higher concentration of ozone in the troposphere (0-15 km altitude), the so-called summer smog, is toxic to humans and may also cause damage to vegetation and materials.
When exposed to solar radiation, nitrogen oxide and hydrocarbons form round level (tropospheric) ozone in a complex chemical. This process is called photochemical oxidant creation. Nitrogen oxides and hydrocarbons are produced during partial combustion. The latter is also created by using petrol or solvents. The ozone formation potential is related to the impact of ethylene (C_2H_4).



0.0040 kg C_2H_4-eq

Acidification potential (AP)

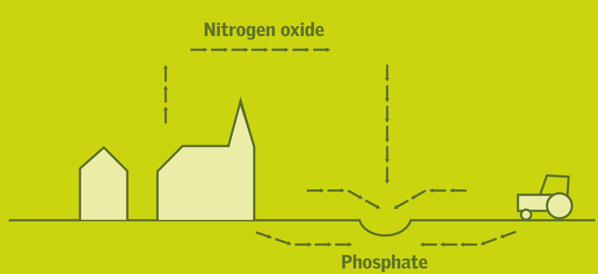
Acidification of soil and water results from the conversion of airborne pollutants into acids. The major acidifying pollutants are sulphur dioxide (SO_2), nitrogen oxides (NO_x) and their acids (H_2SO_4 and HNO_3). These gases are generated during combustion processes in power stations and industrial buildings, in homes, by cars and small consumers. Acidification has a wide range of impacts on vegetation, soil, groundwater, surface waters, biological organisms, ecosystems and building materials, e.g. forest decline and acid rain. The acidification potential groups together all the substances contributing to acidification in relation to the impact of sulphur dioxide (SO_2).

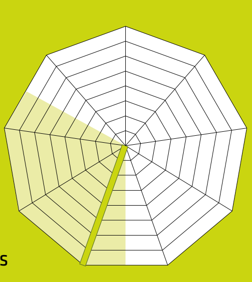


Eutrophication (EP)

Eutrophication means excessive fertilisation and describes the concentration of nutrients and nutrient enrichment in an ecosystem, which may cause an undesirable shift in species composition and elevated biomass production. The major nutrients are nitrogen (N) and phosphorus (P). These substances are contained in fertilisers, nitrogen oxides from combustion engines, domestic wastewater, industrial waste and wastewater. Plants in excessively fertilised soils exhibit weakening of their tissue and lower resistance to environmental influences. In aquatic ecosystems, increased biomass production may lead to depressed oxygen levels, because of the additional consumption of oxygen in biomass decomposition.[1] This may result in fish death and the biological death of water. Furthermore, a high concentration of nitrate can render groundwater and surface waters unusable as drinking water since nitrate reacts and becomes nitrite, which is toxic for human beings. The eutrophication potential groups together the substances in comparison to the impact of phosphate (PO_4^{-3}).

[1] *Handbook on Life Cycle Assessment, Guinée, Kluwer academic publishers, p.82*





Environmental loads

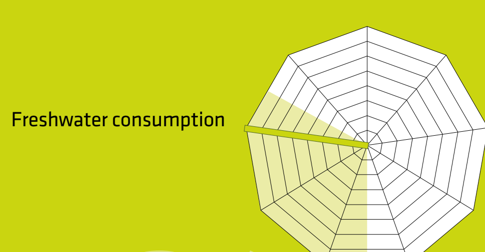
QUANTITATIVE CRITERIA

PARAMETER	VALUE	CRITERIA	SCORE
3.1.1 Building's primary energy consumption during entire life cycle		1. < -150 kWh/m² x a 2. < 15 kWh/m² x a 3. < 150 kWh/m² x a 4. < 200 kWh/m² x a	
3.1.2 Global warming potential (GWP) during building's life cycle.		1. < -30 kg CO_2-eq./m² x a 2. < 10 kg CO_2-eq./m² x a 3. < 40 kg CO_2-eq./m² x a 4. < 50 kg CO_2-eq./m² x a	
3.1.3 Ozone depletion potential (ODP) during building's life cycle.		1. < 2.25E-07 kg R_{11}-eq/m² x a 2. < 5.3E-07 kg R_{11}-eq./m² x a 3. < 3.7E-06 kg R_{11}-eq./m² x a 4. < 6.7E-06 kg R_{11}-eq./m² x a	
3.1.4 Photochemical ozone creation potential (POCP) during building's life cycle.		1. < 0.0025 kg C_3H_4-eq./m² x a 2. < 0.0040 kg C_3H_4-eq./m² x a 3. < 0.0070 kg C_3H_4-eq./m² x a 4. < 0.0085 kg C_3H_4-eq./m² x a	
3.1.5 Acidification potential (AP) during building's life cycle.		1. < 0.010 kg SO_2-eq./m² x a 2. < 0.075 kg SO_2-eq./m² x a 3. < 0.100 kg SO_2-eq./m² x a 4. < 0.125 kg SO_2-eq./m² x a	
3.1.6 Eutrophication potential (EP) during building's life cycle.		1. < 0.0040 kg PO_4-eq./m² x a 2. < 0.0055 kg PO_4-eq./m² x a 3. < 0.0085 kg PO_4-eq./m² x a 4. < 0.0105 kg PO_4-eq./m² x a	
		TOTAL AVERAGE:	

Freshwater consumption

3.2. ACTIVE HOUSES MINIMISE FRESHWATER CONSUMPTION

The depletion and scarcity of global freshwater resources are escalating and thus it is becoming increasingly important to consider water consumption – and treatment – during the life-time of an Active House. For example, when freshwater is saved, it results in wastewater savings as well and both issues are part of the specifications – wastewater as qualitative indications. Freshwater consumption can be reduced by installation of water-saving tabs, use of grey or rain water for toilets and gardening, and the use of easy-to-clean surfaces.



> 80% of the

QUANTITATIVE CRITERIA

PARAMETER	VALUE	CRITERIA	SCORE
3.2.1 Minimisation of freshwater consumption during building's use[1]		Calculation is based on the national average water consumption per building per year 1. Improvement ≥ 50% (vs average) 2. Improvement ≥ 30% 3. Improvement ≥ 20% 4. Improvement ≥ 10% $\% = \frac{\text{National average} - \text{building consumption} \times 100}{\text{National average}}$	

[1] *The parameter 'Solid and liquid wastes' has been discussed and will be incorporated in a later, enlarged version*

floor inside th

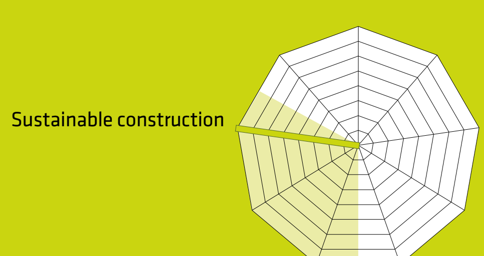
Sustainable construction

3.3. ACTIVE HOUSES TAKE SUSTAINABLE CONSTRUCTION AND SOURCING INTO CONSIDERATION

When designing an Active House, it is important to evaluate recycled content and sourcing.

The recycled content is evaluated by weight and shall take into consideration 80% of the weight of the building. It includes pre-consumer, internal and post-consumer recycling.

Responsible sourcing includes the requirement to use certified sourcing either directly, like PEFC and FSC for sourcing of wood, and a supplier certification EMS for other materials.



QUANTITATIVE CRITERIA

PARAMETER	VALUE	CRITERIA	SCORE
3.3.1 Recyclable content		By weight, the average of recycled content for all building materials (weighted by the proportion of the material in the building) could be: 1. ≥ 50% 2. ≥ 30% 3. ≥ 10% 4. ≥ 5% 80% of the weight of the building should be accounted for. (In the recycled content, we take into account internal, pre-consumer and post-consumer recycling).	
3.3.2 Responsible sourcing		1. 100% of the wood used is certified (FSC, PEFC) and 80% of the new material suppliers have a certified EMS 2. 80% of the wood used is certified (FSC, PEFC) and 50% of the new material suppliers have a certified EMS 3. 65% of the wood used is certified (FSC, PEFC) and 40% of the new material suppliers have a certified EMS 4. 50% of the wood used is certified (FSC, PEFC) and 25% of the new material suppliers have a certified EMS	
		TOTAL AVERAGE:	

Qualitative parameters

4.0. ACTIVE HOUSE QUALITATIVE PARAMETERS

The Active House qualitative parameters are listed in the following. They contain the other important issues to consider when designing an Active House. These issues are often process-oriented; some provide guidance on how to achieve the performance level described in the quantitative part, some provide guidance on how to achieve a more holistic approach (biodiversity, culture and local setting).

Example of the use of qualitative parameters, based on 4.2.1 energy demand.

PARAMETER	CRITERIA	ARGUMENTS/ANSWER	YES/NO
Demand on individual products and construction elements	Have the chosen products and construction solutions been evaluated from a cost-effective, life cost perspective and maintenance view?	*All main solutions (roof, wall, foundation and windows) have been calculated from a cost-effective perspective within the individual solutions' lifetime.* *An evaluation of maintenance of technical solutions will be carried out.*	**YES**
Architectural design solutions	Have architectural design solutions been used to reach a holistic approach of the building and to reach a low energy demand?	*During the design phase, alternative design solutions have been modelled in BIM and the predicted performance of energy, indoor comfort and environment has been evaluated. The results were used to adjust and optimise the architectural design solution.*	**YES**
Demand on individual appliances	Have the best energy performing solutions for appliances been chosen?	*All white goods are minimum class A+ and all installed/in-built lamps are LED and evaluated for light quality.*	**YES**

4.1. COMFORT

4.1.1. DAYLIGHT

PARAMETER	CRITERIA	ARGUMENTS/ANSWER	YES/NO
View	Are windows located to offer the best possible views to the exterior environment (sky and surroundings)?		
Visual transmittance	Are windows (providing a view to the outdoors) selected to have the highest possible visible transmittance		
Glare management	Have the following aspects been considered to avoid risk of glare. • Transmittance • Shading • Design • Reflection • Redirection • Geometry and layout of the rooms		
Daylight in secondary rooms	Have circulation zones and bathrooms access to daylight?		

4.1.2. THERMAL ENVIRONMENT

PARAMETER	CRITERIA	ARGUMENTS/ANSWER	YES/NO
Individual control, winter	Is it possible to adjust the temperature at room level according to momentary needs, e.g. with adjustable thermostats?		
Individual control, summer	Is it possible to manually influence the thermal conditions in each room, e.g. by opening windows or adjusting solar shading? In the case of mechanical cooling systems, is it possible to adjust the temperature at room level, e.g. with adjustable thermostats?		
System interface	Have the climate system interfaces (e.g. wall thermostats) been selected to be as intuitive and simple as possible?		
Draught	Have ventilation openings (including windows, ventilation grilles and mechanical ventilation devices) been located and detailed so that discomfort caused by draught is minimised? **Note:** Adjustability (e.g. of operable windows and ventilation grilles) is an important issue to take into account in this context.		

4.1.3. INDOOR AIR QUALITY

PARAMETER	CRITERIA	ARGUMENTS/ANSWER	YES/NO
Individual control	Is it possible to manually influence the air change rate in the rooms (especially living room, kitchen and bedrooms), e.g. by opening windows, and if mechanical ventilation is installed, is it possible to adjust the airflow rate at three or more levels?		
Dampness	To avoid problems related to dampness and mould, is it guaranteed that there is sufficient extraction in rooms with periodic damp-production peaks (esp. kitchens, bathrooms and toilets)? **Note:** The minimum exhaust air flow in these 'wet rooms' should be as specified in national building codes or guidelines.		
Low-emitting building materials	Have indoor climate-labelled materials been used where possible? **Note:** Examples of indoor climate labels: the Danish Indoor Climate label, the Finnish M1 label, the German AgBB or GUT label or the French label.		

4.1.4. NOISE AND ACOUSTICS

PARAMETER	CRITERIA	ARGUMENTS/ANSWER	YES/NO
Inside system noise	Has it been ensured that noise from all mechanical services in continuous operation is below 25 db(A) in living rooms, kitchens and other main rooms, and below 20 db(A) in bedrooms, study rooms and other rooms that need extra quietness? For inside system noise, exposure to system noise (e.g. from ventilation or heating systems) is determined with a sound pressure measurement e.g. as described in ISO 140: 1998.		
Outside noise	If the building is in a noisy environment, have sufficient sound insulation measures been taken?	Qualitative criteria	
Acoustic privacy	Are inner walls and floor divisions designed to reduce noise transmission between rooms? Is there at least one room (and its entrance door) that is extra sound insulated?		

4.2. ENERGY

4.2.1. ENERGY DEMAND

PARAMETER	CRITERIA	ARGUMENTS/ANSWER	YES/NO
Demand on individual products and construction elements	Have the chosen products and construction solutions been evaluated from a cost-efficient, life-cost perspective and maintenance view?		
Architectural design solutions	Have architectural design solutions been used to reach a holistic approach of the building, as well as to reach a low energy demand?		
Demand on individual appliances	Have the best energy-performing solutions for appliances been chosen?		

4.2.2. ENERGY SUPPLY

PARAMETER	CRITERIA	ARGUMENTS/ANSWER	YES/NO
Design	Has integration of renewable energy been worked with as a part of the building design and typology of the building and the plot?		
Origin of energy supply	Has the energy supply been evaluated from a cost perspective, and how was the decision about the origin of the energy supply made?		

4.2.3. PRIMARY ENERGY PERFORMANCE

PARAMETER	CRITERIA	ARGUMENTS/ANSWER	YES/NO
Energy use and CO_2 emissions	Has the energy demand and the use of renewable energy been optimised in order to use the most cost-efficient solutions with the lowest CO_2 emissions?		

4.2.4. ENERGY VALIDATION ON SITE

PARAMETER	CRITERIA	ARGUMENTS/ANSWER	YES/NO
Onsite control of solutions and products	Has onsite control focused on proving that the energy solutions and products meet the designed level?		
Air permeability of the building	Has the air permeability of the building been tested?		
Thermal bridges	Have the thermal bridges been evaluated during the construction phase?		
Qualification of the controller	Has the control been established by a certified expert?		

4.3. ENVIRONMENT

4.3.1. ENVIRONMENT LOADS

PARAMETER	CRITERIA	ARGUMENTS/ANSWER	YES/NO
LCA of the building	Were the results of an LCA used to optimise the design?		

4.3.2. FRESHWATER CONSUMPTION

PARAMETER	CRITERIA	ARGUMENTS/ANSWER	YES/NO
Appliances	Have water saving appliances been installed?		
Use of grey or rain water	Is grey or rain water used to reduce the water consumption in garden, toilets and for washing?		

4.3.3. ECOLOGICAL IMPACTS

PARAMETER	CRITERIA	ARGUMENTS/ANSWER	YES/NO
Job site management	Were the following items considered to minimise the impact of the job site? • Optimise the management of construction waste • Limit nuisance and pollution • Minimise resource consumption • Respect workers		
Disassembly	Has the building been designed so that 70% by weight of the building will be able to be reused, recycled or backfilled at its end of life? This will meet and anticipate the European Directive on construction waste.		
Biodiversity	Has respect for fauna, flora and the environment been considered, in order to provide nests for birds, create green vegetation, minimise chemical treatment, etc.		

European Directive from 2008 (2008/98/EC)

- *Waste hierarchy*
- *Construction and demolition waste: 70% by weight by 2020 (re-use, recycling and backfilling of 70%)*

4.3.4 EXTERNAL CONTEXT AND ACCESSIBILITY

PARAMETER	CRITERIA	ARGUMENTS/ANSWER	YES/NO
Building traditions	Does the design of the building reflect a relationship with regional building traditions? E.g. were regional materials, architectural typology and craftsmanship analysed and used as design parameters?		
Active outdoor living	Is the design of the building adapting to the potentials and constraints of the local climate? E.g. creating private outdoor spaces with a comfortable climate and access to sunlight that encourage healthy active outdoor living.		
Streets and landscapes	Does the design impact on existing streets and landscapes? E.g. provision for children to play safely outside the house and supporting the public outdoor space for local behaviour, needs and tradition?		
Infrastructure	Does the infrastructure support healthy, comfortable and ecological transport? E.g. connection and distance to nearest public transport for commuting, distance to schools and supermarket and the possibility of easy and safe use of bicycles.		
Accessibility	Does the design take into account physically challenged people, children, elderly people or other groups with special needs?		
Ecology and land use	Does the building optimise the relationship with the local ecology and land use and at the same time minimise environmental risks? E.g. maximising surface for seepage of rainwater, minimising use of land.		
Climate changes	Were possible risks caused by climate changes (storms and flooding) identified and limited in the design of the building and landscape?		

4.4. BUILDING MANAGEMENT

When designing an Active House, it must be ensured that the building in operation works as intended and that the users are capable of behaving as intended.

- In order to ensure efficient and responsible operation of the building and to assist building users in a responsible behaviour, it is important that the building and systems work as intended, that building users are aware of actual performance and that assistance is provided to promote efficient and responsible behaviour.

PARAMETER	CRITERIA	ARGUMENTS/ANSWER	YES/NO
Management of energy	• Training of building users in energy-efficient behaviour. Yearly performance check of building and systems (service contract) • User guidelines on energy-efficient operation of building and technical systems • Continuous (hourly) monitoring and display of energy use and production • Commissioning of building, building services and renewable energy systems during the first year of operation.		
Management of indoor climate	• Training of building users in efficient behaviour. Yearly performance check of building and systems (service contract) • User guidelines on operation of building and technical systems Continuous (hourly) monitoring and display of performance and indoor air quality • Commissioning of building, building services, shading and ventilation systems during the first year of operation.		
Management of environment	• Training of building users in resource-efficient and responsible environmental behaviour. Yearly performance check of building and systems (service contract) • User guidelines on optimal maintenance and water-efficient operation of building and technical systems • Continuous monitoring and display of water use • Commissioning of building, building services and water systems during the first year of operation.		

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ACTIVE HOUSE

Network and knowledge sharing

Active House Alliance members support the vision of Active House and are committed to taking an active role in promoting this vision.

The Active House Alliance includes companies and organisations from the construction sector as well as manufacturers, architects, engineers and research and knowledge centres from the construction sector.

On becoming a member of the Active House Alliance, you are invited to participate in internal workshops and knowledge-sharing activities as well as in the development of the alliance and the materials and specifications being developed.

Members of the alliance are also invited to participate in training regarding those specifications and they are allowed to use the tools developed by the alliance.

If you wish to contribute to the development of the alliance and to become a member, please contact the secretariat for further information and membership fees.

Contact the Active House Secretariat at:
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Read more at www.activehouse.info

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NETWORK AND KNOWLEDGE SHARING