Development of European Ecolabel and Green Public Procurement Criteria for Office Buildings
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Product definition and scope

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1. Executive summary

The purpose of the study is to define the product group "Office buildings" which is a candidate for the development of EU Ecolabel and GPP criteria. First, a review of the existing definitions in legislation and official classifications is carried out. Next, office buildings are classified on the basis of existing literature parameters that differ from one to another office building. Last, based on this information, a definition and a classification of the "office buildings" are proposed to be considered for the development of EU Ecolabel and GPP criteria.

The implementation of the EU Ecolabel Regulation, which refers to the 10-20% best environmental performing ones, is expected to result in a significant potential for environmental savings, with presumably limited costs and efforts. Up to 40% of the primary energy consumption in Europe is due to the building sector and among the buildings office ones are expected to sharply increase its share (square meters), energy consumption and generally speaking the environmental impacts caused by this type of buildings.

Moreover, as an important share of office buildings are public ones, the development of GPP criteria become an issue of high importance. Both Ecolabel and GPP criteria shall take into consideration the net balance between the environmental benefits and burders. They shall be based on the most significant environmental impacts which are expressed as far as possible via technical key environmental performance indicators.

During the preparation of this background document, it has become clear that there is a lack of consistent and reliable data regarding the number of office building, both existing and new and disaggregated levels (types of buildings, size, etc). Thus, the results of the present analysis should be carefully considered, with a certain degree of uncertainty.

The proposed definition determines the scope of the study and provides all the relevant background information for gaining a general overview of the product group. In this sense, a general definition which covers as far as possible the definition of official standards, legislation and MS agreements has been proposed for this study:

Office Building is a building which contains administrative, financial, technical and burocratic activities as core representative activities. The office area must make up a vast of majority of the total building's gross area dedicated to purpose providing a service to other companies or to individuals.

According to this definition, this study covers public and private buildings which are mainly devoted of the administrative, burocratic and clerk work. Although the share of the building devoted to these activities is not yet exactly determined, a minimum office share of 50-80% is under consideration.

Table 1 gives an overview of the Office Building classification suggested in this study. Office buildings are classified depending on their age into new, existing and renovated

buildings as well as on the climatic zone where they are built. The age of the building and the phase of the construction process play an important role in the determination of the Ecolabel/GPP criteria as they can be focused on the design phase achieving high environmental performance rates.

On the other hand, the climatic zone where they are built influences the energy performance of the building as well as the water consumption and other environmental aspect, being necessary to establish different benchmarks regarding the location.

Table 1. Classification of the office buildings

Age	New buildings	Constructions that result in a new stand alone structure or extension to an existing structure. Ecolabel/GPP criteria for the design phase are the most important ones
	Existing buildings	Construction that results in the fundamental remodelling or adaptation of existing elements of the building envelope, structure and renewal of key building services Ecolabel/GPP criteria should be focused on maintenance and use phase
	Renovation	Building or structure that already exists. It also includes maintenance and operation activities
Climatic zone	A1	CDD below 345 and HDD above 4001
	B1	CDD below 345 and HDD between 2501and 4000
	C2	CDD between 2501 and 4000 and HDD below 250
	B2	CDD above 345 and HDD between 2501and 4000

A detailed revision of the existing and on-going legislation and voluntary agreements has been carried out. The aim of this revision is to avoid contradictions of the Ecolabel/GPP criteria within the existing criteria and requirements of the current legislation and consequently get a high degree of harmonization between the MS.

The construction sector is a strong regulated sector not only in Europe but also all over the word. Regarding the environmental concerns these MS schemes share several common points such as a scoring system that includes mandatory and optional criteria and common criteria areas like:

- energy consumption,
- building material selection,
- water consumption,
- waste management or
- indoor air quality

However, they differ from the methodology to calculate the environmental impacts, the minimum benchmarks required and the indicators used to assess the environmental impacts.

2. Introduction

The EU Ecolabel [Ecolabel 2009] scheme is a policy tool part of the Sustainable Consumption and Production policy (SCP) [SCP 2008]. SCP is introduced as a concept that looks holistically at systems of production and consumption and explores how these systems can change to reduce their ultimate environmental impact. The SCP centres attention on mobility, housing and food as these areas of consumption have the largest environmental impacts. SCP aims at reducing the negative impact of consumption and production on the environment, health, climate and natural resources.

Making better consumption choices and producing and consuming more efficiently are two of the key points of the SCP programme. On one hand, it tries to change the consumption patterns and on the other hand, it promotes the use of technologies that reduce the amount of resource use and emissions per unit of consumption.

Progressing towards sustainability requires changes to individual behaviour and mindsets but also requires structural changes such as better choices and even less consumption as well as more efficient production and consumption. Effective policy instruments can help in shaping these and among these instruments the Ecolabel and Green Public Procurement (GPP) schemes are included.

The EU Ecolabel is an informational instrument that displays information regarding the environmental performance of the products, providing information to consumers, procurement officials and retailers. The Ecolabel offers the possibility to consumers to choose a more sustainable product within a group providing the same function and can reduce their consumption of impact-intensive items since the EU Ecolabel can be only awarded by the 10-20% of the best environmental performance products. In addition, the Ecolabel relates to the entire lifecycle of the product and its criteria are based on scientific evidences taking into account the latest technological developments.

The GPP scheme is another policy tool that aims at promoting voluntary measures to increase the green spending of public authorities. GPP is not only important because governments are among the largest purchasers of goods and services, but also because they can set positive examples for consumers and business to follow. With GPP, authorities can demonstrate that

they are taking global challenges seriously and can inspire others to do the same. Furthermore, environmental standards applied by public authorities may spread and set a benchmark for markers as a whole. Due to the high number of common points in the scientific evidence needed to develop the EU Ecolabel and the GPP criteria, this study will also be used as basis for the development of GPP criteria. The GPP criteria will be care devised in core and comprehensive criteria and can lead to savings, especially when a life cycle costing (LCC) is considered.

This study focuses on developing EU Ecolabel and GPP criteria for a specific product group included into the housing sector: "Office buildings". Buildings are responsible for 40% of energy consumption and 36% of EU CO_2 emissions, as the European Commission establishes [Energy Europe EC]. An office building is a non-residential building which contains spaces mainly designed to be used for offices. Offices can be built in almost any location and almost any building can be used as an office. However, modern requirements make the characteristics of an office space more specific due to technical (networking, communications, climatization), legal (illumination levels, safety, etc.) or prestige and status (location, aesthetic and functional considerations) requirements. In the last years, these circumstances led to the construction of singular buildings which are devoted only or primarily for being used as offices [Graf Klein 1982 and Schlenger 2009].

Among all the different types of buildings, in the near future office buildings are expected to significantly increase their floor area, global energy consumption and environmental impacts The increase of energy consumption is mainly because the long use of the building (in average more than 8h/day) and high requirements in indoor comfort what makes necessary a control of the room temperature, ventilation, etc [Schlenger 2009]. Moreover, some authors suggest that there is an important potential for reducing their total energy consumption and other environmental impacts [Balaras 2007]. For these reasons, this kind of buildings is those proposed to apply for the EU Ecolabel for office buildings.

At present, the European construction sector is a sector strictly regulated. Therefore the development of new labels and guidelines should take into account the current legislation and voluntary agreements at European and Member State levels. Moreover, this product group offers a potential for gaining experience for the harmonization of the Member State Ecolabels what should be considered as a hotspot of this study.

The task 1 aims to define and categorize the office buildings product group. According to the EU Ecolabel methodology for the development of criteria, the categorization proposed should be relevant from a functional, technical, economic and environmental point of view. Moreover, the task aims to analyze the current and ongoing legislative initiatives related to the office building sector as well as the existing environmental label's criteria at European, Member State and Third Countries level.

The task is divided in two subtasks: Product definition and categorization and revision of the existing and ongoing legislation and standards, including the analysis of existing environmental labels criteria for buildings.

3. Product definition and categorization

Office buildings as a product group itself is hardly addressed in the European statistics as it is considered as a part of a broader product group "Buildings". Several definitions and categorization of the product group "Buildings" are found either in official standards such the Classification of Types of Constructions (CC) [CC 1998] or in European directives as for example the Energy Performance Building Directive (EPBD Recast 2010) [EPBD recast 2010].

A proper definition of the product group is essential for the development of this study since it allows setting up the scope and boundaries of the study. On the other hand, the product group categorization is essential for the proper development of the study and the future application of the EU Ecolabel. It will allow the development of homogenous criteria regardless the differences among the buildings. But, as the revised categorizations do not match directly with product group of this study, a new categorization will be proposed in this section. This new categorization will be confirmed by a first screening of the volume of sales and trade, environmental impact and potential for improvement of the product. (See Task 2).

3.1. Product definition

The definition of the product group under study "Office buildings" should complain with:

- the definition of a **product group** provided by the EU Ecolabel Regulation [Ecolabel 2009]: "**a set of products that serve similar purposes and are similar in terms of use, or have similar functional properties, and are similar in terms of consumer perception**"

- the definition of a **building** provided by EPBD recast 2010 [EPBD recast 2010]: "**a roofed construction having walls, for which energy is used to condition the indoor climate: a building may refer to the building as a whole or parts thereof that have been designed or altered to be used separately**". Consequently, the buildings components like roofs, walls insulation materials, construction materials, windows or doors will not be separately addressed in this study.

- and when possible, harmonize the existing definitions given by the MS Ecolabels and legislations.

In order to provide the most possible harmonized definition of the product group "office building" a revision of the state-of-the-art was carried out. Each revised legislation, voluntary agreement, official classification, etc is summarized in this section.

3.1.1. EU trade statistics and classifications

There is a number of official statistics that can provide a definition of the product group under study. However, as shown in Table 1, only some of them provide a proper definition to be considered in this study.

Table 1: Definition of "office buildings" by the EU trade statistics

EU trade Statistics	Definition	Reference
PRODCOM list 2010	--	[PRODCOM 2010]
NACE	**non-residential buildings**: The construction of complete non-residential buildings (including office buildings), on own account for sale or on a fee or contract basis. Outsourcing parts or even the whole construction process is possible.	[NACE]
Classification of types of construction	**non-residential buildings** "Non-residential buildings are constructions which are mainly used or intended for non-residential purposes. If at least 50% of the overall useful floor area is used for residential purposes, the building is classified as a residential building." **office buildings**: "Office buildings are used as places of business, for clerical and administrative purposes, e.g. banks, post offices, municipal offices, government department offices, etc. This item also includes conference and congress centers, law courts and parliament buildings. On the other hand, this item excludes offices in buildings mainly used for other purposes."	[CC 1998]
Combined Nomenclature	--	[CN 2011]

3.1.2 Definition according to standards

The Standard **CEN-TC-350** does not provide a specific definition for an office building. However, this standard defines **building in general** as: "**the construction works that has the**

provision of shelter for its occupants or contents as one of its main purposes and is usually enclosed and designed to stand permanently in one place".

On the other hand, the **ISO-TC-59 standards** also provide some definitions. Actually, the ISO 6707:2004 [ISO 6707-1:2004] **adds to the above definition that an office building is a building used principally for administrative or clerical work**.

3.1.3. Definition according to MS and third countries Ecolabels

At present there are several existing MS labels that provide definitions on "office buildings". Table 2 summarizes the definition given by the main MS and Third countries schemes.

Table 2: Comparison of definition given by different schemes

Scheme	Definition	Comments
BREEAM, Office areas [BREEAM]	Office buildings are buildings that host cellular or open plan offices, meeting rooms, training/presentation rooms. Other associated functions/areas that could be included in this group are: reception and waiting areas, staff restaurant and/or kitchen facilities, restrooms, WCs and changing facilities, storage and waste management areas, I.T suites, server rooms, staff gym or crèche, ancillary areas e.g. plant room, circulation space. **The office areas must make up >50 % of the gross internal floor area of the building. This group cannot be used to assess data centres.**	--
HQE [HQE]	Office buildings include all entities whose function is to provide a service that is commercial or non-market for companies or individuals other than sports that are subject to a specific repository certification. **Excluded are buildings used for housing, industrial buildings, sports and agriculture.**	--
DGNB [DGNB]	--	--
ITACA-SBC PROTOCOL [ITACA]	--	Named only in the classification
VERDE [VERDE]	Buildings whose purpose is to provide administrative, technical and financial information to either companies or individuals	Belong to the group called New Construction and Refurbishment for Housing and Offices Buildings
GBTOOL [GBTOOL]	--	--
DISTINTIU [DISTINTIU]	Office buildings are those whose main activities are administrative and bureaucratic ones, either public or private companies.	--
LEED [LEED]	--	--
GREEN STAR [GREEN STAR AU]	Office buildings are considered those with a minimum of 80% of the building's gross floor area dedicated to those businesses, technical and administrative purposes providing a service to other companies or to individuals.	GFA, (measured to exclude internal car parks)
CASBEE [CASBEE]	--	Named only in the classification

3.1.4 Other definitions

The Whole Building Design Guide [WBDG 2009] defines an office building trough its characteristic space. "**The Office space type refers to a variety of spaces including: meeting spaces integrated into the office environment, reception, office support spaces such as work rooms, storage rooms, file rooms, mail rooms, copier areas, service units/coffee bar, and coat storage integrated into the office environment, and telephone and communications equipment rooms located in tenant suites containing tenant equipment**"

The definition given by NAIOP [NAIOP], a Commercial Real Estate Development Association located in United States, is as follows: "**a property providing environments conducive to the performance of management and administrative activities, accounting, marketing, information processing, consulting, human resources management, financial and insurance services, educational and medical services and other professional services. At least 90% of the interior space is designed and finished to accommodate office usage but the space may include other usage**".

3.2 Product classification

3.2.1 EU trade statistics, classifications and legislation

The officials EU trade statistics and classifications do not provide a further classification of the "office buildings" since they are considered as a sub-group of a boarder product group called "buildings". The categorization of "buildings" mainly classifies the group depending on the function of the products and consequently the "office building" product group is regarded as a part of the commercial buildings and not further categorized.

As an example, the Central Product Classification [CPC 2008] regulated by the United Nations is as follows:

Table 3: Classification of constructions and construction services of the Central Product Classification

5 - Constructions and construction services
5.3. – Constructions
5.3.1. – Buildings
5.3.1.2. - Non-residential buildings
5.3.1.2.2. - Commercial buildings.

The commercial building subclass includes: shopping centres, shopping malls, department stores, detached shops and boutiques, indoor markets etc., warehouses, exhibition halls, office

buildings, bank buildings, air, rail or road transport terminals, parking garages and petrol and service stations.

As another example, office buildings are into the classification of buildings provided by EPBD recast 2010 [EPBD recast 2010]:

Table 4: Classification for calculating purposes given by EPBD recast 2010

Categorization
(a)single-family houses of different types; (b) apartment blocks; (c) offices; (d) educational buildings; (e) hospitals; (f) hotels and restaurants; (g) sports facilities; (h) wholesale and retail trade services buildings; (i) other types of energy-consuming buildings

The EPBD recast 2010 encourages all the MS to develop different methods for the calculation of the energy performance of buildings in accordance to the categories mentioned in Table 4.

3.2.2 EU and third countries Ecolabels

In a similar way, each EU and Third country Ecolabel scheme proposes characteristics for the categorization of buildings and in some cases for office buildings as well. As seen in Table 5 most of the schemes classify the **buildings regarding the age into new, renovated or existing buildings**, or ever further. In addition, the German Ecolabel scheme [DGNB] divides buildings into new office buildings and administration buildings.

Table 5: Comparison of characteristics and categorization given by different schemes for office buildings

Ecolabel	Categorization	Comments
BREEAM offices [BREEAM]	BREEAM Buildings are categorized in: - new building - existing building	BREEAM Offices assessments can be carried out on both new and existing office buildings - non occupied or occupied, as follows: New build, Major refurbishment, Fit out.
HQE [HQE]	--	It concerns the phases of planning, design and implementation in new or rehabilitation but also the exploitation phase.
DGNB [DGNB]	- new office - administration buildings	--
ITACA-SBC PROTOCOL [ITACA]	--	It evaluates buildings of different destination of use (including tertiary) in all the phases of the life cycle, from the design to the use.
VERDE office building [VERDE]	- New construction - Main rehabilitation	--

GBTOOL [GBTOOL]	- new building - renovations (> 40% of area)	Design phase, construction phase or operations phase.
DISTINTIU [DISTINTIU]	--	Only for office buildings in use phase, so operations stage
LEED Commercial Interiors [LEED]	- New Construction and Major Renovations, - Existing Buildings	--
GREEN STAR-Office [GREEN STAR AU]	Office Office Interiors Office Design Office As Built	Green Star validates the environmental initiatives of the design phase of new office construction or base building refurbishment; or construction and procurement phase of a Class 5 office building.
CASBEE [CASBEE]	CASBEE for Pre-design, CASBEE for New Construction, CASBEE for Existing Building and CASBEE for Renovation,	--

3.2.3 Other categorizations

The association NAIOP [NAIOP] provides a categorization also based on the age of the building. The classification is as follows:

- Proposed/Planned Office Buildings: the status of a building that has been announced for future development but not yet started construction.

- Under Construction Buildings Office Buildings where either:

a) actual ground breaking has occurred (site excavation or foundation work) and construction is ongoing (not abandoned or discontinued) but for which a certificate of occupancy has not yet been issued; or

b) properties undergoing conversion to office from another use; or

c) properties undergoing a major renovation where 75% or more of the building is not available for lease and the building generally requires a certificate of occupancy to be made available for lease.

- Renovation Office Buildings: a general term applied to the process of upgrading an existing improvement.

On the other hand, buildings have been widely classified in the literature depending not only on their age but also regarding the **location of the buildings taking into account the climate conditions**. There are mainly two classifications:

a) ***Köppen-Geiger climate classification*** [KÖPPEN-GEIGER, 2007]. This climate classification based on the work of Wladimir Köppen, and dating from 1900, continues to be the most

widely used climate classification over a century later and has been the basis for many other classifications and regulations [Schlenger 2009].

The period of greatest activity was from the mid-nineteenth century through to the 1950s. What is somewhat surprising about this time profile of activity is that as both the availability of data and computing power to process them has become increasingly widely available post-1960, the level of activity in the development of new climate classifications has markedly declined.

In this classification, Europe is defined as the west region of a north-south line through the Urals Mountains down to the Arabian Sea and includes the Arabian Peninsula and the countries of the Middle East. The Köppen-Geiger climate type map of Europe, Figure 1, shows that only four main climate types are found in Europe. The dominant climate type by land area is cold D (44.4%), followed by arid B (36.3%), temperate C (17.0%) and polar E (2.3%).

Figure 1 is based on 1209 precipitation and 684 temperature stations. Of these stations a total of 496 had both precipitation and temperature data for the same location for which the climate type is known and can be checked against the map. The climate type at 488 of these locations matched the map exactly and in the remaining 8 locations the correct climate type was present in a neighbouring cell.

Although the traditional classification systems (including this one) have been created to describe the climatic conditions for creatures and vegetation, there is a general agreement in the scientific and research community to use it in relation with buildings and other technical issues.

In relation to the development of EU Ecolabel criteria, it is recommended to look at other classification systems to further investigate the relation between energy demand on buildings and climate.

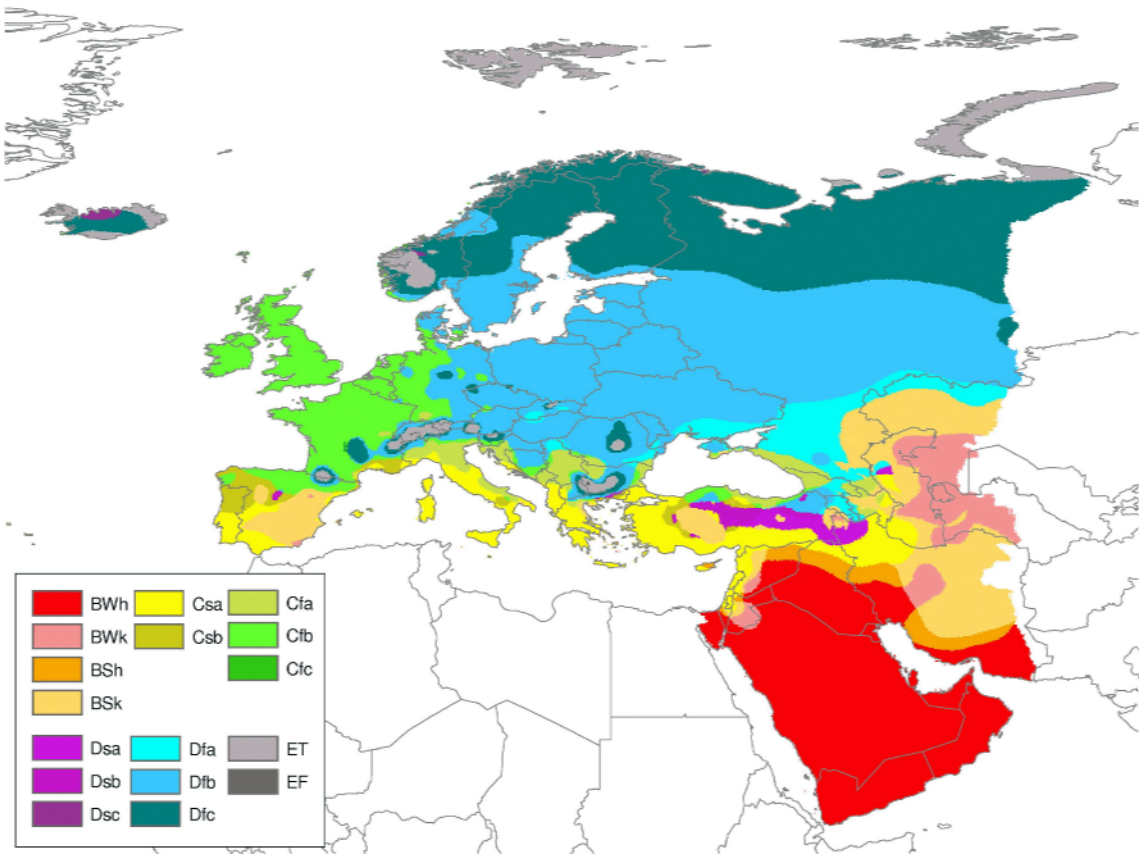

Figure 1: Köppen-Geiger climate type map of Europe

b) A second classification based ***on heating degree days (HDD) and cooling degree days (CDD)***[1] has been analyzed. HDD are computed by adding the temperature differences between the outdoor temperature and a reference indoor temperature (usually one that is conventionally considered to be comfortable for human beings e.g. 18 °C) for each day over the heating period. Accordingly, CDD values are defined with respect to cooling demands. Following the IMPRO-Building study [IMPRO 2008], the EU-27 space can be broken down in three different zones regarding HDD as shown in Table 6.

To ensure comparable climatic boundary conditions, the HDD as well as the CDD of each country are suitable indicators for comparison. These indicators are the best way to represent similar zones for heating or cooling in the EU-27.

[1] Provided that the values are referred to a long-term period to avoid statistical fluctuations. In this report the average is based on the period 1980 to 2004 [IMPRO].

The long-term average of HDD-CDD, based on the period 1980-2004, is used. A relatively long term base period is desirable to avoid the influence of short term changes in mean temperatures [CELECT project]. Thereby three different categories have been set.

The key point of this categorization is to introduce the data for the location the building and determine the benchmarks of the Ecolabel criteria for each category. Therefore, those data, HDD and CDD of the exact building´s location, are a must for its categorization.

Note that for the CDD, North and Central Europe are merged as a unique area. Figure 2 shows the HDD and CDD for the different EU-27 Member States [CAIT 2011]. CDD are much more uniformly distributed by countries than HDD, although a bigger aggregation error may be attributed to the CDD of some specific areas for example the Spanish north and south regions, which are included into the same areas. Although, these calculations are done correctly, there is a European standard [EN 15927-6] which puts into question CDD term worth, because the influence of solar radiation and humidity are not taken into account.

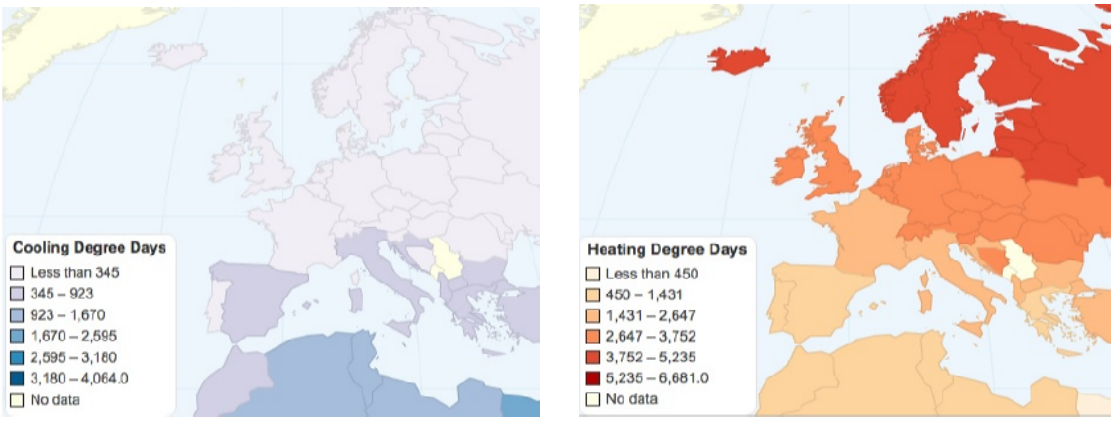

Figure 2: Left: cooling degree days. Right: heating degree days

Table 6: Heating and cooling degree days in the countries of the EU-27. Source: [CELECT project].

Climate Zone	Country	Long term average heating degree days	Long term average cooling degree days
C2 Zone ≤ 2500 HDD	Malta	592	341
	Cyprus	764	408
	Portugal	1143	73
	Greece	1199	471
	Spain	1435	311
	Italy	1762	172
	France	2268	53
B1 Zone 2501 – 4000HDD	Belgium	2984	26
	Ireland	2990	-
	Luxemburg	3053	51
	United Kingdom	3065	4
	The Netherlands	3097	8
	Slovenia	3141	63
	Austria	3187	94

	Hungary	3188	116
	Bulgaria	3208	91
	Germany	3230	40
	Slovakia	3241	100
	Denmark	3364	7
	Romania	3358	80
	Czech Republic	3680	52
	Poland	3695	56
A1 Zone ≥ 4001 HDD	Estonia	4308	4
	Latvia	4317	15
	Lithuania	4392	33
	Sweden	4500	7
	Finland	4792	0

The great advantage of this methodology is that it encompasses the most influential meteorological data regarding energy demand for buildings, such as solar radiation, illumination, humidity, rainfall, and outdoor and/or indoor temperature and that it is technically and scientifically recognised.

Finally, it should be noted that the importance of the above mentioned factors have already been taken into account in previous European projects, such as IMPRO-Buildings [IMPRO 2008], the COST action C16 [Wetzel & Vogdt 2005] or the project INVESTIMMO [Bauer 2004], All of these projects are focused on residential buildings in Europe. However, the extrapolation of this methodology to office buildings seems to be reasonable.

3.3. Proposal of the definition and categorization of office buildings

3.3.1 Definition

An office building is a non-residential building which contains spaces mainly designed to be used for offices. According to this definition, offices can be built in almost any location and almost any building can be used as an office. However, modern requirements make the characteristics of an office space more specific due to technical (networking, communications, climatization), legal (illumination levels, safety, etc.) or prestige and status (location, aesthetic and functional considerations) requirements. In the last years, these circumstances led to the construction of singular buildings which are devoted only or primarily for being used as offices.

As shown in the above sections, there is a scarcity of official definitions to describe this product group and most of them are based on the functionality of the building, collecting the kind of activity for which the building is designed.

In order to make a difference between an office building and any other commercial building, a certain percentage of the total floor area should be devoted to financial, burocratic or

administrative purposes. As revised in the literature, some schemes limited this percentage above 50% or 80% whereas most of the schemes do not mention it. According to the authors opinion, the key point in this definition is to ensure that the vast majority of the building's total floor area is office and business use.

Consequently, based on the previous analysis of existing legislation, standards, labelling schemes and statistics, the following definition is proposed for the development of Ecolabel/GPP criteria for office buildings:

"A building which contains administrative, financial, technical and burocratic activities as core representative activities. The office area must make up a vast majority of the total building´s gross area dedicated to purpose providing a service to other companies or to individuals. Therefore, it could have associated other type of spaces, like meeting rooms, training classes, staff facilities, technical rooms, etc."

Excluded from this definition are parking areas that are not counted in this total building´s gross area.

3.3.2 Categorization

Basically, regarding the literature review carried out about the categorization of office building, the two main categories proposed are:

1.- Building Age

The office building stage is essential to develop the EU Ecolabel and GPP criteria. As commented in this section, the toughness of the criteria should be different if the design, the construction or the renovation phases of the building should be taken into account. If the building is already built, the operation phase is the only life cycle phase that plays an important role, being quite difficult to be improved.

This criterion will allow differentiating among those three categories:

- **New buildings**, construction that results in a new stand alone structure or extension to an existing structure, which will come into operation or use for the first time upon completion of the works. Thus, EU Ecolabel and GPP criteria and benchmarks can influence the phases of designing and defining.

- Renovated buildings, construction that results in the fundamental remodeling or adaptation of existing elements of the building envelope, structure and renewal of key building services. If there is a **major renovation,** an architectural project is behind its improvement or renovation

and consequently the EU Ecolabel and GPP criteria can influence the designing and renovating phases. So the building has its own intrinsic restrictions, but there are some other characteristic that will change and evolve.

- **Existing buildings**, a building or a structure that already exists. The EU Ecolabel and GPP criteria have little chance of influencing the design and construction activities but they focus more on operations and maintenance activities. This category addresses operational and maintenance issues of working buildings. Therefore offices building operations, processes, systems upgrades, minor space-use changes, and minor facility alterations or additions, are suitable to be awarded with this ecolabel.

It encourages owners and operators of existing buildings to implement sustainable practices and reduce the environmental impacts of their buildings over their functional life cycles.

All of the above named age criteria are noted down in table 7.

Table 7: Office building phase categorization

Building Phase	Definition for the Phase
New Buildings	construction that results in a new stand alone structure or extension to an existing structure
Renovated Buildings	construction that results in the fundamental remodeling or adaptation of existing elements of the building envelope, structure and renewal of key building services
Existing Buildings	A building or structure that already exists. It also includes maintenance and operation activities

2.- **Climate zone**

The location of each building case will determine the climatic conditions in which the building will spend its life-cycle and especially its use phase. The location of the building is inherent, so it is necessary to provide both data: HDD and CDD for each exact location of the building, the country or region is not valid. When these data are provided, the building should pass trough Table 8, so as a result a climate zone will be defined.

As it is shown in Table 8, letter rates are given accordingly with HDD average levels, from A to C whereas number rates are defined because of CDD average levels, 1 or 2. Although there are in total six different climate zones, only A1, B1 and C2 will be the most common ones. If the data on Table 9 are considered, so the inputs for the EU27 countries, neither A2 nor C1 will be chosen. That means that if a region needs much heating (high HDD average level), probably it will not need excessive cooling (high CDD average level).

Table 8: Climate zones based on heating and cooling degree days criteria [IMPRO 2008].

		Long term average Cooling Degree Days CDD	
		CDD below 345 → **1**	CDD above 345 → **2**
Long term average Heating Degree Days HDD	HDD above 4.001 → **A**	A1	A2
	HDD between 2.501 and 4.000 → **B**	B1	B2
	HDD below 2.500 → **C**	C1	C2

Table 9 summarizes the two categorization criteria analyzed in this section. All in all, 18 different sub-categorized classes of office building can be found. These categories will be used for the proposed base cases in the following sections.

Table 9: Office building categorization criteria

Building Phase	Climate Zone based on HDD	Climate Zone based on CDD
New Buildings	A	1
Renovated Buildings	B	2
Existing Buildings	C	--

4. Measurement and other standards

Standards are documents that define materials, methods, processes, practices, or outcomes. They can then be used to set requirements, provide better practice, and deliver guidance. The benefits of the standards are wide ranging and include improved safety, quality, convenience, efficiency, prosperity, and support trade and export opportunities. That is the main reason why this report makes an effort to investigate and introduce standards in this section.

4.1 Standards at European level

European standards are developed by the ISO committees and when concerning the construction and buildings, standards are mainly developed by the ISO/TCs committees.

Generally, the aim of these standards is to provide homogeneous methodologies and definitions which would be applied across Europe to evaluate the performance of the office buildings, thus EU Ecolabel and GPP criteria would use those.

In annex I of this document, there is detailed information about these standards at MS level. Table 10 shows the list and the number of standards published up today regarding this project scope.

Table 10: Technical ISO Committees on building sector

Committee	Title	Standards published
TC 21	Equipment for fire protection and fire fighting	94
TC 59	Buildings and civil engineering works	107
TC 71	Concrete, reinforced concrete and pre-stressed concrete	24
TC 74	Cement and lime	8
TC 77	Products in fibre reinforced cement	13
TC 89	Wood-based panels	38
TC 92	Fire safety	105
TC 98	Bases for design of structures	20
TC 136	Furniture	25
TC 160	Glass in building	33
TC 162	Doors and windows	21
TC 163	Thermal performance and energy use in the built environment	90
TC 165	Timber structures	27
TC 167	Steel and aluminium structures	4
TC 178	Lifts, escalators and moving walks	27
TC 179	Masonry - STANDBY	3
TC 182	Geotechnics	35
TC 189	Ceramic tile	26
TC 195	Building construction machinery and equipment	27
TC 205	Building environment design	9
TC 218	Timber	58

Among all the standards summarized in this table the following ones are considered to play an important role for the development of the EU Ecolabel and GPP criteria:

- **ISO TC 59 Building construction** [ISO-TC-59].

The ISO TC 59 is mainly focused on environmental care, economic and social benefits, and generally speaking, on sustainable construction methodologies. Therefore, the review and implementation of this standard will be of great importance in the building construction sector as to:

- General terminology.
- Organization of information in the processes of design, manufacture and construction.

- General geometric requirements for buildings, building elements and components including modular coordination and its basic principles, general rules for joints, tolerances and fits.
- General rules for other performance requirements, including functional and user requirements related to service life, sustainability, accessibility and usability.
- General rules and guidelines for addressing the economic, environmental and social impacts and aspects related to sustainable development.
- Geometric and performance requirements for components that are not in the scope of separate ISO technical committees.
- Procurement processes, methods and procedures.

The already existing documents and those under development are named on Table 11 and 12:

Table 11: Already existing standard documents. Source [ISO-TC-59]

ISO	Name	Comments
ISO 15392:2008	Sustainability in building construction.	General principles.
ISO/TS 21929-1: 2006	Sustainability indicators.	Framework for development of indicators for buildings.
ISO 21930:2007	Environmental declaration of building products.	--
ISO 21931-1:2010	Framework for methods of assessment of the environmental performance of construction works.	Buildings.

Table 12: Standard documents under development. Source [ISO-TC-59]

ISO	Name	Comments
ISO/NP TS 12720	Sustainability in building construction.	Guidelines for the application of the general principles on sustainability.
ISO/DIS 21929-1	Sustainability indicators.	Framework for the development of indicators and a core set of indicators for buildings.
ISO/CD 21929-2	Sustainability indicators.	Framework for the development of indicators for civil engineering works.
ISO/DTR 21932	Building construction.	Sustainability in building construction, Terminology.

Specifically, ISO TC 59 will support EU Ecolabel and GPP criteria for environmental issues, concerning: environmental declarations of building products, design life of buildings, durability, responsibilities independent of private and public authorities, and guidelines in designing accessibility for all.

- The ISO TC 205 Building environment design [ISO-TC-205]

ISO TC 205 is creating a system of International Standards to address the 'built environment'. The main areas of work covered by ISO TC 205 are:

- The design of energy-efficient buildings.

- Building control systems design.
- Indoor air quality.
- Indoor thermal environment.
- Indoor acoustical environment.
- Indoor visual environment.

The already most important published and under development standards are:

Table 13: Standard documents already published. Source: [ISO-TC-205]

ISO	Name	Comments
ISO 16813:2006	Building environment design, Indoor environment	General principles.
ISO 16814:2008	Building environment design, Indoor air quality	Methods of expressing the quality of indoor air for human occupancy.
ISO 16818:2008	Building environment design, Energy efficiency	Terminology
ISO 23045:2008	Building environment design	Guidelines to assess energy efficiency of new buildings.

Table 14: Standard documents under development. Source: [ISO-TC-205]

ISO	Name
ISO/DIS 13153	Framework of the design process for energy-saving single-family residential and small commercial buildings with the energy consumption ratio as a criterion.
ISO/DIS 16817	Building environment design, Indoor environment, design process for visual environment.

The standard [ISO-TC-205] is initially limited to commercial and institutional environments, but office buildings may apply these requirements too. Economics, efficiency and personal comfort are of primary importance to the TC in the development of its work programme. The scope addresses the building fabric (or envelope) and energy-efficiency of heating, ventilation and cooling equipment and objective is to enhance the efforts toward rational use of natural resources to increase the markets for energy efficient buildings and building equipment.

Moreover, the application of indoor environment standards will help to assure the health, productivity and well being of building occupants. Healthy sustainable buildings are those that create high quality indoor environments while minimizing their impacts on the outdoor environment.

In conclusion, it will help to limit and define the future EU Ecolabel and GPP criteria in terms of indoor air quality, wellbeing and health, thus reduce outdoors impacts.

- **The CEN TC 350-Sustainability of construction works.** [CEN-TC-350]

The CEN TC 350 is responsible of the development of voluntary horizontal standardized methods for the assessment of the sustainability aspects of new and existing construction

works and for standards for the environmental product declaration of construction products. The standards will be generally applicable (horizontal) and relevant for the assessment of integrated performance of buildings over its life cycle. The areas of concern are: economic performance assessment of buildings, social performance assessment of building, products level, and environmental performance of buildings, building Life Cycle Description, developed by the following standards:

Table 15: Standard documents already published. Source: [CEN-TC-350]

CEN	Name	Comments
CEN/TR 15941:2010	Sustainability of construction works, Environmental product declarations	Methodology for selection and use of generic data.
EN 15643-1:2010	Sustainability of construction works, Sustainability assessment of buildings,	General framework.
EN 15643-2:2011	Sustainability of construction works, Assessment of buildings	Framework for the assessment of environmental performance.

Table 16: Standard documents under development. Source: [CEN-TC-350]

CEN	Name	Comments
prEN 15643	Sustainability of Construction Works, Assessment of Buildings,	Framework for the assessment of social performance.
prEN 15643-4	Sustainability of Construction Works, Assessment of Buildings	Framework for the assessment of economic performance.
FprEN 15978	Sustainability of construction works, Assessment of environmental performance of buildings.	
FprEN 15942	Sustainability of construction works, Environmental product declarations	Communication format business-to-business
Under drafting	Sustainability of construction works Assessment of social performance of buildings	Methods

According to this standard, a change in the application and calculation of the LCA for buildings is proposed. Its purpose is to provide guidelines for the assessment of the environmental performance of new and existing buildings based on a life cycle approach for the quantitative evaluation. The general requirements are described in the framework pr EN15643 part 1 and the specific requirements in pr EN 15643 part 2. Other standards in the same area related to this standard are shown as the darkened areas in Figure 3:

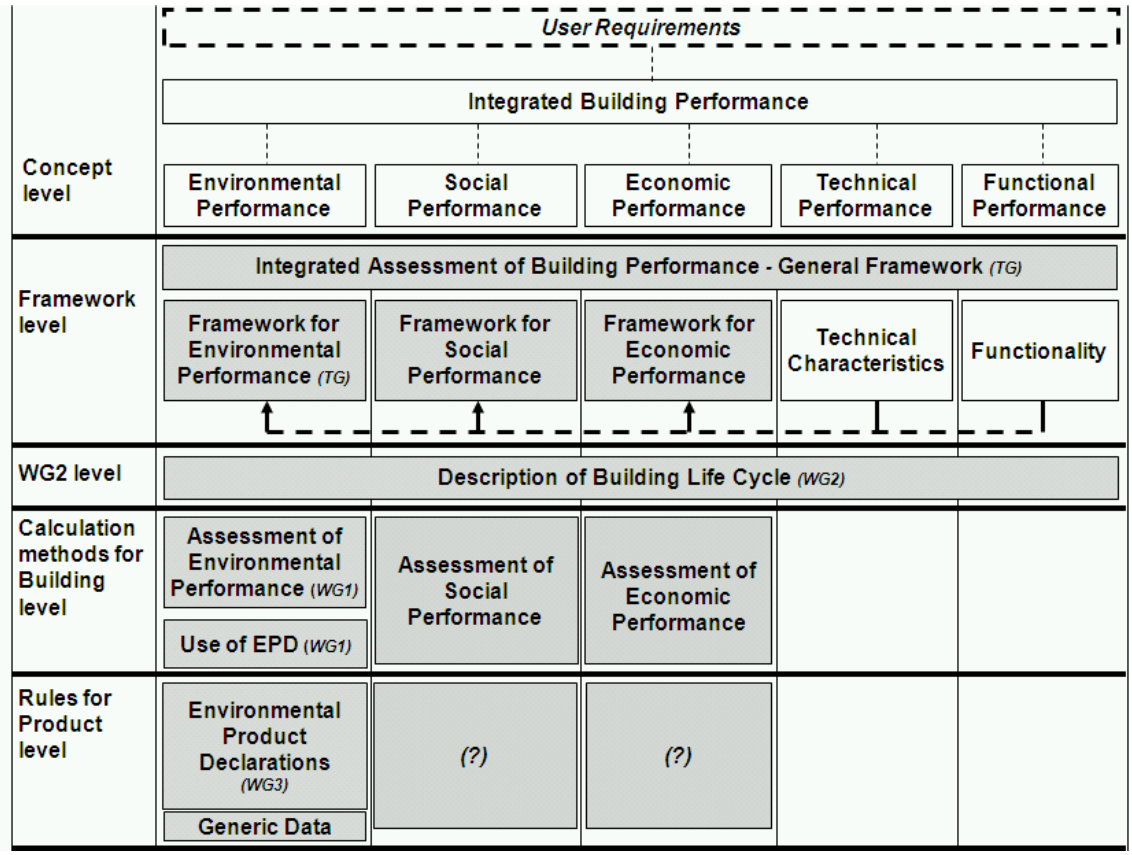

Figure 3: Standards supporting integrated building performance within [CEN-TC-350]

This European Standard is intended for the evaluation and assessment of design options and specifications for new and existing buildings and refurbishment projects. The standard gives:

- the description of the object of assessment;
- the system boundary that apply at the building level;
- the procedure to be used for the inventory analysis;
- the characterisation models for environmental indicators ;
- the means for the presentation of the assessment results;
- and the requirements for the data necessary for the calculation;

The approach to the assessment covers all stages of the building life cycle and is based on data obtained from Environmental Product Declarations (EPD), their "information modules", (prEN 15804) and when appropriate other information related to the environmental performance of the building as a whole and to the construction products, processes and services, over the life cycle of the building. In order to calculate the environmental impacts for the environmental assessment of a building (or part of a building) an intended use of the assessment, shall be

defined, agreed and documented in accordance with the requirements of this standard before an assessment is carried out.

The goal of the assessment, based on the calculation method described in this standard, is to allow the aggregation of environmental impact data to quantify the environmental performance of the object of assessment.

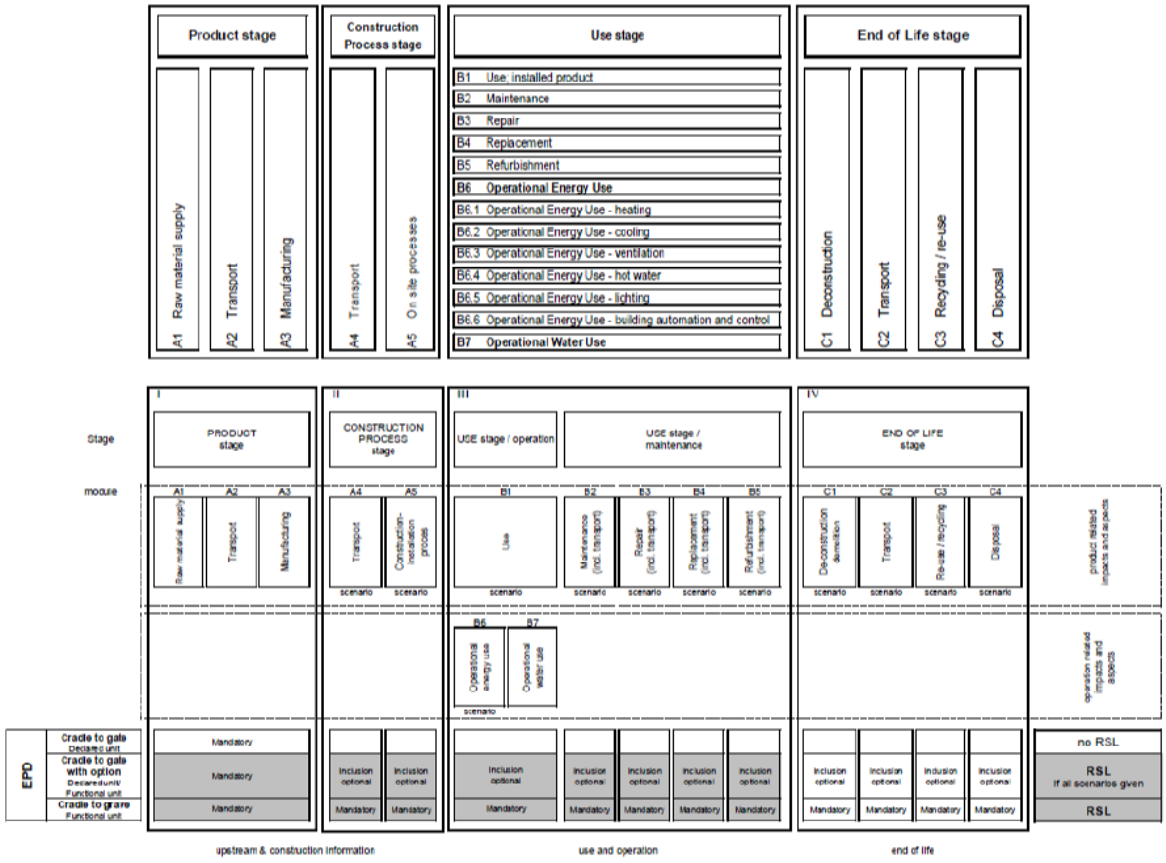

Figure 4: Display of modular information for the different life cycle stages of the building. Source: [CEN-TC-350]

The numbering from module A1 to module C4 of figure 4 covers the whole life cycle of the building. All impacts related to the (sub) stages shall be allocated to the (sub) stages of consideration during the building life cycle.

In conclusion, this standard will give a precise guideline for the LCA calculating method and the overall impact area and consequently it will affect the proposed boundaries and reference values to calculate the environmental impacts for office buildings developed in EU Ecolabel and GPP criteria.

- **Other significant CEN/TC Standards**

These documents serve as reference when choosing designs, appliances and other equipment for the office building. So there are five CEN technical committees covering the following areas, which may be helpful to be reviewed:

- CEN/TC 89: Thermal performance of buildings and building components.
- CEN/TC 156: Ventilation for buildings.
- CEN/TC 169: Light and lighting.
- CEN/TC 247: Building automation, controls and building management.
- CEN/TC 371: Project Committee EPBD to coordinate the standardization activities related to the EPBD 2002 and EPBD recast 2010

These aspects are connected with the EU Ecolabel criteria since they are part of the whole office building and can influence the global environmental impact. Among them, the EN 15603:2008 proposes to:

a) collate results from other standards that calculate energy use for specific services within a building;

b) account for energy generated in the building, some of which may be exported for use elsewhere;

c) present a summary of the overall energy use of the building in tabular form;

d) provide energy ratings based on primary energy, carbon dioxide emission or other parameters defined by national energy policy;

e) establish general principles for the calculation of primary energy factors and carbon emission coefficients. This standard defines the energy services to be taken into account for setting energy performance ratings for planned and existing buildings, and provides for this:

f) method to compute the standard calculated energy rating, a standard energy use that does not depend on occupant behaviour, actual weather and other actual (environment or indoor) conditions;

g) method to assess the measured energy rating, based on the delivered and exported energy; h) methodology to improve confidence in the building calculation model by comparison with actual energy use;

i) method to assess the energy effectiveness of possible improvements.

This European standard is applicable to a part of a building (e.g. office), a whole building, or several buildings. It is up to national bodies to define under which conditions, for which purposes and for which types of buildings the various ratings apply. This standard handles the

energy performance of a building as a whole. The assessment of the energy performance of specific technical building systems is also handled in the appropriate part of EN 15241, prEN 15243 and EN 15316 series.

Finally, this group of standards would be included in EU Ecolabel and GPP criteria concerning appliances and equipment used in the office building, as they give guidance on these elements energy performance, consumption, etc.

4.2. Third Country and Other Standards

The **Standards Australia** [Standards Australia] is an independent, not-for-profit organisation that develops internationally standards on the usage of materials in buildings like geotextils (AS 3705), glazing (AS/NZS 2208), masonry (AS 3700) or steel (AS 4100) structures, apart from other standards related with the energy performance in appliances for buildings and its installations like air condition, ventilating heating, etc.

The **American National Standards Institute**, [ANSI] developed a standard, which is similar to the ones already described coming from ISO and CEN committees.

The **ANSI/ASHRAE 105-2007: Standard Methods of Measuring, Expressing and Comparing Building Energy Performance** does not establish building energy goals or limits or present a method for certification of prediction methodology, such as computer programs. On the other hand, this standard covers the measurement of energy use for existing buildings and the prediction of energy use for proposed buildings; specifies techniques for measuring, expressing, and comparing the energy performance of buildings; provides minimum requirements for reporting predicted or measured energy performance; and provides minimum requirements for specifying a building energy performance comparison method.

Apart from the revised standards, some scientific publications address the status of the energy standards for buildings. For example **"Worldwide Status of Energy Standards for Buildings"** [Janda 1994] describes the worldwide status of energy standards for buildings in 81 countries keyed to the legal status (i.e. mandatory, voluntary, proposed) and building sector coverage (i.e. residential, commercial, or both) of such standards in different countries, as shows in Figure 5. According to these authors, energy standards, particularly for non-residential buildings, will play an increasingly significant role in the coming international energy efficiency policies. Although all signs point out that energy standards will play an increasingly significant role in the future of national and international policies, for the development of the EU Ecolabel criteria only EU standards will be taken into account.

Figure 5: Status of the energy standards in 81 countries in 2009, [Janda 1994]

5. Existing legislation

5.1 Legislation and agreements at European level

5.1.1. EU Directives

Directive 2010/31/EU of the European Parliament and the Council of 19 May of 2010 on the energy performance of buildings (recast) [EPBD recast 2010]

The objective of the recast of EPBD 2002 on the energy performance of buildings, EPBD recast 2010, is to clarify and simplify certain provisions, extend the scope of the Directive, strengthen some of its provisions so that their impact is more effective, and to provide for the leading role of the public sector. In doing so, the transposition and implementation of the EPBD recast 2010 is to be facilitated and a significant portion of the remaining cost-efficient potential in the buildings sector will be reaped. At the same time, the objectives and principles of the current Directive are retained and it is again left to Member States to determine the concrete

requirements and ways to implement it as before. The EPBD recast 2010 was motivated by the EU expectation to lower the energy consumption by 5-6% across EU member states, slashing CO_2 emissions by 5% by 2020 and to harmonize and strengthen EU legislation and methodologies across all member states.

This Directive is aimed at the reduction of buildings energy consumption by proposing guiding principles for Member States with regard to the energy performance. **Office buildings** are only mentioned as a type of buildings to be taken into account (single family houses, sports facilities, etc…) with regard to the specific energy consumption levels calculation. No further definition or requirements for **office building** are provided.

The total energy demands of the buildings, and therefore of office buildings, consists of several inputs such as heating, cooling, ventilation and lighting. With the EPBD recast 2010 the European Commission has provided a guideline for the EU MSs to evaluate buildings in these inputs. This guideline shall be implemented by each MS regarding their national requirements and standards for construction and refurbishment of buildings. The implementation of this directive in most of the EU-MS is still in progress [Schlenger 2009]. As a result, the comparison of benchmarking for buildings is a complex issue across Europe.

The key points of EPBD recast 2010 are:

- **Member States should set their requirements using their own calculation methodology** with a view to **achieve the cost-optimal levels** determined by them. The MS should adopt, either at national or regional level, **a methodology for calculating the energy efficiency of buildings**, and take into account different elements like: thermal characteristics, heating insulation, air-conditioning and built-in installation, indoor climatic conditions and hot water supply. Also, the positive influence of other aspects such local solar exposure, natural lighting, electricity produced by cogeneration and district or block heating or cooling systems should be taken into account.

- All Member States should set in **place minimum requirements for energy performance with cost-optimal levels.** The level of these **requirements should be reviewed every 5 years**. MS should **differentiate between new and existing buildings and between different categories**. According to this point and although the methodology to calculate the energy performance of an office building might be the same than that of a residential building, the minimum performance should be different.

Prior to the EPBD recast 2010, some MS developed their own methodology to calculate the energy performance of the buildings. In some cases, the methodology only includes some minor changes on the calculation of residential and office buildings energy performance, as for example in Spain. The Spanish methodology considered lighting when calculating the energy performance of an office building, but not of a residential building. Due to the heterogeneity in the methodologies used by each MS, its direct applicability to the EU Ecolabel is not recommended.

- There is **no longer a threshold of 1000m^2 of refurbishment** to fulfil the minimum energy performance. This measure excludes 72% of the buildings stock which disposes of an outstanding, cost-effective energy saving potential. Clearly, the best moment for the introduction of energy efficiency measures is when the building undergoes major renovations (approx. every 25-40 years for residential buildings but approx. every 10 years for office buildings). In this way the additional investment needs are not high and due to energy savings they are repaid within the lifetime of the measures.

- For **existing buildings,** their energy performance should be upgraded so that they also satisfy the minimum requirements. No specific targets are set for the refurbishment of existing private buildings, which account for 99% of the current building stock. However, **public authorities could be required to refurbish at least 3% of their buildings by floor area every year**. The European Commission proposed this in its long-awaited European energy efficiency plan, presented on March 2011 in Strasbourg.

- Some buildings may be exempt from the application of the minimum requirements: officially protected, places of worship, temporary, residential for limited seasonal use or small[2] stand-alone buildings.

- The Directive strongly **encourages the introduction of intelligent energy consumption metering systems**, whether the building is newly constructed or undergoes renovation.

- The **goal of nearly zero-energy consumption** for new buildings by 31 December 2020 is set. For public owned or occupied buildings this deadline is set by 31 December 2018. Furthermore, the Directive encourages the creation of national plans to put in practice the definition of nearly zero-energy buildings, the definition of intermediate targets for improving

[2] < 50 m^2 of total useful floor area.

the energy performance of new buildings by 2015. It also encourages the provision of information on the policies and financial measures adopted to encourage improving the buildings energy performance. Some steps forward have been done, MEPs [MEPS 2011] in the European Parliament define zero-energy buildings as buildings "**where, as a result of the very high level of energy efficiency of the building, the overall annual primary energy consumption is equal to or less than the energy production from renewable energy sources on site**". The Directive does not clearly define what a "nearly zero energy building" is, either for new build or refurbishment of existing buildings. Article 2(1a) gives a purely qualitative definition: **A "nearly zero energy building" is a building that has a very high energy performance.** The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby, [Steering 2011].

- A system of **energy performance certificates for buildings** should be implemented. When the building unit is offered for sale or for rent, the corresponding energy performance indicator should be included in the advertisements in commercial media. For the case of new buildings, the certificate should be shown to the prospective buyer. It should be handed over to the new tenant. For buildings occupied by a public authority or buildings of public use with a total floor area of over 500 m^2, the energy performance certificate shall be displayed in a prominent place and be clearly visible[3].

Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services

The purpose of this Directive is to increase the energy end-use efficiency products and services. The goal is to achieve a minimum annual volume of the 1% in energy savings, and an overall 9% in the period from 2008 to 2016.

There is not explicit mention of office buildings, but the energy saving measures for end users include **guidelines about the insulation of buildings**, the addition of passive solar elements to the outside buildings constructions, the installation of solar thermal systems, etc.

[3] This threshold shall be lowered to 250 m^2 on 9 July 2015.

Directive 2005/32/EC of the European Parliament and of the Council of 6 July 2005 establishing a framework for the setting of ecodesign requirements for energy-using products

This Directive establishes a framework for setting ecodesign requirements (such as energy efficiency) for all energy using products in the residential, tertiary and industrial sectors. The directive does not introduce directly binding requirements for specific products, but does define conditions and criteria for setting requirements regarding environmentally relevant product characteristics (such as energy consumption). This Directive applies in principle to all energy using products and covers all energy sources.

In respect with **office buildings**, heating and water heating equipment, domestic lighting, domestic appliances, office equipment and HVAC systems are considered as a priority in the working plan regarding buildings. These elements are connected with the energy performance of buildings but they are out of the scope of this study.

Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of the Member States relating to construction products

This "Construction Products Directive" [Directive CPD] regulates the products for building works. Products may only be placed in the market if they are fit for their intended use. They should provide for an economically reasonable working life, the essential requirements with regard to mechanical strength, stability, security in case of fire, hygiene, health and safety of use. Furthermore, they should provide protection against noise and help to save energy and provide thermal insulation.

Environmental issues are addressed at the article 3 of the annex I. **The construction work must be designed and built in such a way that it will not be a threat to the hygiene or health of the occupants or neighbours, especially with the giving-off of toxic gas, the presence of dangerous particles or gases in the air, the emission of dangerous radiation, pollution or poisoning of the water soil, faulty elimination of waste water, smoke, solid or liquid wastes, the presence of damp in parts of the works or on surfaces within the works.**

Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives

This Directive [Waste Directive] repeals directives 75/439/EEC, 91/689/EEC and 2006/12/EC and establishes a legal framework for the treatment of waste. It sets the basic concepts and definitions related to waste management and lays down waste management principles such as

the "polluter pays principle" or the "waste hierarchy": 1) prevention, 2) preparing for reuse, 3) recycling, 4) other recovery (notably energy recovery) and 5) disposal. It aims at protecting the environment and human health through the prevention of the harmful effects of waste generation and waste management.

Member States can implement legislative measures with a view to reinforcing this waste treatment hierarchy and take steps to ensure that, **by 2020, 70% of weight of waste non-hazardous construction and demolition waste will be intended for reuse, recycling and other materials recovery operations, including filler operations using waste instead of other materials.**

Concerning **hazardous waste**, it must be **stored and treated in conditions that ensure the protection of health and the environment**. It must not, in any case, be mixed with other hazardous waste and must be packaged or labelled in line with international or Community regulations. Any establishment or undertaking intending to carry out waste treatment must obtain a permit from the competent authorities who determine notably the quantity and type of treated waste, the method used as well as monitoring and control operations.

Any **incineration or co-incineration method aimed at energy recovery must only be carried out if this recovery takes place with a high level of energy efficienc**y.

Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy

The Water Framework Directive [WFD 2000] objectives are to ensure the good quality of running water across Europe by 2015. **The construction sector has a high indirect impact on running water schemes across Europe. Reduced water consumption and waste relating to construction works and products contribute significantly to the fulfilment of the aims and objectives of the WFD.**

The installation of intelligent water-saving technologies in buildings as well as measures to re-use water combined with rainwater usage systems are measures to enhance the quality of European water resources by reducing the pressure on springs and surface waters, and reducing wastewater streams.

5.1.2 EU Regulations and Communications

Regulation (EC) 66/2010 of the European Parliament and of the council of 25 November 2009 on the EU Ecolabel

The aim of Regulation is to establish a voluntary ecolabel award scheme intended to promote products with a reduced environmental impact during their entire life cycle and to provide consumers with accurate, non-deceptive, science-based information on the environmental impact of products.

COD 2008/0098 Regulation of the European Parliament and of the Council laying down harmonized conditions for the marketing of the construction products

A product level, the European Commission is developing a new Construction Products Regulation which will replace the Directive 89/106/EEC. The new CPR proposal involves the obligation to declare (using the "CE" marking), the performance of building products. The proposal includes a new prerequisite for the sustainable use of natural resources during the whole life cycle (design, construction and demolition).

Where applicable, provisions for an intended use or uses of a construction product in a Member State, aimed at fulfilling basic requirements for construction works, determine the essential characteristics the performance of which should be declared. In order to avoid an empty declaration of performance, at least one of the essential characteristics of a construction product which are relevant for the declared use or uses should be declared. Besides, when assessing the performance of a construction product, account should also be taken of the health and safety aspects related to its use during its entire life cycle.

In addition, where applicable, the declaration of performance should be accompanied by information on the content of hazardous substances in the construction product in order to improve the possibilities for sustainable construction and to facilitate the development of environmentally friendlier products. All the hazardous substances will comply and be treated as it is specified in articles 6.6 and 6.7 of the Ecolabel Regulation [Ecolabel 2009].

Communication from the Commission of 11 February 2004. Towards a thematic strategy on the urban environment

The main objectives covered by this Communication are to revitalize and mainstream the environmental management of Europe's largest towns and cities and to overcome isolated policies (buildings, infrastructure, transport, energy, waste, etc.) with a general focus on

sustainable urban management, sustainable urban transport, sustainable construction and sustainable urban design. Within these main objectives the development of a common methodology for evaluating the overall sustainability of buildings and the built environment is the main target of this thematic strategy. Aspects such as the life cycle assessment of buildings and the development of indicators for life-cycle costs are part of this strategy.

The Thematic Strategy on the Urban Environment was adopted on 11 January 2006. It strongly encourages Member States, regional and local authorities to develop programmes to promote sustainable construction. The document focuses not only on energy related aspects, such as increasing the renovation rate, but also on the labelling of building products and strategies for the prevention and recycling of waste.

5.1.3 Green Public Procurement

This is a set of criteria that should be applied to all public tendering processes for public authorities. Since the annual expenditure in new and renovation of existing buildings represents up to 50% for most governments, these criteria are especially important for **offices,** which play a major role [GPP construction].

GPP construction takes into account environmental criteria related to energy consumption, the use of renewable energy sources, the construction materials and products, waste and water management, and other aspects of the environmental impact: the architect's design and the monitoring and user perspective aspects.

Generally speaking GPP criteria are developed with the aim to be simple and universally applicable. However, due to the complexity of the product group, the differing climatic conditions and the differing national legislative frameworks, this goal is hardly achieved. One key point of these criteria is the attention paid to the fact that the energy performance strongly depends on the architect's choices during design. Therefore, it pays attention to the integration of the environmental requirements into the architect's work during the competition procedure for construction work.

Other environmental requirements regarding the percentage of sustainable building materials, the recycling of materials, the reduction of dangerous substances and the energy demand for the construction plot are demanded.

In this case, GPP [GPP construction] gives recommendations for the procurement of construction works, including the supply of related services such as cooling, heating and ventilation services and the provision of electricity. It addresses the design, construction, use

and disposal phase of buildings such as public services buildings and office buildings. For each of these phases environmental criteria are proposed.

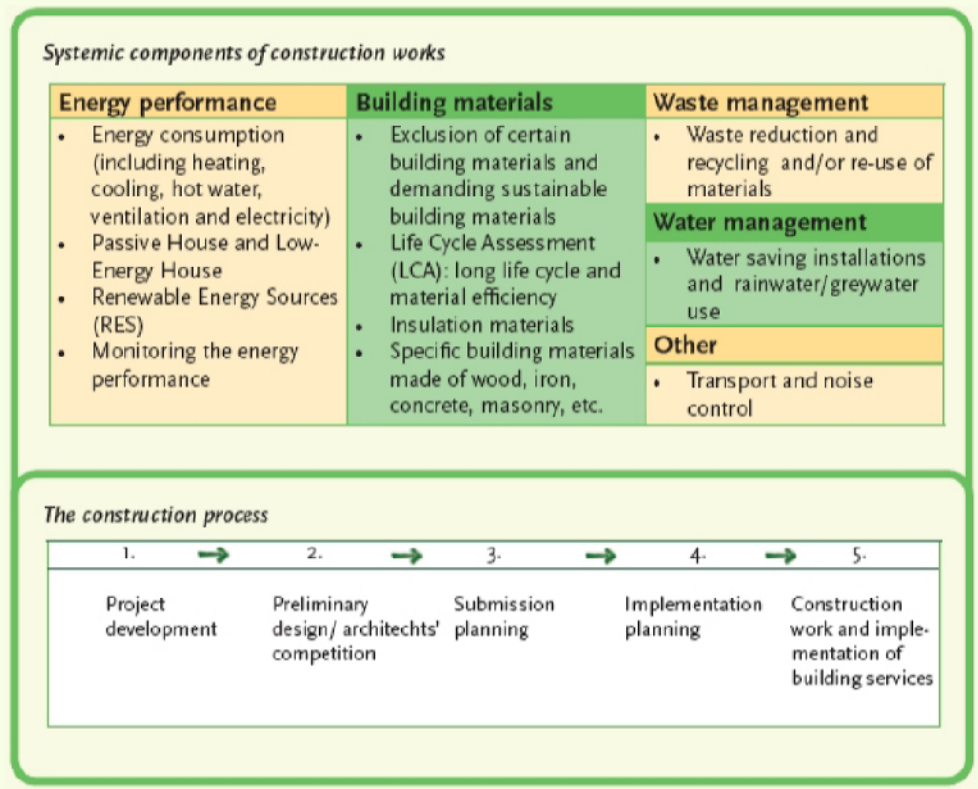

Figure 6: GPP proposed areas for developing criteria regarding construction works [GPP construction]

Table 17 shows the impacts and the areas considered by GPP in order to develop the criteria and Table 18 provides the background technical assessment why these areas are considered to be the most important ones.

Table 17: Key environmental impacts [GPP construction]

IMPACT	GPP Approach
The consumption of energy for heating, cooling, ventilation, hot water, and electricity, and resulting CO_2 emissions	- Maximize the energy performance of buildings - Ensure high energy efficiency standards for heating, cooling, ventilation and hot water systems, and electronic devices - Encourage the use of localised5 renewable energy sources (l-RES)
The consumption of natural resources	- Include a systematic Life Cycle Approach (LCA) for building materials - Encourage the use of sustainably harvested and produced resources
Over-consumption of fresh water resources both during construction and during the use phase	- Encourage the installation of high-end water saving technologies and reduce the use of freshwater during the construction process.
Emission of substances harmful to human health and the environment during the production or disposal of building materials leading to air and water pollution Negative health impacts on building users due to	- Encourage the use of non-toxic building materials - Encourage the use of substitute substances/materials for dangerous building materials

building materials containing dangerous substances	
Transportation of construction materials and products generates CO_2 emissions that have an influence on climate change	- Use energy efficient vehicles for transportation and on the building site - Apply effective supply chain management systems

Table 18: Background study and environmental aspects [GPP construction]

Aspect	Background reason
Production of materials	Raw materials are extracted from renewable and non-renewable resources for the production of building materials. When processing the raw materials into building products, energy and environmentally-hazardous chemicals are needed and harmful emissions to air, water and soil can arise. When planning and constructing a building, the production phase can be influenced by favouring environmentally-sound materials. Possibilities are to use building materials that fulfil the criteria of an eco-labelling scheme and recycled materials and to avoid, where possible, materials containing environmentally-hazardous substances.
Construction	During the construction phase, there can be harmful emissions of substances and materials to air and water. In the surrounding area of the construction site, there might be disturbance from noise and transport of material by heavy vehicles, influencing people and local eco-systems. Environmentally-responsible collection and disposal/recycling of construction waste are important. It is also important to consider the effects of construction processes on the indoor environment during the use of the building, e.g. material and quality controls to prohibit built-in damp damage. Quality management in construction can also be important for ensuring a long life, for proper insulation, and for the correct functioning of the ventilation and heating/cooling systems and other appliances.
Use	The use of energy for space, water heating and ventilation, electrical equipment and lighting cause the largest environmental impacts of a building during its lifetime. Water consumption and the production of waste water are other important impacts of buildings. In the planning and construction phases of a building, it is important to consider the ultimate use of the building and possible reduction of environmental impacts through: - energy efficiency (ventilation, heating and cooling, insulation, lighting, various appliances, etc.) - water efficiency - promotion of good condition and long-life of the building, by, for example, a service and maintenance plan for the house - improving the indoor environment, considering constituent materials/ good ventilation / material and quality control during the construction phase, for example, to prohibit built-in damp damage - including the possibility to alter and modify the inner space (i.e. distribution of rooms and functions like bathrooms and kitchens). The service and maintenance plan ('House care book') should describe the functioning and properties of all the technical equipment, material content as well as appropriate advice for maintenance and repair of all the relevant structures and covering materials, including a timetable for repairs and renovations, etc.
Waste	At the end of a building's life, there are several kinds of waste to be taken care of. Waste amounts can be reduced by ensuring a longer life for the building: a service and maintenance plan for the house can contribute here. Problems during renovations and at the end of life can be reduced/avoided by preventing environmentally hazardous substances in the construction materials.

5.2. Legislation at Member State level

The assess of the environmental impact of buildings in most of the MS is considered, as a general rule, by national programs (some of them of voluntary application) where the building is considered as a whole and the energy performance is the main environmental impact

considered. The improvements in the energy savings depends on the earlier implementation of the EPBD 2002 by the Member States. For example, Denmark, Germany, the Netherlands or the United Kingdom, which went beyond the requirements of the Directive and are now thus in a better position to take on the tasks of the EPBD recast 2010. Regarding this situation, a report called "Towards an Energy Efficient European Buildings Stock" [RICS 2009] was done within the project BUILD UP. In annex II of this document it is summarized part of the information provided.

5.3. Labels at Member State level

Because of the large amount of data collected, all the tables regarding criteria areas and benchmarks are available in the annex III of this document.

5.3.1 France

The voluntary initiative "Haute Qualite Environmentalle" [HQE], the also voluntary but mandatory for all public sector residential buildings[4] Qualitel and an organization responsible for the label (Qualitel) are the main elements of the French green building design. Its objectives are to reduce the environmental impact with both eco-design and eco-management.

HQE bases on a global approach, but with increasingly focus in energy and water management and a greater demand for certification. It is a multi-criteria approach divided into three main components:

- An environmental management system of the operation (SME) where the client sets his objectives and defines the role of different actors;
- 14 targets to structure the technical, architectural and economic answers for those objectives and
- Performance indicators.

Moreover, there are two standards that closely approach office buildings

- **NF tertiary sector buildings: Construction and renovation** that was designed specifically for offices buildings
- NF Tertiary Buildings in Operation

[4] Mandatory for buildings larger than 25 units

Qualitel standard has the dual aim of meeting technical and environmental challenges and coming into action on users' needs, on community's expectations and on assessment for building sector professionals.

The scheme aims at pointing out the targets the building should comply with. Moreover, this scheme developed a document called "model for evaluation of environmental quality of buildings" [MEEQB 2008] that although it does not replace the certification standard HQE it describes the benchmarks and calculation methods that should be used. (see annex III).

5.3.2 Germany

The *German Sustainable Building Certificate* [DGNB] is one of the codes that was developed firstly for **offices** and covers all relevant topics of sustainable construction (ecology, economy, socio-cultural topics as well as functional ones). The evaluation is not based in a single measure (as happens with the French and the English systems) but is based in a list of 51 different criteria. Each criterion is weighted differently, according to "New construction office and administration buildings" code. In this code, 6 topics considered the relevant sectors of sustainable construction evaluate the building's quality and the quality of the location.

To shut up, the DGNB system is a framework with detailed specifications and characteristics for conducting a building LCA. On this basis, benchmarks with two elements (construction and operation) have been derived and can be used to define the life cycle based environmental performance of buildings. Specific data, criteria and benchmarks are listed on annex III of this document.

5.3.3 Spain

GBC Spain, Green Building Council, has established an evaluation system based in the application or the VERDE tool [VERDE]. GBC Spain applies the evaluation methodology for environmental impact of buildings known as VERDE that establishes a total of six Certification levels. It is only possible to certify residential and office buildings. In addition, design stage and construction finished stage would be certified. VERDE methodology makes and approach to LCA of the building. Reduction levels are calculated regarding the impacts associated with environmental and design issues, such as indoor environmental quality and socioeconomic matters. The evaluation procedure is focus only on the building, thus excluding the area outside the building footprint.

In Catalonia, Spain, the "Distintiu de Garantía de Qualitat Ambiental" [DISTINTIU] has established other methodology for the building certification. It is a system to identify products

and services that satisfy certain properties or features involving environmental care. The environmental criteria for the offices building category are divided in ten sections, each of which contains basic specific criteria required as well as optional criteria. All of them rated from 1 to 9, mainly regarding lighting, climatization, energy efficiency in installations and offices machinery, maintenance, waste management, CO_2 emissions, etc. To get the "Distintiu de Garantía de Qualitat Ambiental", the building must meet each basic criteria and obtains a minimum of 80 points in the computation for at least three of the optional ones.

5.3.4 Switzerland

The voluntary "Minergie" has been in effect since 1997. Buildings with such Ecolabel achieve an energy consumption reduction of the 300% (with respect to conventional buildings) with only a 2-4% increase in the construction costs.

This label is divided in four different categories as shown in table 19. In addition, in annex III there is a table with all the information regarding criteria for this Ecolabel.

Table 19: Swiss Minergie Categories

Minergie-standard	- general energy consumption is lower than 75% of that of the average buildings - fossil fuel consumption is lower than 50% of the energy consumption of this building - increase of the costs should be only 10% in comparison to a standard building
Minergie-P	- very low energy consumption, it is specially demanding in regard to heating. This standard corresponds to the passive house
Minergie-Eco	- ecological requirements such as recyclability, indoor air quality, noise protection, etc to the regular requirements
Minergie-Modules	- building components and building equipment elements which are certified as being exceptionally well performing with regard to energy efficiency

5.3.5 United Kingdom

There are two main procedures:

- the mandatory *Code for Sustainable Homes*, for residential buildings [CSH],
- the voluntary *Building Research Establishment Environmental Assessment Method* [BREEAM]. It has a specific scheme for office buildings. See annex III for more detailed information about criteria and benchmarks of this label.

The "Code for Sustainable Homes" measures the sustainability of new buildings in nine different dimensions as shown in Table 20: energy, water, materials, surface water run-off, waste, pollution, health and well being, management and ecology. Each of them has a different grade of flexibility. The result is a single rating for the whole building. These criteria are evaluated at two different stages: design and post-construction being much more demanding that the minimum standards needed to satisfy Building Regulations.

Table 20: The mandatory Code for sustainable homes. Source [CSH]

Category	Flexibility
Energy/CO2 Water	Minimum standards at each level of the Code
Materials Surface water run-off Waste	Minimum standards at Code entry level
Pollution Health and well-being Management Ecology	No minimum standards

The BREEAM single rating of the building aims at assessing the environmental impact of the building using a range of indicators by providing a set of predefined criteria. Many of the criteria set specific performance targets while others are more subjective and harder to quantify and does not cover every possible design solution. The BREEAM code can be applied to new buildings, design stage and post-construction stages and buildings undergoing major refurbishment.

BREEAM Offices is the world's most widely used means of reviewing and improving the environmental performance of office buildings. It can be carried out as three different categories: new built, major refurbishment or fit out. **BREEAM Offices scheme c**overs ten categories of sustainability including: **management, health and wellbeing, energy, transport, water, materials, waste, land use and ecology, pollution and innovation**. Each category consists of a number of issues. When a performance target has been achieved the number of available BREEAM credits can be awarded. It has two main stages, one for the design (interim certificate) and the last one for the Post-construction stage (final certificate).

Apart from the BREEAM scheme for Office Building, some programs have been developed by the Department of Energy, Climate Change and Energy Saving in the UK aiming to reduce CO_2 emissions from buildings. Among these programs, "**Low Carbon Buildings Programme**" [LCBP], supports the installation of combined energy efficiency technologies (such as geothermal heat pumps), renewable energies (solar, biomass, wind or mini hydro stations) and micro-cogeneration in residential buildings, schools and other public buildings and the "**Definition of Zero Carbon Homes and Non-domestic Buildings: Consultation**" [ZCH 2008], sets out the parameters of what is known in UK as "Zero Carbon Homes". A Zero Carbon Home must offer a zero annual CO_2 emissions balance, considering the emissions associated with energy consumption for heating, ventilation, hot sanitary water, lighting, appliances and other devices, as well as the avoided emissions by the energy exported from the grid to the building.

5.3.6 Nordic Swan, Nordic countries

The Nordic Swan Ecolabel for buildings is a combination of requirements for the building process, materials and energy consumption and point score system. Among the developed schemes, the closest one to the scope of this study is the "**Small houses, apartment buildings and pre-school buildings" scheme** [Nordic Swan v2.1], since there is a lack of schemes for offices or non residential buildings. This criteria scheme comprises a combination of obligatory requirements and point score requirements. Reviewed table in annex III of this document, regarding area, criteria and benchmarks proposed by this label.

5.3.7 Overview over mandatory and voluntary legislation in EU Member States

To sum up, the differences and common points between the EU MS labels are as follows:

- <u>Common points</u>:

1. the existence of mandatory and optional criteria. These two kinds of criteria help make difference among the importance of the environmental impacts of buildings. The criteria indicate the potential improvements in the near future and can be considered as the new lines for building development and evolution.

2. Similar general criteria areas such as:

-**Energy** (total energy consumed, pollution associated with building, ACV of the building, energy embedded in materials and processes or on-site generation);

-**Materials** used in the building (or banned hazardous substances, quality and provenance of materials, ability to be recycled or nature thereof);

-**Waste** generated around the same (different stages of life of the building, reusing or recycling them);

-**Indoor environment** (conditions of comfort, day light, illumination, noise, outside views, ventilation or air quality);

-**Water** (greywater and rainwater use, waste water and total water consumption) and finally

-**Management** of all processes (from design, construction, use or dismantling of building).

- <u>Differences</u>:

1. Some criteria areas e.g. **transport, relations with external conditions, green spaces and services for office building or even, land use**.

2. Benchmarks

5.4 Mandatory and Voluntary legislation in Third Countries

5.4.1 New Zealand

The Green Star NZ [GREEN STAR NZ] is a comprehensive, national, voluntary environmental rating scheme that evaluates the environmental attributes and performance of New Zealand's buildings using a suite of rating tool kits developed to be applicable to each building type and function. Green Star NZ was developed by the New Zealand Green Building Council (NZGBC) in partnership with the building industry in order to:

- Establish a common language and standard of measurement for green buildings.
- Promote integrated, whole building design.
- Raise awareness of green building benefits.
- Recognize environmental leadership.
- Reduce the environmental impact of development.

Green Star NZ works by evaluating a building against a number of categories that assess the environmental impact that is a direct consequence of a building's site selection, design, construction and maintenance. The **nine categories included within all Green Star rating tools are: Management, Indoor Environment Quality, Energy, Transport, Water, Materials, Land Use & Ecology, Emissions and Innovation Credits** are awarded within each of the categories based on the building's environmental merits in a range of areas and takes into consideration the unique development requirements and impacts of each sector. In annex IV of this document there is a table with all the areas and criteria proposed by GREEN STAR NZ. Points are then weighted and an overall score is calculated, determining the project's Green Star NZ rating.

5.4.2 Australia

The **Nationwide House Energy Rating Scheme [NatHERS]** enables the design of a home to be assessed by skilled professionals using sophisticated computer modelling programs to improve the quality of design and achieve building approvals in Australia.

Zero stars means the building shell does practically nothing to reduce the discomfort of hot or cold weather. A 5 star rating indicates good, but not outstanding, thermal performance. Occupants of a 10 star home are unlikely to need any artificial cooling or heating.

However, in Australia the most common certification is Green Star [GREEN STAR AU], explained in the previous section.

5.4.3 Japan

The **Comprehensive Assessment System for Building Environmental Efficiency) [CASBEE]** is the main scheme in Japan. It is a quite complex system that it is intended to be applicable to buildings in a wide range of applications. The CASBEE covers the following four assessment fields:

- Energy efficiency.
- Resource efficiency.
- Local environment.
- Indoor environment.

All the criteria established by CASBEE are shown in Annex IV of this document as well the rating system they apply.

5.4.4 Canada

The main initiative is the ***EnerGuide* for New Homes** [EnerGuide], lead by the NRCan Office of Energy Efficiency, aims at promoting the use of cost-effective, energy-efficient building practices and technologies. Introduced over 20 years ago, the R-2000 Standard is continuously upgraded to include new technologies as they become established in the marketplace. The Standard, flexible enough to apply to any type of building, includes requirements related to energy efficiency, indoor air quality and the use of environmentally responsible products and materials without technical regulations specifying construction procedures. Homes are categorized in three different groups:

- **Energy efficiency**: The R-2000 Standard is based on an energy consumption target for each house and a series of technical requirements for ventilation, air tightness, insulation, choice of materials, water use and other factors. The requirements are rigorous – about 40% above building codes. The result is new houses that use at least 30 % less energy than conventional new houses.

- **Comfort ability**: They incorporate a whole-house ventilation system and low- emissions building materials and finishes to ensure superior indoor air quality.

- **Environmentally friendly**: It is the lower requirement. By using less energy, R-2000 houses produce fewer greenhouse gases that contribute to climate change.

5.4.5 United States

The **US Green Building Council** is a non-profit trade organization that promotes sustainability in how buildings are designed, built and operated [LEED]. It is voluntary; however, the distinctive trait is that is a mandatory requirement for certain buildings in many US localities.

The assessments are developed and applied at the design, construction and operational life cycle stages. It considers a broad range of environmental impacts under the following issue categories: **sustainable sites, water efficiency, energy & atmosphere, materials & resources, indoor environmental quality and innovation**. Points are awarded in each of the above areas and the final overall score is calculated. The building is then rated on a scale from Certified (minimum acceptable) to Platinum (highest rating) and a certificate awarded to the development. All the criteria established by LEED are shown in Annex IV of this document.

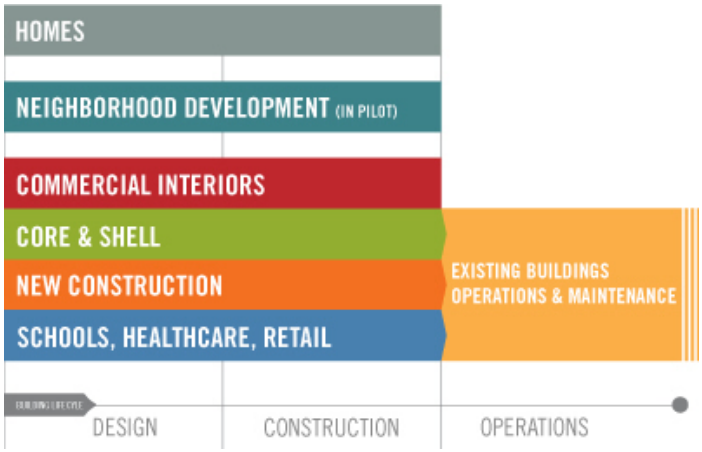

Figure 7: LEED Rating Systems Source: U.S. Green Building Council, USGBC

In addition, the **International Energy Conservation Code 2004 [IECC 2004]** is a model building code for energy efficiency of new buildings with a special chapter for **commercial buildings**. It was launched in 1998 in the United States. Figure 8 is a map regarding the level of acceptance for the code:

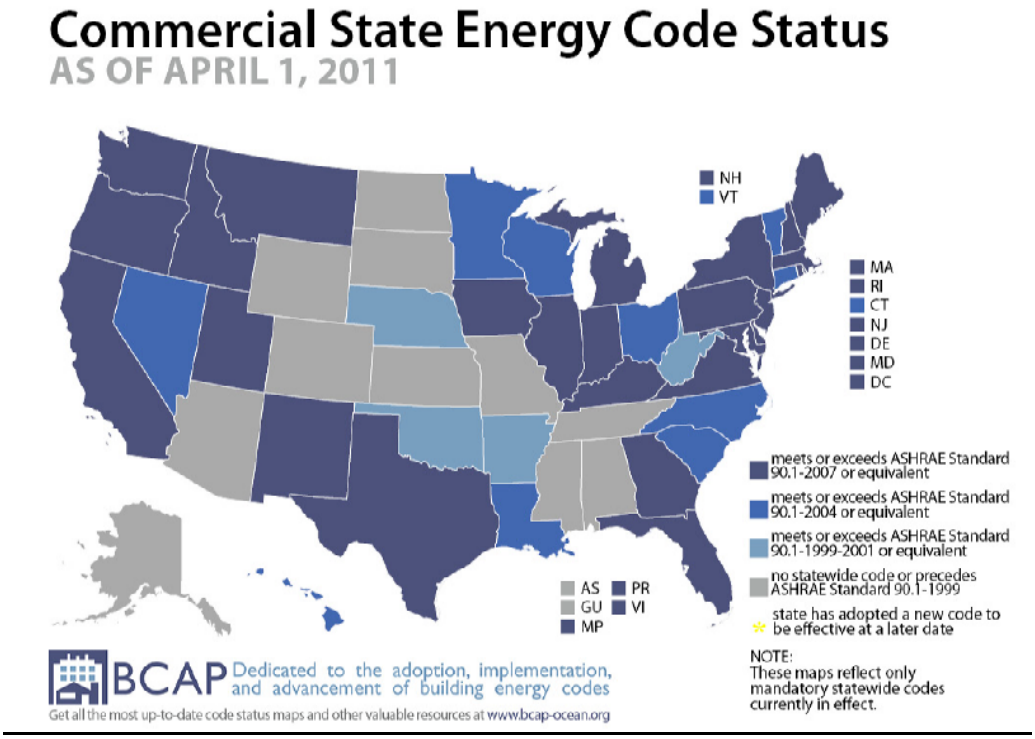

Figure 8: States who has adopted the IECC. Source: BCAP website

The main aim of the code is to set minimum standards that will consistently produce safely constructed buildings. Building code also promotes **use of new materials and building techniques**. Building energy codes are important because they set meaningful thresholds for all new construction and existing buildings, such as:

- Windows: maximum U-factors, air leakage for windows, doors and skylights.
- Insulation: minimum levels of insulation for walls, ceilings, floors, foundations and ducts.

Those are going to be the main criteria areas where the IECC will connect with the development of the EU Ecolabel and GPP criteria.

The code applies for major renovation and refurbishment project too. Rules are based on climatic zones (HDD, CDD and some humidity conditions) and prescriptive values for building parts, heating and cooling systems, ventilation and lighting. Insulation requirements are set as R-values/ U-factors for each climatic zone separately and have to be fulfilled for each building part in the prescriptive model. Some specific regulations are given for pipe and duct insulation, air tightness, sealing, hot water systems, mechanical ventilation and circulation of hot water. Rules for heating and cooling equipments are only given as sizing requirements.

The code is flexible as some aspects of the building can be made less energy efficient as long as the total of the resulting building still fulfils the total requirements, as if all the parts were in accordance with the code.

5.4.6 Other International Initiatives

United Nations Sustainable Buildings and Climate Initiative (SBCI)

The United Nations Sustainable Buildings and Climate Initiative (SBCI) works to promote sustainable building practices around the world by implementing the following process.

- Provide a common platform for the stakeholders for addressing sustainability issues of global significance, especially climate change.
- Establish globally acknowledged baselines based on the life cycle approach, with a first focus on energy efficiency and CO_2 emissions.
- Develop tools and strategies for achieving a wide acceptance and adoption of sustainable building practices throughout the world.

World Green Building Council (GBCs)

Green Building Councils (GBCs) are member based organizations that partner with industry and government in the transformation of their **building industries** towards sustainability through the adoption of green building practices. On the ground in nearly 70 countries, GBCs create change in their local markets as a way to globalize environmentally and socially responsible building practices. WGBC foster new and emerging Green Building Councils by providing them with the tools and strategies to establish strong organizations and leadership positions in their markets.

Green Building Challenge Process

Green Building Challenge (GBC) [GBTOOL] is an international collaborative effort to develop a building environmental assessment tool that exposes and addresses controversial aspects of building performance and from which the participating countries can selectively draw ideas to either incorporate into or modify their own tools.

The goals of the Green Building Challenge process are:

- To advance the state-of-the-art in building environmental performance assessment methodologies.

- To maintain a watching brief on sustainability issues to ascertain their relevance to "green" building in general, and to the content and structuring of building environmental assessment methods in particular.
- Sponsor conferences that promote exchange between the building environmental research community and building practitioners and showcase the performance assessments of environmentally progressive buildings.

The GBC process is managed by the International Initiative for a Sustainable Built Environment (iiSBE), whose web-site is www.iisbe.org. The task of organizing Sustainable Building conferences that include GBC presentations is now being carried out by iiSBE.

GBTool [GBTOOL] is the method used to assess the potential energy and environmental performance of the case-study projects in the Green Building Challenge process. See annex IV of this document for reviewing all the area and criteria proposed by this method.

Centre Scientifique du Bâtiment (CSTB)

CSTB works alongside its subsidiaries to support innovation and act as a trustworthy third party in the building industry, to develop, capitalize and share essential scientific and technical knowledge with its partners and customers so that buildings and their environment provide solutions to sustainable development challenges. Its missions are:

- to provide a solution to sustainable development challenges by implementing an integrated approach to construction, to improve environmental and energy performances taking account of safety and health, adapting to users' needs and achieving economic competitiveness and

- to innovate confidently, from the conception of a product / process until feedback from experience.

Building Technologies Program (US DOE)

The mission of the Building Technologies Program (BTP) is to develop technologies, techniques, and tools for making buildings more energy efficient, productive, and affordable. BTP is focused **on improving commercial and residential building components**, **energy modeling tools, building energy codes, and appliance standards.**

BTP supports research and technological development to reduce energy consumption in residential buildings and commercial. In the US, buildings consume 21% of primary energy consumption and 20% of CO_2 emissions, which is more energy than any other sector; and therefore there is great potential for improving energy efficiency. Moreover, commercial

buildings are accounting for 18% of primary energy consumption and 36% of electricity consumption.

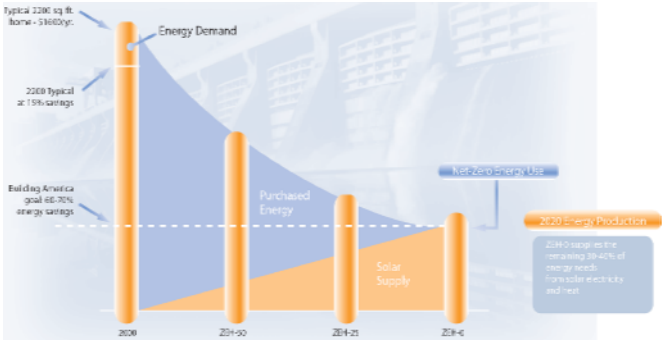

Figure 9: Progression to the goal of zero energy buildings Source: [Huovila 2007]

The BTP promotes the use of more efficient technologies in the thermal envelope of buildings, equipment, lighting, active and passive solar use, regulation and control, etc. At the same time, it aims to optimize building´s design considering the interactions between energy system and building components or materials.

The portfolio of activities includes improving the energy efficiency of building components and equipment and their effective integration using whole-building system design techniques, the development of building energy codes and equipment standards as well as the integration of renewable energy systems into building design and operation. Those technologies and designs´ approaches will achieve zero energy buildings by 2020 for residential and 2025 for commercial buildings.

Task 40-Solar Heating & Cooling Programme & Annex 52-Energy Conservation in Buildings and Community Systems Programme [Task 40-IEA]

The Task 40-IEA, established in 1977, is unique in that it is accomplished through the international collaborative effort of experts from Member countries and the European Union. Main aims are: accelerates the pace of technology development, promotes standardization, enhances national R&D programmes, permits national specialization, and saves time and money.

The Task 40-solar Heating & Cooling Programme & Annex 52-Energy Conservation in Buildings and Community Systems Programme (IEA) are called “Towards Net Zero Energy Solar Buildings”, NZEB. The objective of the Task is to study current net-zero, near net-zero and very

low energy buildings and to develop a common understanding, a harmonized international definitions framework, tools, innovative solutions and industry guidelines. The Task source book and the datasets will provide realistic case studies of how NZEBs can be achieved. This Task will pursue integrated architecture and optimal integrated design solutions that provide good indoor environment for both heating and cooling situations. A goal of the Task is to advance the NZEB concept from an idea into practical reality in the marketplace.

Life Cycle Initiative (UNEP/SETAC)

The United Nations Environment Programme (UNEP) and the Society for Environmental Toxicology and Chemistry (SETAC) launched an International Life Cycle Partnership, known as the Life Cycle Initiative, to enable users around the world to put life cycle thinking into effective practice.

Following the publication of the report on the LCA's state of art in the construction [Kotaji 2003], it was established a working group on this subject. This report describes the main requirements for LCA studies in building and construction procedures, such as selecting an appropriate functional unit, which reflects the requirements of their analysis. It also provides guidelines for consideration future scenarios for the different stages of building's lifetime and stresses the difficulties associated with the allocation of charges and establishing the limits of the system, due to the complexity and longevity of buildings.

The conclusions of various symposia and expert workshops are contained in a final report [Frankl 2007]. The report notes the need to involve businesses, policy makers, universities and research institutes, to achieve an improvement of the DAP through the use of standardized databases, standardization of reporting format and the inclusion of relevant information of the user's safety, health damage and cost of the product. Moreover, some surveys indicated the need to include in the evaluation of the impact, various issues relevant to developing countries, and expand the assessment to various social and economic aspects of sustainability. It also concludes the need for simple and low cost tools. [Udo de Haes 2005]

Green building programme [GBP]

In 2004, the European Commission initiated the Green Building Programme [GBP]. This programme aims at improving the energy efficiency and expanding the integration of renewable energies in non-residential buildings in Europe on a voluntary basis. The programme addresses owners of non-residential buildings to realise cost-effective measures which enhance the energy efficiency of their buildings in one or more technical disciplines. This

initiative was launched because European Commission realised that building sector accounts more than 40% of the primary energy demand [Energy Europe EC]. At the same time, improved heating and cooling of buildings constitutes one of the largest potentials for energy savings.

The programme is divided into different technical modules and their parallel guidelines. Those modules are the base for lunching an Action Plan, in order to define the scope and the measures which will be carried out. Some of them are:

- **Building Envelope**: The Envelope System strongly affects the energy demand of the active systems installed on the building, since it regulates heating and cooling loads and daylight availability. It could achieve 50% energy savings.
- **Sustainable Summer Comfort:** reduce the cooling demand through passive cooling technologies and adopting a new definition of sustainable summer comfort.
- **Heating**: Without doubt most savings are achievable by insulation improvements of the building shell, but also replacing old boilers with new condensing boilers with an efficiency up to > 100% could reduce the energy bill for heating by about 5%.
- **Combined Heat and Power**
- **Solar Hot Water and Heating**: These solar thermal systems are widely applied round Europe, but the programme aims to improve them, resizing them or renovating the components.
- **Air Conditioning**: The best way of reducing energy for air-conditioning is the choice for passive techniques such as solar protection, high thermal mass and night cooling. An assessment should be carried out which will identify the measures applicable to the air-conditioning system, and will include an estimate of the savings, the cost of the measure, as well as the payback time.
- **Lighting:** accounting for up to 1/3 of the electricity used in some office building. Energy savings between 30-50% may be achieved by improving the existing lighting systems. The guideline given, named some steps for improvement: energy efficient lamps and energy connecting devices selection, improvement of luminaries, energy saving lighting control systems, maintenance procedures and at last, design aspects.

- **Office Equipment:** savings about 40 up to 50% are economical feasible and will reduce the energy costs about 200 € per workplace[5]. Working hours and efficiency in every appliance mode are some key points to review. The assessment will point out the measures applicable to the IT system, and will include an estimate of the savings, the cost of the measure, as well as the payback time.
- **Benchmarking:** It provides a useful starting point for individual energy audits and for targeting buildings for energy-saving measures in multiple-site audits.

Concluding, GBP helps EPBD recast 2010 as it will stimulate additional savings in the non-residential buildings, including office buildings. So all the areas herewith studied and also the results will help EU Ecolabel and GPP criteria definition.

5.5 Sustainable Building Standards

Nowadays there are several sustainable building standards which involve different construction techniques and equipment. However, they are more focused on residential buildings and are not easily extrapolable to other type of buildings.

"Solar Houses" standard involves high insulation thicknesses and high solar gain, achieving in fact "Zero-Heating Buildings". The first pilot house was the "MIT Solar House I" [Butti 1980] which included a large area of thermal solar collectors and water storage. A few years later, the "Bliss House" [Bliss 1955] was built, which used air solar collectors and thermal storage in rock. Later, in the late 70's, a housing [Esbensen 1977] and the home of Saskatchewan [Besant 1979] were built with high insulation thicknesses to achieve in both cases, a zero or near zero consumption for heating.

Despite the pilot houses, the suitability of this standard is today doubtful, because depending on the internal loads of the building and the climatology of the location, it may be unsuitable. In addition, the increasing indirect consumption of the buildings is not considered.

Without any doubt, "Solar Houses" have influenced in the current standards of low-energy buildings, such as the **"Passive House"** standard proposed by [IWU] and validated by the Passivhaus-Institut in Darmstadt (Germany). This standard applies the principles of high insulation and air tightness and the implantation of heat recovery ventilation (HRV) systems [Feist 2005]. Currently, the standard is being adopted successfully in Central European

[5] Data found on 5th of May 2011 under http://www.eu-greenbuilding.org/index.php?id=10520

countries like Germany and Austria, while it is spreading to the rest of the world, existing at present more than 15,000 “Passive House” buildings. Table 21 shows the main requirements of this standard.

Table 21: Requirements of the “Passive House” Standard

Maximum heating demand	Maximum energy final consumption	Maximum Thermal Transmittance U for windows	Thermal Transmittance U for walls	Air tightness at 50 Pa
15 kWh/m^2 year	120 kWh/ m^2 year	0,8 W/m^2 K	0,1-0,15 W/m^2 K	0,6 per hour

A standard promoted by both the DOE and the European Parliament is the **“Net Zero Energy Buildings”**. These buildings produce as much energy as they consume in an annual basis and are usually supplied by on-site renewable energy systems. Despite the interest this standard has for the development of EU Ecolabel and GPP criteria, it cannot be directly applied as it does not consider other environmental impacts apart from those caused by the primary energy consumption. For example, it does include either the environmental impacts caused by the secondary energy consumption such as the embodied energy in materials consumed energy during transportation or construction or the environmental impacts caused by other environmental aspects such as the water consumption, waste, etc.

On the other hand, the “**Life Cycle Zero Energy / Emission Buildings**” (LC- ZEB) considers the whole life cycle impact. In this standard, the sum of the Annual Energy Use “AEU” (including heating, cooling, ventilation, hot water and lighting demand) and the Annualized Embodied Energy “AEE” (including the embodied energy in materials and systems during the manufacture, transportation, construction, maintenance, and final disposal stage) must approach zero. Conventional buildings usually have high energy consumption at the use phase and low embodied energy in the building materials while low-energy buildings tend to have higher values of embodied energy. These values are even higher in the net zero energy buildings and in the energy-producing buildings [Blengini 2010]. The LC-ZEB standard would be located usually on the right lower quadrant of the figure 10 and there are several energy and environmental indicators, such as the primary energy consumption, CO_2 equivalent emissions, water footprint, etc that may be used to evaluate the performance of the building.

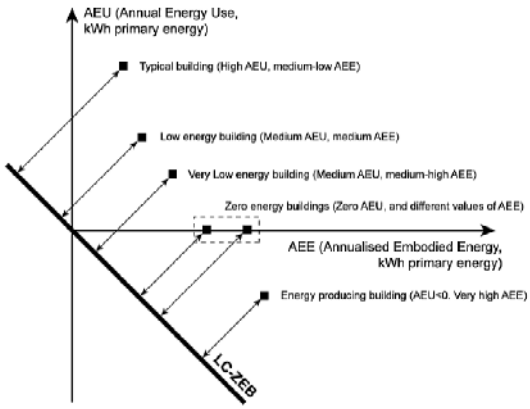

Figure 10: Life Cycle-Zero Energy Building (LC-ZEB) Standard. Source: [Hernández 2010]

Therefore, this standard follows the LCA of the buildings, which allows considering the environmental impact in all the stages of their life cycle, including the production of the building materials and equipment, the transportation and construction, the use and maintenance, and the final disposal. At present, the current legislation is leading to the minimization of the direct energy consumption of the building during the use phase. This energy consumption accounts on average for 60-70% of the total environmental impacts but it strongly depends on the type of building, constructive solutions and climatology. If the use phase energy consumption decreased, the environmental impacts coming from other phases would increase [Zabalza 2010] and consequently their importance in the whole LCA.

Therefore, the mentioned authors [Blengini and Zabalza 2010] are in favour of using LCA analysis for buildings, as a global methodology of energy consumption calculation and total environmental impacts, what is agreed with the methodology proposed by the Ecolabel regulation [Ecolabel 2009].

5.6 Comparison and analysis of existing Ecolabel Criteria for Office Buildings

5.6.1 General requirements for EU Ecolabel criteria

According to the EC Ecolabel Regulation [Ecolabel 2009] the criteria developed in this study should be based on the environmental performance of the office buildings along their whole life cycle and be based on a scientific basis.

Therefore, based on the literature and label schemes reviewed, the most significant environmental impacts are the impacts on climate change, nature and biodiversity, energy and resource consumption, generation of waste, emissions and use and release of hazardous substances.

Taking into account those considerations, several criteria areas can be suggested for the development of the EU Ecolabel. These criteria areas as well as the criteria benchmarks proposed are compared across the most important MS Ecolabel schemes in this section.

- Energy consumption criteria

Total energy consumption is the main criterion in most of the MS Ecolabel schemes. The benchmark related to the total energy consumption of the building is addressed in different ways such as:

- limiting the total primary energy consumption (in kWh/m^2a or MJ/m^2/y)
- requiring a percentage of improvement (between 5-25% depending on the type of building) in comparison to a reference building energy consumption
- limitation in the CO_2 or GHG emitted (using the indicator: kg CO_2 eq/m^2/y)
- limitation in the used of CFC-based refrigerants.
- combination of the above measures.

The **promotion of on-site renewable energy production** is also a common criterion of most of the MS Ecolabel schemes. This criterion is addressed in two different ways:

- a percentage from the total energy supply (between 1- 12% of the energy self-supply)
- requiring a minimum production (15-20 MJ/m^2/year).

Finally, a benchmark dealing the **heat transmission across the walls, windows, facades, roofs,** etc is proposed. These benchmarks can be suggested as:

- a maximum or minimum U-value,
- a maximum GWP value
- a comparison of these values to a reference building.

A summary of the criteria and benchmarks proposed in the MS labels is presented in Table 22.

Table 22: Comparison of energy consumption criteria (I)

Ecolabel	Energy consumption	CO_2 emissions	Renewable on-site production	Thermal transmittance values (U-values)
LEED [LEED]	Improvement referred to a ref building: >10% new buildings >5% existing ones	Zero use of CFC-based refrigerants	1-12% on-site RE Solar, wind, geothermal, low-impact hydro, biomass and bio-gas strategies	-
GREEN STAR [GREEN STAR AU]	No data	No data	No data	No data
CASBEE [CASBEE] (PAL value)	ERR value, 5-25% primary energy saving referred to 1870	< 75% CO_2 of reference value	0- 20 MJ/m^2/year of natural energy usage 0- 15 MJ/m^2/year of RE usage	Outer Walls U=3.0 - 6.0 W/m2K Others Walls: U=1.0 - 3.0 W/m2K

	MJ/m^2/y)			
BREEAM [BREEAM]	43 kWh/m^2 a	zero ozone depleting potential Based on EPC rating: ≤63 $kg_{eq}CO_2$/year/m^2 new buildings ≤100 $kg_{eq}CO_2$/year/m^2 refurbishments	On-site RE production feasibility study 10-15% of local RE	Insulation index calculation Insulation material with GWP<5
HQE [HQE]	≥ 20% gain in primary energy use, or THPE level in current legislation, Cep ≤ $Cep_{réf}$	< 20-10 kg_{eq} CO_2/m^2/y SHON	- Feasibility study - % of the energy coming from different RE	$U_{bat} < U_{bat, base}$ $I_4 < I_{4, reference}$
DGNB [DGNB]	Ecobalance and calculation of EnEV Non-renewable primary energy calculated in kWh/m²NFA*y		Specifications of EnEV 2007, DIN 410 and DIN EN 12207 - 15 % of the heat demand by solar heat.	- $U_{building}$ - thermal bridges - permeability of joints - condensate - air change rate
VERDE [VERDE]	<20% consumption of reference value (MJ/m2)	Different rates for lighting, heating, cooling and SHW	Use of RE above CTE requirements (MJ/m2)	Current legislation CTE
GBTOOL [GBTOOL]			Adaptability to future changes in type of energy supply as renewable	-
DISTINTIU [DISTINTIU]	< 15-25 % of reference building Record energy consumption	-	Use of RE depending on the % of performance on the law requirements	For windows and façade holes Max.:2,97 W/m2K Min.: 2,31 W/m2K

The energy consumption of the buildings is also influenced by the energy consumption of the appliances, lighting and ventilation. These three criteria areas are addressed in most of the MS labels as well, as presented in Table 23.

The use of Ecolabel appliances is out of the scope of this study and therefore, these authors will not addressed this issue in this work. The **daylight harvesting** as well as other parameters and indicators dealing with daylight and lighting are widely suggested. This criterion is addressed by:

- minimum daylight factors (DF > 1-2%),
- minimum floor area with day lighting,
- minimal efficiency of the fittings
- maximum exploitation of the daylighting.

The **ventilation** also influences the energy consumption of the building as the temperature of the incoming fresh air is not the same as the room temperature. Moreover, ventilation can be carried out by using mechanical or natural ventilation systems. This criteria area is addressed by

- setting up the maximum ventilation rates
- promoting the natural ventilation
- a percentage of the needed airflow rate.

Table 23: Comparison of energy consumption criteria (II)

Ecolabel	Use of Ecolabelled appliances	Daylight harvesting	Ventilation rates
LEED [LEED]	-	> 75% of the regularly occupied spaces must have day lighting	Natural and mechanical ventilation differences 0.4 l/s/m2
GREEN STAR [GREEN STAR AU]	No data	No data	No data
CASBEE [CASBEE] (PAL value)	high efficient equipment use monitoring for efficient operation	Daylight factor 1 – 2.5 % Daylight sensors	1.2 or 1.4 times the volume required law level
BREEAM [BREEAM]	Use of appliances of low energy consumption	40-75% energy efficient fittings, Minimal DF=2%	Provide air cross flow compliance with legislation natural ventilation where possible
HQE [HQE]	Select efficient equipment no specifications	> 40% of surface sensible to daylight	No rates are given Natural ventilation versus mechanical one
DGNB [DGNB]	Promote labelled appliances usage	use daylight, low energy lightings, automatic controls No glaring and visibility to the exterior	10-20 m3/h/ m2
VERDE [VERDE]	Electrical devices must be class A in terms of energy efficiency	DF≥ 1% of general value	≤15% of airflow nuisance reference value
GBTOOL [GBTOOL]	-	Provision of daylighting and avoid glaring	Mechanical ventilation Naturally ventilated one side spaces Naturally cross ventilated spaces
DISTINTIU [DISTINTIU]	70% of the electrical devices must be class A	Maximum exploitation of daylight	-

-Selection of building material criteria

The materials used in the building take great importance in all MS label schemes. This approach is formed from a small inventory provide by the designer or owner. These criteria address:

- **presence of recycled and reused materials**, trough the weight percentage of them
- materials with some sort of ecolabel standard
- **nature of the material sources**, especially if they are made of wood and therefore what percentage of weight comes from sustainable forestry
- **transportation** and on site placing of construction materials rewarding the use of local materials or even the need of LCA analysis
- **durability/maintenance** proposed will promote the use of long life materials and low maintenance ones

Table 24 specifies some of the benchmarks used by these European environmental schemes in terms of construction materials choice are concerned.

Table 24: Comparison of building material criteria (I)

Ecolabel	Use of recycled materials	Use of reused materials	Use of wood based materials	Transportation limitations	Maintenance / Products durability
LEED [LEED]	55-95% of existing structure of the building <50% reuse of interior materials 10-20% of recycled materials 5-10% of reused materials		> 50% (based on cost) of certified wood-based materials	10-20% use of locally sourced materials	Rapidly renewable materials: bamboo, agrifiber, cotton insulation, linoleum, wheatboard, wool, strawboard and cork
GREEN STAR [GREEN STAR AU]	No data	No data	No data	No data	No data
CASBEE [CASBEE] (PAL value)	Minimum of different labelled recycled materials	enhance the reusability of materials	<50% of timber from sustainably managed forests, m3	-	- restrict the growth of mites and mold, - facilitate cleaning and maintenance - ease of equipment renewal
BREEAM [BREEAM]	Responsibly sourced (primary and finished materials)		Responsibly sourced		
HQE [HQE]	Choice materials for a long life and easy to be adapted		>30dm3/m² volume of FSC or PEFC certified wooden materials	Decrease air pollution during the construction phase	- ease maintenance - low environmental impact materials -designs during the operation phase
DGNB [DGNB]	Promote recycled materials use	-	Range of use: 20-50% of FSC- or PEFC certificated wood or wood-based materials, No use of tropic, sub-tropic, or boreal wood	< 50% products' impacts as $E_{consumption}$, Water consumption, Climate change impact, generated Waste and resources consumption	Long life materials, Ease maintenance, removal and separation when demolishing
VERDE [VERDE]	Calculate % the materials suitable for reusing or recycling		-	LCA report is convenient	LCA report is convenient
GBTOOL [GBTOOL]	% recycled materials and their quality	-	% wood certified by sustainable forestry	-	Protection of materials from destructive elements
DISTINTIU [DISTINTIU]	> 2 material families with ecolabel /type 1 >50% prefabricated materials		-	-	-

-Water consumption criteria

Water consumption is an issue that appears in most European schemes due to its importance for general buildings. In the case of office buildings its importance is much lower because of the lower water consumption of this kind of buildings.

Water consumption is addressed in the MS labels by means of the following criteria:

- limitation of the global consumption n l/m2 or day

- **water saving measures** in water demanding services and in irrigation
- installation security against floods and water leaks
- a **good management** promotion among the users and owners of the office building.
- the possibility of **collecting rainwater or onsite treatment**, On one hand, the usage of rainwater for non potable uses, but the definition of such a measure in percentage, is too restrictive. Most buildings do not have that possibility, either because their site situation or simply by default separated water network. On the other hand onsite treatment for waste water could not be economically efficient, as the offices do not consume large amounts of water, becoming this criterion unsustainable.

Table 25: Comparison of water consumption criteria (I)

Ecolabel	Water consumption	Flow rate for appliances	Water leaks	Water waste treatment	Harvesting rainwater
LEED [LEED]	use 30% less water than the water use baseline calculated for the building For irrigation reduce 50% of the potable water consumption	Toilets: 1.6 gallons per flush Urinals: 1.0 gpf Lavatory: 0.5 gallons per minute at 60 psi Showers: 2.5 gpm at 80 psi Water Sense-certified fixtures and fixture fittings should be used	-	Packaged biological nutrient removal systems, constructed wetlands and high-efficiency filtration systems as treatments on site	Use only captured rainwater, recycled wastewater, recycled gray water or water treated and conveyed by a public agency specifically for non potable uses for irrigation
GREEN STAR [GREEN STAR AU]	No data	No data	No data	No data	No data
CASBEE [CASBEE] (PAL value)	Water-saving equipment must be used. Examples for toilets, showers, etc	-	-	Simple filtration and storage tanks in case of a natural disaster	Simple filtration system allowing conversion of rainwater to potable water
BREEAM [BREEAM]	Maximum 5.5m3/person/year	Determine the effective flush volumes and flow rates for WCs, urinals, taps and showers	Install a major Leak Detection System	-	If any rainwater collection or grey water recycling systems are specified for the purpose of meeting WC/urinal flushing demand, determine

					some information
HQE [HQE]	Water consumption 20-40% reduction, either drinking either secondary uses	CC toilets ≤ 0.7 CCref toilets Flushing: 6 l/flush Urinal: 3,8 l/flush Basin: 10 l/min Shower: 14 l/min	Soil permeability and urbanization problems, Coefficient of waterproofing	Necessary depending on the contamination source. Pretreatment and then in situ procedures Compliance with actual legislation	Provide a feasibility study and if possible use rain water or wasted water
DGNB [DGNB]	Potable Water consumption+ sewage emergence = the "specific water-use value"	-	-	In situ treatments (filtration, storage) Infiltration or usage of storm water	Usage of storm water for flushing
VERDE [VERDE]	Reduction of the consumption < 30% reference value	Determine the effective flush flow rates for WCs, urinals, taps and showers and compare with the reference rate	-	-	Provide if possible rainwater or grey water collection
GBTOOL [GBTOOL]	Annual net amount of potable water per person used in the case-study building: m3/person/year	There are some rates and differences among the appliances	Provision of leak detection system covering all main water and gas supplies	The removal and treatment of grey water but not wasted water	Promote re-use of grey water and captured rainwater on site m3/m2/year
DISTINTIU [DISTINTIU]	-	Maximum values Shower: 10 L/min Taps: 8 L/min Urinal: 6 L/flush Presence detection and flow restrictions	-	-	-

-Waste management criteria

Waste management is addressed by:

- the recycling of all waste: paper, plastics, cardboard and electrical and electronic equipment
- proposing a **management plan and** providing a good handle of the waste
- the need of **storage space** for recycling materials has to be visible, orderly and accessible to staff

- writing a plan for **recycling-recovery and valorisation of waste**; this should be the logical order. Normally these criteria are given in percentage of weight or in relation to the m^2 of office

- promoting the reuse of **construction and demolition waste** in new building constructions

Table 26 lists the various benchmarks and purchase in relation to waste management.

Table 26: Comparison of waste management criteria (I)

Ecolabel	Valorization of the construction waste	Reuse of the construction waste	Recycling of the construction waste	Operation waste separation
LEED [LEED]	Identify local waste handlers and buyers for glass, plastic, metals, office paper, newspaper, cardboard and organic wastes Use landfills as last possibility Instruct occupants on recycling procedures 50-75% recycled debris			Designate an area for recyclable collection and storage
GREEN STAR [GREEN STAR AU]	No data	No data	No data	No data
CASBEE [CASBEE] (PAL value)	-	% of the existing building is used for the new one	Installation of equipment for waste reduction, compaction or composting	Storage area and separation are needed
BREEAM [BREEAM]	Write a Site Waste Management Plan Showing the amounts of waste generated, valorization choice included	Amount of reused or recycled materials should be over 25% (by weight or volume) of the total high-grade aggregate uses for the building		Provide a proper Recyclable Waste Storage >2m^2 per 1000m^2 of net floor area for buildings <5000m^2 > 10m^2 for buildings ≥5000 m2 + 2m^2 where catering is provided
HQE [HQE]	>20 % of the total waste mass generated, better on site	Maximize the weight of waste reuse in construction phase	>30% of the total waste mass generated	Hazardous waste DD Inert waste DI Packing waste Normal Industrial waste DIB
DGNB [DGNB]	Waste that is neither avoidable nor salvageable should be ecologically disposed	Recapture homogenous deconstruction materials and extract high-grade recycling materials		Characterization: 1. Building services 2. Non-structural (de)construction parts 3. Non-bearing carcass structure 4. Bearing carcass structure
VERDE [VERDE]	-	-	Best practice 90% of recycling benchmark	Compliance with current legislation
GBTOOL [GBTOOL]	-	% of retained of old structure or	% of total weight-recycling of steel from existing	% by weight of solid wastes coming from different phases and origins

		existing materials as part of the new building	structure	
DISTINTIU [DISTINTIU]	-	-	-	Good characterization and separation Provide enough space for storage

-Indoor air quality criteria

The indoor environment in the office appears as one of the most critical areas and studied concerning the quality of air, daylight, outside views

The MS labels address these criteria by:

- limitation or benchmarks for some substances/characteristics such as CO, NOx, humidity level, and temperature, all of them connected directly with comfort conditions established for offices.

- **limit the use of certain compounds especially defined as hazardous materials** in paints, varnishes and building materials that can emit to the indoor environment. Some of these compounds are listed in the following tables 27 and 28.

- promote the proper use of ventilation, mechanical and natural, air exchanges, etc.

- outside views and the amount of artificial and natural light workplace counts with

Table 27: Comparison of indoor air quality criteria (I)

Ecolabel	Toluene	NO_x	Pentachlorophenol (PCP)	CO	Total Volatile Organic Compounds (TVOC)
LEED [LEED]	-	-	-	9 part per million and no > 2 parts per million above outdoor levels	Maximum concentration 500 micrograms per m^3 Usage of low emitting materials
GREEN STAR [GREEN STAR AU]	No data	No data	No data	No data	No data
CASBEE [CASBEE]	Building materials that are free of substances designated under the PRTR current Law (toluene, PCBs, etc)	NOx/SOx emission guidelines for small combustion equipment (Ministry of the Environment) Concentration <90% of reference value	-	-	Low emission levels of VOCs and other formaldehyde
BREEAM [BREEAM]	-	Max. NO_x emissions from heating energy are ≤100 mg/kWh (at 0% excess O_2)	-	-	Define and measure them, but no limitation
HQE [HQE]	-	-	-	-	Max. presence in Floors:1000 µg/m^3 Walls: 1000 µg/m^3

					materials
DGNB [DGNB]	-	-	-	-	Choice of low-emission products Measure fugitive organic substance (VOC)
VERDE [VERDE]	-	< 70 mg/kWh, best practice 30 mg/kWh	-	-	90% of total material weight with low content of VOC
GBTOOL [GBTOOL]	-	Annual kg of SO_2 equiv.normalized for area: kg of SO_2 equiv /m^2/year Regarding also NOx	-	-	eliminate or control the emission of VOC regarding: floors, maintenance, paintings, adhesives
DISTINTIU [DISTINTIU]	-	Max. emissions 70 mg/kWh	-	Max. emissions 80 mg/kWh	-

Table 28: Comparison of indoor air quality criteria (II)

Ecolabel	Polychlorinated biphenyls (PCB)	Formaldehyde	Etc.
LEED [LEED]	-	Max. concentration 27 parts per billion	Monitor CO2 concentrations
GREEN STAR [GREEN STAR AU]	No data	No data	No data
CASBEE [CASBEE] (PAL value)	-	-	Reduce the risk of legionellosis in operation
BREEAM [BREEAM]	-	Included in TVOC	Microbial Contamination Reduce the risk of legionellosis in operation
HQE [HQE]	-	Max. presence in Floors: 62,5 µg/m^3 Walls: 125 µg/m^3 materials	Cancinogenic 1 and 2 max. presence is 5 µg/m^3
DGNB [DGNB]	-	-	-
VERDE [VERDE]	-	90% of total material weight with low content of formaldehyde	-
GBTOOL [GBTOOL]	-	-	-
DISTINTIU [DISTINTIU]	-	-	-

-Construction, demolition and other criteria

Some criteria related to this criteria area are:

- Important issues such as **façade orientation** or proper **site selection** will be included,
- good planning and the **use of dismantled/demolition materials** are a good way to quantify the last phase, so demolition of the building. In addition, special attention should be noted for managing hazardous or forbidden waste.

Concluding, not use or operational phase but the above mentioned, are somehow ambiguous and heterogeneous in all the schemes, making different objectives and scopes for the same objective.

Table 29: Comparison of construction, demolition and other criteria (I)

Ecolabel	Site selection	Use of previously developed sites	Non hazardous waste disposal	Etc.
LEED [LEED]	Give preference to sites that do not include sensitive elements or restrictive land types	Brownfield redevelopment	Develop and implement a construction waste management plan	Site development, density and community connectivity, transportation, parking capacity are some issues LEED takes into account
GREEN STAR [GREEN STAR AU]	No data	No data	No data	No data
CASBEE [CASBEE] (PAL value)	Take care of the Off-Site Environment Urban development and integration with the existing		-	-
BREEAM [BREEAM]	-	> 75% of the proposed development's footprint is on an area of land which has previously been developed for use by industrial, commercial or domestic purposes in the last 50 years	-	Completed a pre-demolition/pre-refurbishment audit of the existing building in order to maximize the recovery of material from demolition or refurbishment
HQE [HQE]	Optimization of the land use, m^2	-	Promote reuse, recycle and valorize on site Waste planning must be done as legislation requirement	-
DGNB [DGNB]	Land use m^2 In which degree/sense the type of area consumption is changed	Recovery of contaminated locations	-	-
VERDE [VERDE]	Amount of land use m^2	-	-	Maximize the recycling of demolition materials, best practice 50% of total
GBTOOL [GBTOOL]	Use of land and change in quality of land: m^2 land per m^2 net area	-	-	-
DISTINTIU [DISTINTIU]	-	-	-	-

6. Conclusions

As conclusions of the first task: Product definition and categorization of the "Technical background study in support of environmental product policy for buildings" the following ones are drawn

- **Definition of office building as product**: a building which contains administrative, financial, technical and burocratic activities as core representative activities. The office area must make up a vast majority of the total building´s gross area dedicated to purpose providing a service to other companies or to individuals. Therefore, it could have associated other type of spaces, like meeting rooms, training classes, staff facilities, technical rooms, etc.
- **Categorization of office building sector** should be done regarding:
    - **Building age**: the office buildings will be divided into:
        - *new office buildings*: those constructions that result in a new stand alone structure or extension to an existing structure
        - *existing office buildings*: construction that results in the fundamental remodeling or adaptation of existing elements of the building envelope, structure and renewal of key building services
        - *renovation of the office buildings*: a building or structure that already exists. It also includes maintenance and operation activities.
    - **Climate zone**: Six climatic zones have been established from which only four are present In Europe. In the categorization HDD and CDD are considered in these categories.

- The construction sector is a strong regulated sector not only in Europe but also all over world. This legislation includes directives, regulations and communications that have been to a certain extend transported into the national legislation of the MS. This fact causes that the mandatory benchmarks to be fulfilled are not the same and depend on the location of the building. In addition, in most MS labels and agreements are already proposed which aim at awarding the best environmental performance buildings. Although the variety of voluntary agreements is impressively high, there are some common points that are addressed in most of them:
    - a scoring system is mainly used in the MS ecolabels. This system can include mandatory benchmarks as well as optional benchmarks to be fulfil

- the criteria areas as well as criteria statements are similar in most of these MS labels.

Among the criteria areas, those repeatedly addressed are

-energy consumption

-building materials selection

-water consumption

-waste management

-indoor air quality

The level of ambition regarding the overall environmental performance strongly depends on the architects' design. T**he design phase is a key phase** for reducing the environmental impacts of the buildings, as most of the performance characteristics will be defined during this phase. Therefore, the EU Ecolabel criteria developed for new buildings can be focused on this phase

However, there are existing buildings where the design phase is over. In this case other phases such as **maintenance or operational phases** become relevant. These phases are proposed to be modified by the accomplishment of the EU Ecolabel criteria encouraging users to have a better environmental behaviour.

Existing legislation and voluntary agreements seem to promote a better environmental performance of the new and existing building stock. This fact will cause a minimization of global environmental impacts of building sector. The harmonization and implementation of the legislation and agreements gives Europe a common vision and mission towards sustainable development, where the buildings take a major role, as they are responsible for 40% of energy consumption and 36% of EU CO_2 emissions [Energy Europe EC].

LCC and LCA are well-known useful instruments for the assessment of building performances and therefore they will be used in the coming sections for the economical and environmental evaluation of the proposed models.

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http://www.cen.eu/CEN/Sectors/TechnicalCommitteesWorkshops/CENTechnicalCommittees/Pages/WP.aspx?param=481830&title=CEN%2FTC+350

[Energy Europe EC] Energy Europe website, European Commission.
http://ec.europa.eu/energy/efficiency/buildings/buildings_en.htm

[EnerGuide] Natural Resources Canada. http://oee.nrcan.gc.ca/residential/energuide-for-houses.cfm

[EPBD recast 2010] DIRECTIVE 2010/31/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 May 2010 on the energy performance of buildings (recast).

[EP HCP] European Parliament legislative resolution of 18 January 2011 on the Council position at first reading with a view to the adoption of a regulation of the European Parliament and of the Council laying down harmonized conditions for the marketing of construction products and repealing Council Directive 89/106/EEC.

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[GBTOOL] GBTool is the method used to assess the potential energy and environmental performance of the case-study projects in the Green Building Challenge process. GB / SB Challenge: Green Building Challenge/Sustainable Building Challenge.
http://www.iisbe.org/sb_challenge

[GPP construction] GPP construction technical background report .Green Public Procurement, construction works, and product sheet.

[Graf Klein 1982] Judy Graf Klein, Facts on File, Inc. “The office book: ideas and designs for contemporary work spaces”. Published on 1982, by the University of Michigan. ISBN 0871964996, 9780871964991.

http://ec.europa.eu/environment/gpp/pdf/toolkit/construction_GPP_product_sheet.pdf

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[GREEN STAR NZ] Green Star environmental rating system for buildings, developed by the New Zealand Green Building Council (NZGBC).
http://www.nzgbc.org.nz/main/greenstar/elaboration/ratingtools/nzoffice

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[IECC] International Code Council. http://www.iccsafe.org/Pages/default.aspx

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[ISO-TC-59] International Organization for Standardization.

http://www.iso.org/iso/iso_technical_committee?commid=49070

[ISO-TC-205] International Organization for Standardization.

http://www.iso.org/iso/standards_development/technical_committees/list_of_iso_technical_committees/iso_technical_committee.htm?commid=54740

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[IWU] Institute for Housing and the Environment, Germany. http://www.iwu.de/en/

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[LCBP] Low Carbon Buildings Programme. http://www.lowcarbonbuildings.org.uk

[LEED] U.S. Green Building Council. http://www.usgbc.org

[LMI 2007] Lead Market Initiative.

http://ec.europa.eu/enterprise/policies/innovation/policy/lead-market-initiative

[Market initiative 2007] European Commission. A lead market initiative for Europe. Brussels, Belgium 2007.

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[NAIOP] the Commercial Real Estate Development Association In the United States. http://www.naiop.org/

[NatHERS] The Nationwide House Energy Rating Scheme, Australia. http://www.nathers.gov.au/

[Nordic Swan v2.1] Nordic Ecolabelling of Small houses, apartment buildings and pre-school buildings. Version 2.1, from 15 December 2009 to 31 December 2014.

[PRODCOM LIST 2010] PRODCOM LIST 2010, classification of products' families http://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LST_NOM&StrLanguageCode=EN&IntFamilyCode=

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2. Annex I: Standards at Member State level

The previous commented standards (section 4.1) are not homogeneously implemented across Europe. Table 30 shows the different level of implementation of CEN and European standards at Member States level.

Table 30: Level of implementation of CEN standards in national legislation related to energy performance of buildings [GPP construction]

Country	Name	(EN) Number	Year	Link
Austria	OIB -Guideline	ÖNORM B 8110-1	2007	http://www.onnorm.at/publish/normung_europa.html?&L=0%3BL%3D053D0 http://www.oib.or.at/
		ÖNORM B 8110-2		
		ÖNORM B 8110-3		
		ÖNORM B 8110-4		
		ÖNORM B 8110-6		
		ÖNORM B 8110-5		
		ÖNORM H 5055		
		ÖNORM H 5056		
		ÖNORM H 5057		
		ÖNORM H 5058		
		ÖNORM H 5059		
		ÖNORM EN ISO 13790: 2004	2006	https://www.onnorm.at/ecom/?LANG=DE&_requestid=48873
Germany	DIN Standars	DIN V 4108-6	2003-2006	http://www.din.de/cmd?level=tplhome&contextid=din
		DIN V 4701-10	2003-2008	http://www.din.de/cmd?level=tplhome&contextid=din
		DIN V 18599 (Part 1-10)	2005	http://www.din.de/cmd?level=tplhome&contextid=din http://www.ibp.fhg.de/wt/berichte/2004/jb_04_43.htm
		Energieeffizienz von Gebäuden - Berechnung des Energiebedarfs für Heizung und Kühlung (ISO/DIS 13790:2005); Deutsche Fassung prEN ISO 13790:2005	-	http://www.din.de/cmd?workflowname=dinSearch&languaged=de
Ireland	Dwellings Energy Assessment Procedure-DEAP		2007	www.sei.ie/epbd/deap
UK	Standard Assessment Procedure-SAP		2007	http://www.sapappendixq.org.uk/page.jsp?id=1
	-	BS EN ISO 13790:2004	2004	http://www.bsiglobal.com/en/Shop/Publication-Detail/?pid=000000000030103903
Italy	UNI standards	UNI EN ISO 13790:2005	2005	http://www.uni.com/it/normazione/en_recep.htm
France	RT2005	RT2005	2000-2005	http://www.rt2000.net/ http://www.infociments.fr/infocim/M2/RT2000.pdf http://www.thermexcel.com/french/ressourc/rt

				2000_rt2005_rt_2000_rt_2005.htm
Belgium	Flemish Region		2007	http://www.energiesparen.be/energieprestatie/#software http://training.eebd.org/page.aspx?id=126&ui=en&lang=en&ap=1
Denmark	Sbi-direction 213: Energy demand in building		-	http://www.sbi.dk/miljo-ogenergi/energiberegning/anvisning-213-bygningers-energibehov
The Netherlands	Energieprestatie	NEN 5128:2004 (residential buildings) NEN 2916:2004 (non-residential buildings)	2006	http://www2.nen.nl/nen/servlet/dispatcher.Dispatcher?id=00013 http://www.senternovem.nl/epn/epc_in_2006/nieuwe_normen.asp
	Guidelines on sustainable construction	National Standard on the Environmental Assessment of Building Products (NEN8006)	-	Netherlands Standardization Institute (NEN) www.nen.nl / www.mrpi.nl
Portugal	Building and HVAC regulation		-	http://www.p3eportugal.com/_ficheiros/5/1/regulamentos_seminarios_7_11Abril.pdf
Belgium	Brussels Region		-	http://training.eebd.org/page.aspx?id=126&ui=en&lang=en&ap=1
Bulgaria	Ordinance on Energy conservation and heat retention of buildings		2005	http://www.mrrb.government.bg/
Czech Republic	draft implementing regulation to the Act	ČSN EN 13790-1	2005	http://eshop.cni.cz/iPopWeb/ikapr/produktSearchAction.do;jsessionid=0000ON44R4R2DVP3CE15TBQZI2I:-1 http://www.aeaonline.cz/
Estonia	-	-	-	http://www.evs.ee/index.php3?lk=english
Greece	-	-	-	http://www.elot.gr/catalogues.htm
Hungary	-	-	-	http://www.mszt.hu/angol/index_eng.htm
Latvia	-	-	-	http://www.egt.bme.hu/
Lithuania	Building Technical Regulation STR 2.01.09:2005 “Energy Performance of Buildings; Certification of Energy Performance of Buildings“.		2005	http://www.am.lt/VI/
Luxembourg	Verordnung über die Gesamteffizienz von Gebäuden.		-	http://www.eco.public.lu/documentation/legislation/projets_e_reglements/2006/08/21_perfen.pdf
Norway	Proposal for new energy requirements	NS-EN 832	2007	http://www.be.no/beweb/regler/tekhoering06/
Poland	Ordinance about the scope and form of energy certificate for building and apartments.		-	www.mtib.gov.pl-projekt (server not found)
Romania	According with the law 372/15.12.2005, the calculation procedures (art. 3) will be adopted by the Government until the end of 2006.		-	http://www.norme.ro/
Slovak Republic	The final calculation procedures (art. 3) should be adopted after the preparation of the EN standards.		2007	http://www.build.gov.sk/mvrrsr/index.php
Slovenia	Regulation on efficient use of energy in buildings.		2007	-
Spain	-		-	-

Sweden	There is no general calculation method and software tool for energy calculations in Sweden.	-	http://www.boverket.se/shopping/ShowItem.aspx?id=2331&epslanguage=SV (complete collection of regulations on building including general building code and energy requirements)
Finland	-	-	http://akseli.tekes.fi/opencms/opencms/OhjelmaPortaali/ohjelmat/CUBE/en/system/projekti.html?id=7681805&nav=Project (I can't access the actual project site)

Each MS did its own recompilation of standards given the possibility to architects, designers and engineers to use the methodologies. The methodologies provided should be regarded as a guideline for building construction and design. Here is provided where they can be found, even which of them has been updated to national level or not.

3. Annex II: Legislation at Member State level

Each MS did its own transposition of the directive [EPBD recast 2010] as it is mandatory for them. But this table 31 expresses the different situation MS has as well as provides info about their national legal framework. This data collection corresponds with section 5.2 of this document.

Table 31: Legislation at MS level. Sources: [RICS 2009] and [ASIEPI 2009]

Country	Responsible	Law	Date	Comments
Austria	Ministry of Economy and Labour	Energy Certification Providing Act	03/08/2006	www.bmj.gv.at
		OIB-Guideline new buildings	01/01/2008	additional requirements may be added at regional level by the 'Bundesländer'
		OIB-Guideline existing buildings	01/01/2009	Existing buildings (including apartments, offices, etc) with a building permit after 1 January 2006 must have a certificate when rented or sold as of 1 January 2008
Belgium	Brussels Capital Region Regional ministry of Environment	ordennance relative a la performance energetique et au climat interioeur des batiments	jun-07	--
		Legislative text on the energy performance and indoor air quality of buildings	14/05/2009	IBGE/BIM and the ABEA are responsible of the execution of the implementation
		certification for new and existing buildings undergoing renovation	30/06/2008	--
		Public buildings and exiting buildings when rented or sold	certification of 2009	the government will issue a list of public authorities and institutions affected by the current regulation and will allow determine the form, the content and the periodicity of the certification of public buildings
	Flemish Region	Dtp of environment, nature and Energy	07/05/2004	Flemish Energy agency (VEA)
			02/12/2005	Certification for new buildings
			27/03/2008	Certification of public buildings over 1000m2
			late 2009	Certification for non-residential
	Walloon region	Ministry of energy and sustainable buildings and ministry of environment	19/04/2008	certificate mandatory for selling from January 2010 on
				Looking for an existing calculation method (asset rating) and software tools for non-residential buildings, to adapt it to the Belgian context and then organise the training of trainers

				certification of public buildings should enter into force within 2010 and will be based on an operational rating. It is valid for 10 years (further information in a handbook)
Bulgaria	Minisry of Regional development and public works and ministry of energy and economy and the energy efficiency agency	Energy efficiency act	01/07/2007	the energy certificate of a new construction is issued by the construction consultant before construction is started and includes the energy performance parameters corresponding to the normative and project requirements for energy efficiency of the completed construction
				the certificate of an existing building is issued after a detailed energy efficiency audit is carried out by physical or legal entities registered in the Energy Efficiency Agency (EEA) register
Cyprus	Ministry of Commerce, Industry and Tourism (MCIT)	'The streets and buildings law' (N101/2006), 'The law for the regulation of the energy performance of buildings of 2006' (N142/2006) and 'The streets and buildings regulation' (K429/2006)	01/01/2010	The Energy Service of MCIT has opened the registry for Accredited Experts, when the registry for non-residential will open, the certificates will be mandatory for non-residential buildings
Czech Republic	Ministry of Industry and Trade	'Act of Energy Management' Articles 6 and 6a, implemented by Decree No 148/2007 concerning the energy performance of buildings	26/03/2006	--
Denmark	Danish Energy Authority (for Articles 3, 5, 7, 8 and 9) and the Danish National Agency of Enterprise and Construction (for Articles 3, 4, 5 and 6).	Decree1294 on the 'Energy labelling of Buildings'	13/12/2005	There are 14 different certification categories from A1 to G2. New buildings. The specific rules for inspectors can be found in the 'Handbook for Energy Consultants' available on: www.femsek.dk. It includes data for typical constructions and installations to facilitate benchmarking and uniformity of certificates. must at least achieve B1 to get a permit for use. Grade A1 and A2 are for low energy buildings
Estonia	Ministry of Economic Affairs and Communications	the Building Act and the Energy Efficiency of Equipment Act	27/09/2006	In the majority of cases, certification will be based on actual energy consumption measurements. In case of new buildings, an estimation is used.

Finland	Ministry of the Environment in cooperation with the Ministry of Employment and the Economy	the 'Act on Building Energy Certification' (478/2007) and the 'Act on Inspection of Air- Conditioning Systems' (488/2007), and a revision of the 'Land Use and Building Act'.	13/04/2007	Energy Performance Certificates are not required for holiday homes or buildings smaller than 50 m2, industrial premises and heritage buildings.
France	the Ministère de l'Écologie, de l'Énergie, du Développement Durable et de l'Aménagement du territoire and the Ministère du Logement et de la Ville	The decree of 19 March 2007 (nr. 20007-363) and the Building Code	19/03/2007	Legislative texts are available on: www.legifrance.gouv.fr. Two labels classify the building or housing, according to its energy performance and its greenhouse gas emission.
Germany	Federal Ministry of Transport, Building and Urban Development (www.bmvbs.bund.de), the Ministry of Economics and Technology and the Ministry for the Environment, Natural Conservation and Nuclear Safety	'Energy Saving Ordinance' (EnEV 2007) (www.bbr.bund.de)	jul-07	Type 1 that only provides information regarding the energy use of the previous 3 years. Type 2 that highlights the actual energy demand of the building and its components.
Greece	Ministry of Development and the Ministry of Environment	--	--	--
Hungary	State Office of Housing and Building (Articles 3 to 7) and the Ministry of Economy and Transport (Articles 8 & 9)	The Ministerial Decree TNM 7/2006, covers Articles 3 to 6. Articles 7 and 10 are in the Ministerial Decree No.176/2008	may-2006 and end of jun-2006	The Chamber of Hungarian Architects has already published an interactive electronic guide and the software is available free of charge (http://etk.mek.hu/).
Ireland	Department of the Environment, Heritage and Local Government (DEHLG) (for Articles 3 to 7) and the Department of Communications, Marine and Natural Resources (DCMNR) (for Articles 8 and 9)	"Action Plan for Implementation of the EPBD in Ireland"	ago-06	A VER ('Building Energy Rating') is an objective scale of comparison for the energy performance of a building ranging from A1 to 6. An advisory report must accompany a BER certificate (tool on www.sei.ie/ber).

Italy	Ministry of Economic Development, in collaboration with the Ministry of Environment and the Ministry of Infrastructures	Legislative Decree, representing a general framework for the transposition of all EPBD articles, except article 9	19/08/2005	--
Latvia	Ministry of Economics with support from The 'Valsts Agentura' – the State Agency for Construction, Energy and Housing	the Law on Building Energy Efficiency	13/03/2008	--
Lithuania	Ministry of Environment (Articles 3 to 7 and partly Article 10) and the Ministry of Economy (Articles 8, 9 and partly Article 10).	'The Law Amending the Law on Construction' and 'The Law on Energy'	01/01/2007	--
Luxembourg	Department for Energy of the Ministry of Economy and Foreign Trade	the Grand-Ducal Regulation concerning energy performance in buildings, 'Loi du 5 août 1993 concernant l'utilastion rationnelle de l'energie'	nov-08	The certificate rates energy performance on a scale from 1 to 9. Three indicators are used: • Primary energy consumption • Heating consumption • CO2 emission
Malta	Ministry for Resources and Rural Affairs	The LN 238 act has been amended by the Energy Performance of Building Regulation (LN 261/2008)	nov-06	The legislation gives the Malta Resources Authority (MRA) the power to delegate to other entities the administration, monitoring and enforcement of the provisions.
The Netherlands	Ministry of Housing, Spatial Planning and the Environment (VROM)	'Decree Energy Performance of Buildings' (BEG) , followed by the 'Regulation on Energy Performance of Buildings' (REG)	24/11/2006 and 29/12/2006	the certificate is called 'Energielabel'
Poland	Ministry of Infrastructure (former Ministry of Construction) in cooperation with the Ministry of Economy	'Construction Act'• Ordinance on the training and examination of experts • Ordinance on the methodology of energy performance calculations • Ordinance on minimum energy requirements	19/09/2007	--

Portugal	Ministry of Economy together with the Ministry of Environment	Decrees 78/2006, 79/2006, 80/2006	04/04/2006	two other legislative documents were published: 'Portaria N.461/2007' which establishes the timetable for implementation of the certification process and 'Portaria N.835/2007' which defines the fee to be paid to the 'National System for Energy and Indoor Air Quality Certification of Buildings' (SCE) for the central registration and validation of certificates issued by qualified experts.
Romania	Ministry of Development, Public Works and Housing	The 'Implementation Law' 372/2005 and a Government Ordinance covering Articles 7 and 10 in October 2008	01/01/2007	Certificates provide a mark ranging from 10 to 100, where 76 is an average value.
Slovakia	Ministry of Construction and Regional Development (for Articles 3 to 7) and the Ministry of Economy (for Articles 8 and 9)	Decree No. 311/2009	oct-09	more information can be found at www.zbierka.sk
Slovenia	Ministry of Environment and Spatial Planning	The 'Buildings Construction Act', the 'Environmental Protection Act' and the amended 'Energy Act' form the basis for implementation	sep-08	A central database for lodging energy certificates for sale, rental or display is being currently developed
Spain	Ministry of Housing except for the revised RITE and the actual certification which is the responsibility of the Ministry of Industry, Tourism and Trade	3 Royal Decrees regarding the 'Código Técnico de la Edificación' CTE, the 'Regulations for Thermal Installations in Buildings' RITE and the 'Basic Procedure for Energy Performance Certification of New Buildings'	during 2007	2 options for the calculation of the energy demand: • official software tool 'CALENER' • A simplified procedure approved by the 'certification Commission' added to the already existing simplified methodology for residential buildings based on 12 tables for the different climate zones

Sweden	Ministry of Enterprise, Energy and Communications and the National Board of Housing, Building and Planning (Boverket)	the regulations BED (BFS 2007:4), the 'Planning and Building Act' (1987:10) (PBL), the' Planning and Building Decree' (1987:383) and , the 'Act on Technical Requirements for Construction Works' (1994:847) and the 'Decree on Technical Requirements for Construction Works' (1994:1215)	21/06/2006 onwards	Sweden does not have an 'Energy Performance Certificate' but an 'Energy Declaration' in order to avoid confusion with the electrical certification.
United Kingdom	Department for Communities and Local Government, supported by the Department for the Environment, Food and Rural Affairs, the Department	Regulation on March 2006 and March 2007 and in Scotland 'The Building (Scotland) Act 2003'	2006/2007	www.homeinformationpacks.gov.uk

4. Annex III: Labels at member state level criteria and benchmarks

In the present annex, tables and data from previously defined label are provided, section 5.3, of this document.

10.1 France

Table 32: Application areas and categorization. Source [HQE]

Category	HPE label	HQE label
Construction type	New or renovated buildings	
Sector	All buildings used for tertiary[6] subjected to RT	All buildings for which the service area covered by one or more repositories technical certification is approved[7] by a majority relative to the total area of the operation
Geographical zone	Metropolitan France	No limitation[8]
Deadline for application	Applications received later than six months after receipt	Applications received later than three months after the DROC

Mainly, the Performance targets associated with HQE have three different levels:

- **BASE**: level corresponding to the minimum acceptable performance for an operation HQE. This may correspond to the regulations if it is sufficiently demanding performance of the work, or failing to current practice.
- **PERFORMANCE**: level corresponding to good practices.
- **HIGH PERFORMANCE**: calibrated level relative to maximum performance observed in operations with high environmental quality, while ensuring that "there is still attainable".

Table 33: HQE Certification Targets for Environmental Quality Buildings. Sources: [HQE] and [MEEQB 2008]

[6] The service sector as defined in this repository includes all entities whose function is to provide a service that is commercial or non-market for companies or individuals other than sports that are subject to a specific repository certification. Excluded are buildings used for housing, industrial buildings, sports and agriculture

[7] Certification benchmarks apply depending on the sector and the application date specified in the "List of applicable documents as part of the NF Tertiary Buildings". Certification benchmarks are available on the site Certivea www.certivea.fr

[8] Some of the environmental quality criteria are established based on methods from the French regulations. The actors in the transaction may propose an alternative method for assessing the Environmental Quality Building (see equivalence principle in paragraph 4.3 and 7.8)

Area	Criteria	Concerns
Site and construction	Target 1: Relationship building with its immediate environment	1.1. Planning the plot for sustainable urban development. 1.2. Quality surrounds outdoor spaces for users. 1.3. Impacts of the building on neighbourhood.
	Target 2: Choice of integrated products, systems and construction processes	2.1. Constructive options for sustainability and adaptability of structure 2.2. Constructive options for ease of maintenance of the tunnel. 2.3. Choice of products in order to limit the environmental impacts of the work. 2.4. Choice of products in order to limit the health impacts of structure.
	Target 3: Construction of low environmental impact	3.1. Optimizing the management of building waste. 3.2. Limiting pollution during construction. 3.3. Limitation of pollution and resource consumption during construction.
Manegement	Target 4: Energy Management	4.1. Reducing energy demand by architectural design. 4.2. Reduction of primary energy consumption. 4.3. Reducing emissions of pollutants into the atmosphere.
	Target 5: Water Management	5.1. Reduced consumption of potable water. 5.2. Optimization of storm water management. 5.3. Wastewater management.
	Target 6: Waste management activities	6.1. Optimizing waste recovery activity. 6.2. Quality of the waste management activity.
	Target 7: Maintenance - Durability of environmental performance	7.1. Maintaining the performance of heating and cooling. 7.2. Maintaining the performance of ventilation systems. 7.3. Maintaining performance lighting systems. 7.4. Maintaining performance management systems of water.
Confort	Target 8: Hygrothermal comfort	8.1. Architectural arrangements to optimize the hygrothermal comfort in winter and summer. 8.2. Creating conditions for hygrothermal comfort in winter. 8.3. Creating conditions for hygrothermal comfort in the premises was not using a cooling system. 8.4. Creating conditions for hygrothermal comfort in summer on the premises using a cooling system.
	Target 9: Acoustic	9.1. Optimizing architectural arrangements to protect users of noise pollution. 9.2. Creating a surround-sound quality suitable for different rooms.
	Target 10: Visual Comfort	10.1. Optimization of natural lighting. 10.2. Artificial lighting comfortable.
	Target 11: Olfactory comfort	11.1. Guarantee of effective ventilation. 11.2. Control of sources of offensive odours and creating a pleasant ambiance olfactive.
Health	Target 12: Quality sanitary spaces	12.1. Master of electromagnetic exposure. 12.2. Creation of specific hygiene conditions.
	Target 13: Air Quality Health	13.1. Guarantee of effective ventilation. 13.2. Control of internal sources of pollution. 13.3. Control of external sources of pollution.
	Target 14: Sanitary quality of water	14.1. Quality and durability of materials used in the domestic network. 14.2. Organization and internal network protection. 14.3. Temperature control in the domestic network. 14.4. Control treatments. 14.5. Master of health risk to the recovery and reuse on site of a non-potable water.

Three Normative documents organize these components: NF P01-020-1, XP P01-020-3 regulations and the application guide P 01 030.

10.2 Germany

According to [CESB 10 Prague] the benchmarks are compiled from two elements. The first element is a fixed value that refers to the construction of the building. It is derived from a German national research project [BMVBS 2008] that evaluates a number of "typical" buildings in order to derive benchmarks on the basis of mean values and an understanding of the relation between a building and its environmental impacts. For this element of the benchmark, values are given in the characteristic documents of each criterion, e.g. 9,4 kg CO_2-Eq./m²NGFa*a for GWP. The second element is a variable part derived from the "Energieausweis", the energy performance German certificate. In accordance with the EPBD 2002, each building has a benchmark set for primary energy demand. For the purpose of LCA-benchmarking, the corresponding final energy demand is multiplied with conversion factors (separately for electric and thermal energy) for each indicator. Therefore, the energy demand is separated into electric energy and thermal energy. These factors stem from the national building products database and reflect the electric energy grid mix, resp. heat generation with a mix of 50 % oil and 50 % natural gas.

The resulting benchmarks ("reference value") for the building's life cycle represents 5 valuation credits out of a range of 1 credit (minimum) to 10 credits (maximum) and reflect the idea of relation between "state of the art", "still acceptable" and "best practice". Each criterion can be assigned a maximum of 10 points, depending on the documented or calculated quality. All criteria are weighted with a factor from 0 to 3, because individual criteria are treated as either more or less relevant. The degree of compliance with the requirements of the certification is calculated in accordance with the evaluation matrix. From a total degree of compliance of: 50 %, the bronze certificate is awarded, 65 % for silver and 89 % for gold. Alternatively, the total degree of compliance is indicated by a grade: a total degree of compliance of 95% corresponds to grade 1,0, of 80 % corresponds to 1,5 or of 65 % corresponds to 2,0.

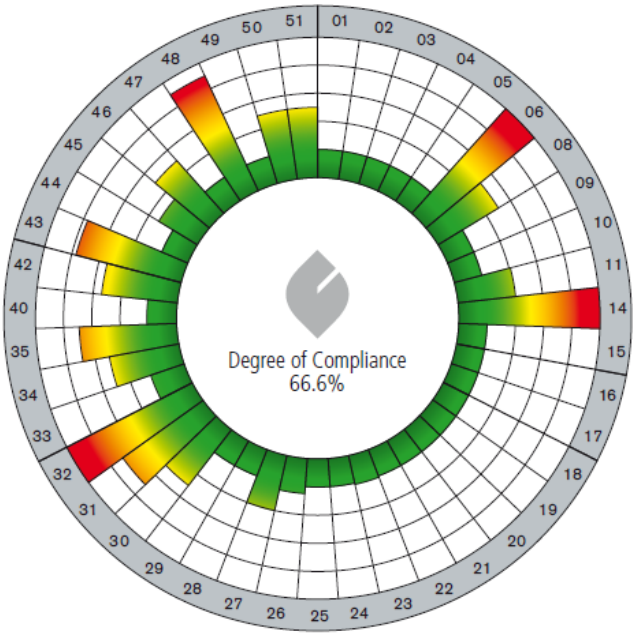

Figure 11: Diagram generated for the DGNB criteria compliance

Table 34: German Sustainable Building Certification Criteria. Source [DGNB]

Category	Criteria
Ecological Quality	01 Global Warming Potential 02 Ozone Depletion Potential 03 Photochemical Ozone Creation Potential 04 Acidification Potential 05 Eutrophication Potential 06 Risks to the Regional Environment 08 Other Impacts on the Global Environment 09 Microclimate 10 Non-renewable Primary Energy Demands 11 Total Primary Energy Demands and Proportion of Renewable Primary Energy 14 Potable Water Consumption and Sewage Generation 15 Surface Area Usage
Economical Quality	16 Building-related Life Cycle Costs 17 Value Stability
Socio-cultural and Functional Quality	18 Thermal Comfort in the Winter 19 Thermal Comfort in the Summer 20 Indoor Hygiene 21 Acoustical Comfort 22 Visual Comfort 23 Influences by Users 24 Roof Design 25 Safety and Risks of Failure 26 Barrier free Accessibility 27 Area Efficiency 28 Feasibility of Conversion 29 Accessibility 30 Bicycle Comfort 31 Assurance of the Quality of the Design and for Urban Development for Competition 32 Art within Architecture
Technical Quality	33 Fire Protection 34 Noise Protection

	35 Energetic and Moisture Proofing Quality of the Building's Shell 40 Ease of Cleaning and Maintenance of the Structure 42 Ease of Deconstruction, Recycling and Dismantling
Process Quality	43 Quality of the Project's Preparation 44 Integral Planning 45 Optimization and Complexity of the Approach to Planning 46 Evidence of Sustainability Considerations during Bid Invitation and Awarding 47 Establishment of Preconditions for Optimized Use and Operation 48 Construction Site, Construction Phase 49 Quality of Executing Companies, Pre-qualifications 50 Quality Assurance of the Construction Activities 51 Systematic Commissioning
Quality of the Location	Is presented separately, and is not included in the overall grade of the object. 56 Risks at the Microlocation 57 Circumstances at the Microlocation 59 Image and Condition of the Location and Neighbourhood 59 Connection to Transportation 60 Vicinity to Usage-specific Facilities 61 Adjoining Media, Infrastructure Development

10.3 Spain

Table 35 lists all the criteria applicable to office buildings as well as some benchmarks.

Table 35: Spanish VERDE Certification Criteria and benchmarks

Area	Criteria	Benchmark
I Project Information	I0 Optimization of the structure service life	--
A Site Selection, Project Planning and Development	A14 Collection and recycling of solid wastes in the community or project.	Common Practice: 0% of waste recycled increased Best practice: 90% increase of recycled waste
	A23 Use of native plantings.	Common Practice: CAR PH = CAR R and PAUT R = 30 % Best practice: CAR MP = 0,25 x CAR R and PAUT M = 100 % CAR = consumption for water irrigation PAUT = green areas occupied percentage by native plant species
	A24 Provision of trees with shading potential.	It is evaluated on the criterion B 03 non-renewable energy consumption during use of the building. Energy demand and efficiency of systems.
	A31 Heat Island Effect - landscaping and paved areas.	
	A32 Heat Island Effect - roofing.	
	A33 Containment of atmospheric light pollution.	
B Energy and atmosphere	B1 Strategies for reducing embodied energy	Common Practice: MJ consumed by the reference building Best practice: 20% less than the MJ consumed by the reference building

	B2 Strategies for reducing non-renewable primary energy used for transport of construction materials.	Common Practice: PMLH: 30% Best practice: PMLM: 100% PML = locally produced materials percentage for each material
	B3 Strategies for reducing operating energy	for benchmarking purposes, it is assessed together with all charges for energy consumption during building use (B 06 = Production of renewable energy in the plot)
	B4 Strategies for reducing peak electric loads	
	B6 Provision of on-site renewable energy systems.	Renewable production of reference: 0% kWh / a Renewable production of best practice: 100% of consumption kWh / a Renewable energy is the one that exceeds the legal requirement in each case study, inside the site.
	B7 Strategies to reduce the emision of leading to photo-oxidants and NOx substances	Common Practice: thermal energy consumption x 70 mg / kWh Best practice: thermal energy consumption x 30 mg / kWh
	B8 Strategies to reduce the substances that destroyed of the stratospheric ozone layer from building material and HVAC system.	--
C Natural Resources	C1 Design measures to reduce use of potable water for occupancy needs.	Common Practice: CtotH: litres / person / day consumed by reference building Best practice: CtotM: 30% reduction in consumption from reference building Ctot = total water consumption
	C2 Retention of rainwater for later re-use.	for benchmarking purposes, it is evaluated either in A 23 use of native plants, either in C 1 potable water consumption depends on the use given to the rain water collected.
	C4 Design features for a split grey / potable water system for later reuse	
	C8 Re-use of salvaged materials.	Common Practice: impacts coming from the building reference Best practice: 20% reduction in the impacts
	C14 Design for disassembly, re-use or recycling.	for benchmarking purposes, it is evaluated in C8 Impact of construction materials. 100% of the impact will be deducted only for the materials reused.
	C17 Strategies to minimize adverse impact of construction process on natural features of the site.	Common practice: 0% reduction of construction waste Best practice: 80% reduction of construction waste
D Indoor Environmental Quality	D2 Removal, before occupancy, of pollutants emitted by new interior finish materials.	Common practice: PCOVph =0% Best practice: PCOVpm = 100% PCOVp = weight percentage of finishing materials with low VOC content
	D7 CO2 concentrations in indoor air.	Common practice: Ch= 500 ppm Best practice: Cm= 350 ppm C = CO2 concentration

	D9 Air movement in mechanically ventilated occupancies.	Common practice: DRH: 15% Best practice: DRM: 15% DR= nuisance value of airflow
	D14 Day lighting in primary occupancy areas.	Common practice: DFH: 1% Best practice: DFM: 5% DF= daylight factor
	D15 Glare in non-residential occupancies.	Common practice: U.G.R.H: 19 Best practice: U.G.R.M: 10 U.G.R.= Unified Glare Rating
	D16 Illumination levels and quality of lighting in non-residential occupancy design.	Common practice: PSCLUXH: 50% Best practice: PSCLUXM: 100% PSCLUX= percentage of areas that meet the quality requirements for lighting
	D17 Noise attenuation through the exterior envelope.	Common practice: RRAEH: D2m,nT,Atr > or = minimun requirement according to Ld average per day and the type of local receptor Best practice: RRAEM: D2m,nT,Atr adding 4 dB(A) to RRAEH RR= sound reduction index D2m,nT,Atr= traffic noise Lp= sound power levelin dB
	D18 Transmission of facility equipment noise to primary occupancies.	Common practice: RRAMH: DnT,A > or = 55 dB(A) and RRIMH: LnT,W < or = 60 dB Best practice: RRAMM: DnT,A > or = 60 dB(A) and RRIMM: LnT,W < or = 55 dB RR= sound reduction level D,nT,A= standard impact noise level LnT,W= "pink" noise for air traffic
E Service Quality	E1 Spatial efficiency.	Common practice: RSUF 1,40 Best practice: RSUF 1,20 RSUF = functional working surface
	E3 Provision and operation of an effective facility management control system.	for benchmarking purposes, it is studied on B 3 non-renewable energy consumption during use of the building. Energy demand and efficiency of systems.
	E5 Degree of local control of lighting systems in non-residential occupancies.	Common practice: PZC = 20% Best practice: PZC = 100% PZC = area percentage likely to have an independent lighting control system
	E6 Degree of personal control of technical systems by occupants.	Common practice: PSCT = 25% Best practice: PSCT = 75% PSCT = Percentage of the working areas of each peripheral area fitted, allowing a system of control over thermal comfort levels to suit both the thermal needs of users, such as ventilation needs
	E13 Development and implementation of a maintenance management plan.	0-5 points

F Social and Economic aspects	F2 Access for physically handicapped persons.	0-5 points
	F6 Access to views from work areas.	Common practice: PAVH: 50% Best practice: PAVM: 90% PAV = area percentage with access to outside views
	F8 Minimization of construction cost.	Common Practice: 15% more over the construction cost per m2 Best Practice: 5% less than construction cost per m2
	F9 Minimization of operating and maintenance cost.	Common Practice: baseline operating cost Best practice: building operating cost of best practice.

10.4 Switzerland

The methodology used in this scheme is explained in this section, although those values are not for offices, but for residential buildings.

In this methodology not only the energy consumption is considered but also the heat recovery and energy efficiency of the equipments used in the building. Taking into account these characteristics a total Energy performance value (EPV) is calculated in order to award the Swiss ecolabel, these values are given in tables 36and 37.

Table 36: The energy performance value (EPV) in kWh/m2of a single family house, heated by oil and domestic hot water produced 70 % with solar thermal collectors and 30 % with electricity

Value in kWh/m2	Useful energy	Equipment efficiency	End use energy	Energy weighting factor	Primary energy
Heating energy (acc. SIA 380/1)	50 A				
Savings by ventilation heat recovery	-15 B				
Effective heating energy	35 C	0,91 D	38,5 E	1 F	38.5 G
Hot water solar-thermal	14 H	?	9,8	0	0 I
Hot water electricity		0,9 D	4,7	2	9,4 I
Electricity for ventilation			3 J	2	6
The energy performance value (EPV)				**Sum K**	**53,9≤38?**

Table 37: The energy performance value (EPV) in kWh/m2 of the single family house above, but with heating and domestic hot water provided by a water-to-water heat pump

Value in kWh/m2	Useful energy	Equipment efficiency	End use energy	Energy weighting factor	Primary energy
Heating energy (acc. SIA 380/1)	50 A				
Savings by ventilation heat recovery	-15 B				
Effective heating energy	35 C	3,2 D	10,9 D	2 F	21,8 G
Hot water solar	14 H	2,9 D	4,8	2	9,6 I
Electricity for ventilation			3 J	2	6
The energy performance value (EPV)				**Sum K**	**37,4≤38?**

- **Heating energy (A):** The heating energy demanded is calculated according to SIA-Standard 380/1 which is based on EN ISO 13790 (formerly EN 832). The result has to be less than 90 % of the limiting value of SIA 380/1 (edition 2009).

- **Heat recovery (B):** The standard calculation according to SIA 380/1 does not take ventilation heat recovery into account. Hence this has to be done separately to get the **effective heating demand (C).**

- **Equipment efficiency (D):** The heating energy demand (useful energy) is divided by the conversion efficiency leading to the end use energy.

- **Heating:** The end use energy (E) is multiplied by an energy weighting factor (F), leading to the weighted energy use for heating (G).

- **Hot water:** The amount of energy consumption for hot water (H) is given for single-family houses (14 kWh/m^2). The same procedure using efficiency and energy weighting factor leads to the weighted energy demand for hot water (I).

- **Electricity for ventilation**: The electricity consumption for ventilation (J) is taken at the end use level and analogously processed to obtain the weighted energy demand.

- **EPV**: The sum of all weighted energy demand components (K) has to be compared to the limiting value.

10.5 United Kingdom

10.5.1 The Code for Sustainable Homes

The Code uses a sustainability rating system – indicated by 'stars', to communicate the overall sustainability performance of a home. A home can achieve a sustainability rating from one (*) to six (******) stars depending on the extent to which it has achieved Code standards. One star (*) is the entry level – above the level of the Building Regulations; and six stars (******) is the highest level – reflecting exemplar development sustainability terms. In the next table 38 it is defined the rating level necessary.

Table 38: Achieving a sustainability rating for minimum standards. Source [CSH]

Code level	ENERGY-Standard (percentage better than Part L[9] 2006	ENERGY-Points Awarded	WATER-Standards (L. Per person per day)	WATER-Points awarded	Other Points required
1(*)	10	1.2	120	1.5	33.3
2(**)	18	3.5	120	1.5	43.0
3(***)	25	5.8	105	4.5	46.7

[9] Building Regulations: Approved Document L (2006) – 'Conservation of Fuel and Power.'

4(****)	44	9.4	105	4.5	54.1
5(*****)	100[10]	16.4	80	7.5	60.1
6(******)	A zero Carbon Home	17.6	80	7.5	64.9

Table 39 lists the issues under each of the sustainability categories included within the Code, the minimum standards where applicable, and the points available for each issue.

Table 39: Minimum standards BENCHMARKS. Source [CSH]

Code level	ENERGY-Standard (percentage better than Part L 2006	ENERGY-Points Awarded
1(*) 2(**) 3(***) 4(****) 5(*****) 6(******)	**Energy/CO2** Percentage improvement over target emission rate (TER) as determined by the 2006 Building Regulation Standards	10% 18% 25% 44% 100% A "zero carbon Home" where is counted lighting, heating, hot water, and all other energy uses in the home.
1(*) 2(**) 3(***) 4(****) 5(*****) 6(******)	**Water** Inernal potable water consumption measured in litres per person per day (l/p/d)	120 l/p/d 120 l/p/d 105 l/p/d 105 l/p/d 80 l/p/d 80 l/p/d
1(*)	**Materials** Environmental impact of materials	At least three of the following 5 key element of construction are specified to achieve a BRE Green Guide 2006 rating of at least D – Roof structure and finishes – External walls – Upper floor – Internal walls – Windows and doors
1(*)	**Surface Water run-off** Surface water management	Ensure that peak run-off rates and annual volumes of run-off will be no greater than the previous conditions for the development site

10.5.2 BREEAM

Table 40 lists all the criteria applicable to office buildings as well as some benchmarks.

Table 40: BREEAM offices Criteria and benchmark. Source [BREEAM]

Area	Criteria and its code	Benchmarks where applicable
Management	Man 1: Commissioning Man 2: Considerate constructors Man 3: Construction site impacts	--

[10] Zero emissions in relation to Building Regulations issues (i.e. zero emissions from heating, hot water, ventilation and lighting).

	Man 4: Building user guide Man 5: Site investigation Man 6: Consultation Man 7: Shared facilities Man 8: Security	
Health and Wellbeing	Hea 1: Daylighting	At least 80% of net lettable office floor area is adequately daylit as follows: a. An average daylight factor of 2% or more b. A uniformity ratio of at least 0.4 or a minimum point daylight factor of at least 0.8% (spaces with glazed roofs, such as atria, must achieve a uniformity ratio of at least 0.7 or a minimum point daylight factor of at least 1.4%) c. A view of sky from desk height (0.7m) is achieved d. The room depth criterion d/w +d/HW < 2/(1-RB) is satisfied.
	Hea 2: View out Hea 3: Glare control Hea 4: High frequency lighting Hea 5: Internal and external lighting levels Hea 6:Lighting zones and controls	--
	Hea 7: Potential for natural ventilation	a.The openable window area in each occupied space is equivalent to 5% of the gross internal floor area of that room/floor plate. For room/floor plates between 7m-15m depth, the openable window area is on opposite sides and evenly distributed across the area to promote adequate cross-ventilation. OR b. The design demonstrates (by calculation, using ventilation design tool types recommended by CIBSE AM1015) that the natural ventilation strategy provides adequate cross flow of air to maintain required thermal comfort conditions and ventilation rates.
	Hea 8: Indoor air quality	a.Air-conditioned and mixed-mode buildings: Where the building's air intakes and exhausts are over 10m apart to minimise recirculation AND intakes are over 20m from sources of external pollution. b. Naturally-ventilated buildings: Where openable windows/ventilators are over 10m from sources of external pollution.
	Hea 9: Volatile organic compounds	All the products listed on table 8 in the document BREEAM offices are limited used.
	Hea 10: Thermal comfort Hea 11: Thermal zoning Hea 12: Microbial contamination	
	Hea 13: Acoustic performance	1. Indoor ambient noise levels in unoccupied staff/office areas comply with the following: a. ≤ 40dB LAeq,T in single occupancy offices b. 40-50dB LAeq,T in multiple occupancy offices c. £ 40 dB LAeq,T general spaces (staffrooms, restrooms) d. £ 35 dB LAeq,T in spaces designed for speech e.g. seminar/lecture rooms e. ≤ 50 dB LAeq,T in informal café/canteen areas 2. Fully fitted buildings only: The sound insulation between acoustically sensitive rooms and other occupied spaces complies with section 7.6.3.1 of BS823342, as follows: a. Dw + LAeq,T > 75 · Dw is the weighted sound level difference between the two spaces · LAeq,T is the design (or measured) indoor ambient noise level in the space adjacent to the acoustically sensitive room. The source and receive room sound pressure levels from which Dw is derived must be measured in accordance with BS EN ISO 140-4:199843 and the guidance in Annex B of Approved Document E44. Measurements must be based on finished rooms,

<table>
<tr><td></td><td></td><td>accounting for any carpets and acoustically absorbent ceilings specified. The measurements can be conducted in either furnished or unfurnished rooms.
3. Pre-completion acoustic testing is carried out by a suitably qualified acoustician to ensure that all relevant spaces (as built) achieve the performance standards required, and any required remedial works in spaces that do not meet the standards are completed prior to handover and occupation.</td></tr>
<tr><td rowspan="4">Energy</td><td>Ene 1:
Reduction of
CO2 emissions</td><td>The number of credits achieved is determined by comparing the building's CO2 index (EPC Rating), taken from the Energy Performance Certificate (EPC), with the table of benchmarks below:
<table>
<tr><th rowspan="2">BREEAM Credits</th><th colspan="2">CO_2 Index (EPC Rating)</th></tr>
<tr><th>New Build</th><th>Refurbishment</th></tr>
<tr><td>1</td><td>63</td><td>100</td></tr>
<tr><td>2</td><td>53</td><td>87</td></tr>
<tr><td>3</td><td>47</td><td>74</td></tr>
<tr><td>4</td><td>45</td><td>61</td></tr>
<tr><td>5</td><td>43</td><td>50</td></tr>
<tr><td>6</td><td>40</td><td>47</td></tr>
<tr><td>7</td><td>37</td><td>44</td></tr>
<tr><td>8</td><td>31</td><td>41</td></tr>
<tr><td>9</td><td>28</td><td>36</td></tr>
<tr><td>10</td><td>25</td><td>31</td></tr>
<tr><td>11</td><td>23</td><td>28</td></tr>
<tr><td>12</td><td>20</td><td>25</td></tr>
<tr><td>13</td><td>18</td><td>22</td></tr>
<tr><td>14</td><td>10</td><td>18</td></tr>
<tr><td>15</td><td>0</td><td>15</td></tr>
<tr><td>Exemplar credit 1</td><td><0</td><td>≤0</td></tr>
<tr><td>Exemplar credit 2</td><td colspan="2">True zero carbon building</td></tr>
</table>
2. The CO2 index for the assessed building must be entered in to the relevant box of the Ene 1 Reduction of CO2 emissions calculator.
3. The building has been modelled using a method compliant with the National Calculation Method (NCM) and an Energy Rating and certificate produced using Approved software by an Accredited Energy Assessor.</td></tr>
<tr><td>Ene 2:
Sub-metering of
substantial
energy uses</td><td>1. Separate accessible energy sub-meters, labelled with the end energy consuming use, are provided for the following systems (where present):
a. Space Heating
b. Domestic Hot Water
c. Humidification
d. Cooling
e. Fans (major)
f. Lighting
g. Small Power (lighting and small power can be on the same sub-meter where supplies are taken at each floor/department).
h. Other major energy-consuming items where appropriate</td></tr>
<tr><td>Ene3: Sub-metering
of high energy load
and tenancy areas</td><td>1. Provision of accessible sub-meters covering the energy supply to all tenanted, or in the case of single occupancy buildings, relevant function areas or departments within the building/unit.
2. The meters are labelled with the end energy consuming use.</td></tr>
<tr><td>Ene4: External lighting</td><td>1. All external light fittings for the building, access ways and pathways have a luminous efficacy of at least 50 lamp lumens/circuit Watt when the lamp has a colour rendering index (Ra) greater than or equal to 60. OR 60 lamp Lumens / circuit Watt when the lamp has a colour rendering index (Ra) less than 60.
2. All external light fittings to car parking areas, associated roads and floodlighting has a luminous efficacy of at least 70 lamp lumens/circuit Watt when the lamp has a colour rendering index (Ra) greater than or equal to 60. OR 80 lamp Lumens / circuit Watts when the lamp has a colour rendering index (Ra) less than 60.
3. All external light fittings for signs and uplighting have a luminous efficacy of at least 60 lamp lumens/circuit Watt when the lamp wattage is greater than or equal to 25W. OR 50 lamp lumens/circuit</td></tr>
</table>

		Watt when the lamp wattage is less than 25W. 4. External light fittings are controlled through a time switch, or daylight sensor, to prevent operation during daylight hours. Daylight sensor override on a manually switched lighting circuit is acceptable.
	Ene 5: Low zero carbon technologies Ene 6: Building fabric performance and avoidance of air infiltration Ene 7: Cold storage Ene 8: Lifts Ene 9: Escalators and travelling walkways	--
Transport	Tra1: Provision of public transport	The public transport Accessibility Index for the building is calculated and BREEAM credits awarded in accordance the benchmarks and BREEAM credits: Accesibility index→BREAAM credits ≥2→ 1 ≥4→ 2 ≥8→ 3
	Tra 2: Proximity to amenities	Where the building is within 500m of the following amenities: a. Grocery shop and/or food outlet b. Post box c. Cash machine
	Tra 3: Cyclist facilities	First credit 1. The number of compliant cycle storage spaces provided is as follows: a. 10% of building users up to 500 PLUS b. 7% for building users in the range of 501 – 1000 PLUS c. 5% for building users over 1000 Second credit 1. The first credit must be achieved. 2. At least two of the following compliant facilities must be provided for the building users: a. Compliant showers b. Compliant changing facilities and lockers for clothes c. Compliant drying space for wet clothes
	Tra 4: Pedestrian and cyclist safety Tra 5: Travel plan	
	Tra 6: Maximum car parking capacity	First credit 1. No more than one parking space is provided for every three building users. Second credit 1. No more than one parking space is provided for every four building users.
Water	Wat 1: Water consumption	1. The credits are awarded as follows: · One credit where consumption is 4.5 - 5.5m3 per person per year · Two credits where consumption is 1.5 - 4.4 m3 per person per year · Three credits where consumption is <1.5 m3 per person per year 2. To determine the water consumption figure for the assessed building, determine the effective flush volumes and flow rates for the following installed sanitary fittings and enter this data into the BREEAM Water Calculator Tool: a. WCs b. Urinals c. Taps d. Showers Exclude kitchen taps, cleaners' sinks and external taps. 3. If any rainwater collection or greywater recycling systems are specified for the purpose of meeting WC/urinal flushing demand, determine the following information (as appropriate to system type): a. Annual rainfall for the site location (mm) b. Rainwater catchment area (m2) c. Catchment type e.g. pitched roof, flat roof d. Rainwater filter co-efficient e. Rainwater collection tank capacity f. Percentage of tap and shower water collected and used for

<table>
<tr><td></td><td></td><td>WC/urinal flushing. g. Percentage of building's WC/urinals using greywater to meet flushing demand.</td></tr>
<tr><td></td><td>Wat 2: Water meter</td><td>--</td></tr>
<tr><td></td><td>Wat 3: Major leak detection</td><td>1. A leak detection system capable of detecting major leaks on the water supply has been installed. The system must cover all mains water supply between and within the building and the site boundary.
2. The leak detection system is: a. Audible when activated b. Activated when the flow of water passes through the water meter/data logger at a flow rate above a pre-set maximum for a pre-set period of time c. Able to identify different flow and therefore leakage rates, e.g. continuous, high and/or low level, over set time periods d. Programmable to suit the owner/occupiers' water consumption criteria e. Where applicable, designed to avoid false alarms caused by normal operation of large water-consuming plant such as chillers.</td></tr>
<tr><td></td><td>Wat 4: Sanitary supply shut off</td><td>Infra-red movement detectors within each toilet facility OR
Sensors or switches placed at or on entry doors to each facility.</td></tr>
<tr><td>Materials</td><td>Mat 1: materials specification
(major building elements)
Mat 2: Hard landscaping and boundary protection</td><td>--</td></tr>
<tr><td></td><td>Mat 3: Reuse of facade</td><td>1. At least 50% of the total final building façade (by area) is reused.
2. At least 80% of the reused façade (by mass) comprises in-situ reused material.</td></tr>
<tr><td></td><td>Mat 4: Reuse of the structure</td><td>1. Where at least 80% by volume of an existing primary structure is reused without significant strengthening or alteration works.
2. Where a project is part refurbishment and part new build, the reused structure comprises at least 50% by volume of the final building, i.e. any new-build extension to a building being refurbished should not be larger than the original building to qualify for this credit.</td></tr>
<tr><td></td><td>Mat 5: Responsible sourcing of materials</td><td>--</td></tr>
<tr><td></td><td>Mat 6: Insulation</td><td>Any new insulation specified for use within the following building elements must be assessed: · External walls · Ground floor · Roof · Building services
First credit → embodied impact
Second credit → responsible sourcing</td></tr>
<tr><td></td><td>Mat 7: Designing for robustness</td><td></td></tr>
<tr><td>Waste</td><td>Wst 1: Construction site waste management</td><td>New build and major refurbishments
<table>
<tr><th rowspan="2">BREEAM credits</th><th colspan="2">Amount of waste generated per 100m² (gross internal floor area)</th></tr>
<tr><th>m³</th><th>tonnes</th></tr>
<tr><td>One credit</td><td>13.0 - 16.6</td><td>6.6 - 8.5</td></tr>
<tr><td>Two credits</td><td>9.2 – 12.9</td><td>4.7 - 6.5</td></tr>
<tr><td>Three credits</td><td><9.2</td><td><4.7</td></tr>
</table>
Demolition projects: Completed a pre-demolition/pre-refurbishment audit of the existing building to determine if, in the case of demolition, refurbishment is feasible and, if not, to maximise the recovery of material from demolition or refurbishment for subsequent high-grade/value applications. The audit must be referenced in the SWMP and cover: i. Identification of the key refurbishment/demolition materials. ii. Potential applications and any related issues for the reuse and recycling of the key refurbishment and demolition materials.</td></tr>
</table>

	Wst 2: Recyled aggregates	Where the amount of recycled and secondary aggregate specified is over 25% (by weight or volume) of the total high-grade aggregate uses for the building. Such aggregates can be EITHER: a. Obtained on site OR b. Obtained from waste processing site(s) within a 30km radius of the site; the source will be principally from construction, demolition and excavation waste (CD&E) – this includes road plannings OR c. Secondary aggregates obtained from a non-construction post-consumer or post-industrial by-product source.
	Wst 3: Recyclable waste storage	1. A dedicated storage space to cater for recyclable materials generated by the building during occupation, compliant with the following: a. Clearly labelled for recycling b. Placed within accessible reach of the building (see Compliance Notes) c. In a location with good vehicular access to facilitate collections. 2. The size of the space allocated must be adequate to store the likely volume of recyclable materials generated by the building's occupants/operation. Whilst a fixed area cannot always be given, the following must be complied with as a minimum: a. At least 2m2 per 1000m2 of net floor area for buildings <5000m2 b. A minimum of 10m2 for buildings ≥5000 m2 c. An additional 2m2 per 1000m2 of net floor area where catering is provided (with an additional minimum of 10m2 for buildings ≥5000m2).
	Wst 4: Compacto/baler Wst 5: Composting Wst 6: Floor finishes	--
Land use and ecology	LE 1: Reuse of land	At least 75% of the proposed development's footprint is on an area of land which has previously been developed for use by industrial, commercial or domestic purposes in the last 50 years.
	LE 2: Contaminated land	1. The site is deemed to be significantly contaminated as confirmed by a contaminated land specialist's site investigation, risk assessment and appraisal identifying: a. the degree of contamination b. the contaminant sources/types c. the options for remediating sources of pollution which present an unacceptable risk to the site. 2. The client or contractor confirms that remediation of the site will be carried out in accordance with the remediation strategy and its implementation plan.
	LE 3: Ecological value of site and protection of ecological features LE 4: Mitigating ecological impact LE 5: Enhancing site ecology LE 6: Long term impact on biodiversity	--
Pollution	Pol 1: Refrigerant GWP-Building services	1. The building has no refrigerants OR 2. The refrigerants used within the building services have a GWP less than 5.
	Pol 2: Preventing refrigerant leaks Pol3: Refrigerant GWP-cold storage	--
	Pol 4: NOx emissions	Where manufacturer's details demonstrate that the plant installed to meet the building's space heating demand has dry NOx emission levels as follows: a. One credit where the dry NOx emissions from delivered space heating energy are ≤100 mg/kWh (at 0% excess O2). b. Two credits where the dry NOx emissions from delivered space heating energy are ≤70 mg/kWh (at 0% excess O2). c. Three credits where the dry NOx emissions from delivered space heating energy are ≤40mg/kWh (at 0% excess O2).
	Pol 5: Flood risk Pol 6: Minimising	--

	watercourse pollution Pol 7: Reduction of night time light pollution Pol 8: Noise attenuation	
Innovation	Inn 1: Innovation	--

10.6 Nordic Swam, Nordic countries

Table 41 lists all the criteria applicable to office buildings as well as some benchmarks.

Table 41: Nordic Swan Small Houses, Apartments Buildings and pre-School Buildings Certification Criteria [Nordic Swan v2.1]

Category	Criteria
1.Overall requirements for the license applicant	1.1 General description of the building (O) 1.2 Responsibility for the construction process (O)
2.Energy and indoor environment	2.1 Energy • Airtightness (O) • Energy consumption (O) • Reduced energy consumption (P) • Energy from local energy source or energy recovery (P) • Permanent light sources (O) • Energy labelled goods (O) • Low-flow showers and taps (O) • Individual measurement of energy (O) 2.2 Indoor environment • Ventilation (O) • Noise (P) • Noise (O) • Daylight factor (O) • Illumination intensity (O) • Demand-controlled lighting (P)
3.Material requirements	• List of products/materials (O) • Use of ecolabelled building products (P) 3.1 Chemical building products • Material safety data sheet (O) • Classification (O) • CMR substances (O) • Prohibited substances (O) • Substances with long-term effects (O) • Nanoparticles (O) • Handling (O) 3.2 Chemical substances in permanent building products • Adverse chemical substances (O) • Chlorine-free plastic products (P) • Nanoparticles in permanent building products and white goods (O) 3.3 Timber and fibre-based materials • Securing wood and bamboo raw materials from sustainable sources (O) • Controlled wood and bamboo (O) • Timber for certified forest (O) • Higher proportion of timber form certified forests (P) • Pressure impregnated timber (O) • Formaldehyde emissions (O) 3.4 Other requirements on building products, materials and interiors • Cladding and roofing (O) • Plastic surface layers for interior floors, walls and ceilings (O) • Windows and exterior doors (O) • Low flush toilets (O)

	• Containers for sorting household waste (O) • Waste and recycling stations for apartment buildings, terraced houses and pre-school buildings (O)
4.Quality management and control of the construction process	4.1 Requirements on the construction process • Radon (O) • Material requirements (O) • Management of building waste (O) • Measurement of waste fractions (P) • Protection from damp (O) • Approved water installations (O) • Inspection during construction (O) • Inspection of the finished building (O) • Quality control (O) 4.2 Points score • Scores (O) 4.3 Quality management • Information to parties involved in the construction process (O) • Laws and regulations (O) • Organization and responsibility (O) • Changes and nonconformities (O) • Complaints (O) • Documentation of completed building (O) • Application documentation (O) • Marketing(O)
5. Instruction to residents/property managers	5.1 General information and maintenance plan (O)

Where ”O” indicates obligatory requirements and ”P” distinguishes point score requirements. Each requirement of this type gives a score being needed a minimum total score to fulfill the constraints of the Nordic Ecolabel. In this way, the building should fulfil all obligatory requirements and a minimum of 40% of the total point score. The benchmarks proposed by this scheme are shown in Table 42:

Table 42: Nordic Swan Small Houses, Apartments Buildings and pre-School Buildings Certification Benchmarks [Nordic Swan v2.1]

Criteria	Benchmark and Specifications
2.1 Energy	
Airtightness (O)	**Max. leakage** **Sweden** Apartment buildings-->0.5 l/ (s*m2) Small houses and pre-school buildings--<0.4 l/(s*m2) **Denmark** Apartment buildings 2 and 3-storey buildings-->0.7 l/(s*m2) 4 and 5-storey buildings-->0.5 l/(s*m2) 6 or more storey buildings-->0.4 l/(s*m2) Small houses and pre-school buildings Single-storey buildings-->1.1 l/(s*m2) Two-storey detached and terraced buildings-->0.8 l/(s*m2) **Norway/Finland** Apartment buildings 2 and 3-storey buildings-->1.1 h 4 and 5-storey buildings-->0.8 h 6 or more storey buildings-->0.6 h Small houses and pre-school buildings

	Single-storey buildings-->1.5 h Two-storey detached and terraced buildings-->1.2 h
Energy consumption (O)	The annual energy consumption of the building shall not exceed 75% of the upper limit on rational specific energy use as detailed by national building regulations.
Reduced energy consumption (P)	One point is awarded for each increment of 2.5% by which the calculated energy use betters the limit value specified under O4. A maximum of 10 points can be awarded.
Energy from local energy source or energy recovery (P)	One point is awarded for the installation of a local heat recovery system for waste hot water, solar collector or solar panel that supplies the ecolabelled building with energy.
Permanent light sources (O)	Permanent light fittings, both indoors and outdoors, must have light sources of energy class B and better. Reflector lamps (directional light sources) must be LED (light emitting diode) or some other energy-efficient directional light source. Exterior lighting must be automatic if the total power requirement exceeds 30 watts.
Energy labelled goods (O)	If a refrigerator, freezer and/or washing machine is installed, this must be of energy class A+. Tumble dryers must be of energy class A or higher. If an oven or dishwasher is installed, this must be of energy class A or higher. White goods that are not covered by the European directive on energy labelling are exempt from this requirement. Energy classes are defined in Commission Directives: 2003/66/EC for refrigerators and freezers. 95/12/EC for washing machines. 95/12/EC for washing machines. 2002/40/EC for ovens. 97/17/EC for dishwashers.
Low-flow showers and taps (O)	All showers (or shower mixers) and basin mixer taps must have flow reducers that are fitted and activated when the building is conveyed to the customer. Low-flow means max 12 l/min at a normal flow rate (forced flow is permitted).
Individual measurement of energy (O)	This requirement applies only to buildings with a common energy source for multiple units. A system for the individual measurement of: l general electricity shall be installed in each dwelling unit. l hot water consumption and waterborne heating energy shall be installed in each dwelling unit if the supply of hot water and heating energy is common to several dwelling units.
2.2 Indoor environment	
Ventilation (O)	National guidelines for indoor and outdoor air quality must be met. Special requirements for pre-school buildings Pre-school buildings must have automatic demand-controlled ventilation. The type of demand control must be described.
Noise (P)	One point is awarded to apartments and small houses that fulfil noise sound-transmission class B in accordance with national standards for sound transmission through walls and floors between housing units, such as between apartments or adjacent terraced houses. National standards for noise sound-transmission measurement: SS 25267 (Sweden), NS 8175(Norway), SFS 5907 (Finland), DS 490 (Denmark) and IST 45 (Iceland).
Noise (O)	Common rooms and rest rooms must fulfil sound-transmission class B in accordance with national standards for sound transmission in Sweden, Norway and Finland. In Denmark and Iceland national regulations applies. National standards for sound-transmission measurement: SS 25267 (Sweden), NS 8175(Norway) and SFS 5907 (Finland).
Daylight factor (O)	The average daylight factor for play rooms and common rooms for children must exceed 4%. The minimum daylight factor for play rooms and common rooms must exceed 1%.
Illumination intensity (O)	The average light intensity from the combination of electrical lighting and daylight must exceed 200 lux at normal lighting levels. When required by special activities, the average light intensity at floor level in areas with common rooms and rest rooms must exceed 300 lux. In laundry rooms and nursery rooms, the average light intensity must exceed 300 lux.
Demand-controlled lighting (P)	One point is awarded for the installation of automatic, demand-controlled lighting (e.g. daylight, movement or presence detectors) on more than 60% of light sources.

List of products/materials (O)	Applicants shall submit a summary containing the following information on materials and product groups that are used in the construction of the house: Product name, product description (material or product group and primary raw material) and brand/producer. Ironmongery is not subject to this requirement.
Use of ecolabelled building products (P)	Points are awarded for the use of ecolabelled (Nordic Ecolabel or EU Ecolabel) building products in the Nordic Ecolabelled building. One point is awarded for each product area within which a minimum of 10% of the product requirement is ecolabelled/recycled and two points for a minimum of 30%.
3.1 Chemical building products	
Material safety data sheet (O)	Material safety data sheets shall be made available for all chemical building products used.
Classification (O)	Hazard class-->Symbols and risk phrases Dangerous for the environment-->N with R50, R50/53 or R51/53 Carcinogenic-->T with R45 and/or R49, or Xn with R40 Mutagenic-->T with R46 or Xn with R68 Toxic for reproduction-->T with R60 and/or R61, or Xn with R62 and/or R63 Very toxic-->T+ with R26, R27, R28 and/or R39 Toxic-->T with R23, R24, R25, R39 and/or R48
CMR substances (O)	Hazard class-->Symbols and risk phrases Carcinogenic-->T with R45 and/or R49, or Xn with R40 Mutagenic-->T with R46 or Xn with R68 Toxic for reproduction-->T with R60 and/or R61, or Xn with R62 and/or R63
Prohibited substances (O)	Chemical building products must not contain : Halogenated paraffins - highly-chlorinated, short-chain (C10-C13) and medium-chain (C14-C17), Fluorinated propellants, Perfluorinated and polyfluorinated alkyl substances (PFAS) Alkylphenolethoxylates (APEO) and alkylphenol derivatives (APD), Brominated flame retardants, Phthalates in products excluding caulk, Phthalates in caulk: DEHP, DBP, BBP, 711P, DIBP DIDP and DINP are prohibited, Boron compounds, Creosote, Benzo(a)pyrene, benzo(b)pyrene, Bisphenol A, Antimony trioxide, Heavy metals: lead, cadmium, arsenic, chromium, mercury or their compounds, Monoacrylamide, Organic tin compounds
Substances with long-term effects (O)	Substances that according to the ESIS list (see below) are considered to have long-term negative effects on the environment must not be found in chemical building products. Examples include substances that are persistent, liable to bioaccumulate and toxic (PBT) and very persistent and very bioaccumulating substances (vPvB).
Nanoparticles (O)	Nanometals, nanocarbon compounds and/or nanofluorine compounds must not actively be added to the chemical building product unless there is sufficient documentation demonstrating that the substance's use does not constitute a health or environmental hazard.
Handling (O)	Hazard class-->Symbols and risk phrases Sensitising-->Xn with R42 or Xi with R43 Harmful-->Xn with R20, R21, R22, R48 or R65 Causes burns-->C with R34 and R35
3.2 Chemical substances in permanent building products	
Adverse chemical substances (O)	The requirement applies to the following product groups: Permanent sealing products, Impregnated timber, Insulation, Plastic products such as ducting (for electrical wiring); high tension cables; waste water pipes; piping for a central vacuuming system and interior floor, ceiling and wall coverings. The following substances are prohibited: Halogenated paraffins - highly-chlorinated, short-chain (C10-C13) and medium-chain (C14-C17), Fluorinated propellants, Perfluorinated and polyfluorinated alkyl substances (PFAS), Alkylphenolethoxylates (APEO) and alkylphenol derivatives (APD), Brominated flame retardants, Phthalates, Boron compounds, Creosote, Benzo(a)pyrene, benzo(b)pyrene, Bisphenol A, Antimony trioxide, Heavy metals: lead, cadmium, arsenic, chromium, mercury or their compounds, Organic tin compounds, Monoacrylamide

Chlorine-free plastic products (P)	If chlorine-free plastic products are used for all products within the following product groups, one point is awarded per product group: Cable ducts (for electrical wiring in e.g. walls) Plastic piping for central vacuum system Mains cables (excluding lifts) Waste water pipes
Nanoparticles in permanent building products and white goods (O)	The building manufacturer must have a documented procedure describing how the company ensures that building products do not contain additives of nanometals, nanocarbon compounds and/or nanofluorine compounds if it cannot be demonstrated that the use of such does not cause environmental or health issues.
3.3 Timber and fibre-based materials	
Securing wood and bamboo raw materials from sustainable sources (O)	This requirement applies to all wood and bamboo-based materials in the building, such as products made of solid wood/bamboo and glulam, veneer and fibre-based products. Wood and bamboo must not be derived from: Protected areas or areas that are treated by a policy with the objective of becoming protected. Areas where ownership or rights of exploitation are unclear. Illicitly felled trees and/or fibre raw material. Ancient virgin forest and forest of high value meriting protection. Genetically modified trees or plants.
Controlled wood and bamboo (O)	These requirements apply to parts made of solid, glulam or veneer wood and bamboo: Roof trusses Framework and joists Indoor panels Facades (including outdoor balcony, terrace and porch) Interior doors and fitments Door frames and thresholds Flooring (including skirting boards) Windows and exterior doors (including linings)
Timber for certified forest (O)	At least 50% of the raw material in solid wood, glulam and veneer products must be derived from areas with certified management following a national forestry standard that is approved by Nordic Ecolabelling. Calculations may be based on either weight or volume.
Higher proportion of timber form certified forests (P)	If the amount of certified timber (as per O25) is more than 60% of the total amount of timber, one point is awarded.
Pressure impregnated timber (O)	Pressure impregnated timber (Class M, A and AB according to Nordic Wood Preservation Council classification) may not, with certain exceptions, be used in Nordic Ecolabelled buildings. Exceptions are made for wood parts in contact with the ground or moisture sources and that require impregnation for safety reasons.
Formaldehyde emissions (O)	This requirement applies to wood and bamboo based materials such as boards, flooring and furniture containing more than 3% by weight formaldehyde-based additives and that are used in the building itself (irrespective of location) or permanent interior fittings such as wardrobes and kitchens.
3.4 Other requirements on building products, materials and interior	
Cladding and roofing (O)	Cladding and roofing must not contain lead or more than 10% by weight solid copper.
Plastic surface layers for interior floors, walls and ceilings (O)	Chlorinated plastics may not be used for interior flooring, wall coverings (technical areas exempt) or ceilings.
Windows and exterior doors (O)	Components of a window or exterior door such as the frame, casements or door leaf that are made of polymers must comprise at least 30% by weight recycled polymers. This requirement does not apply to parts that constitute less than 3% by weight of the total product.
Low flush toilets (O)	All toilets (WCs) installed must be low-flush toilets with two flush modes for max. 3 and 6 l.
Containers for sorting household waste (O)	Containers for sorting household waste (at least 3 fractions) must be installed in the kitchen.

Waste and recycling stations for apartment buildings, terraced houses and pre-school buildings (O)	Pre-school buildings and buildings with more than eight dwelling units must have space designated for a close-by waste and recycling station for at least six fractions to enable the sorting of: Paper, Hazardous waste, Glass, Metal, Electronic waste, Unsorted waste, Cardboard, Compostable waste
4.1 Requirements on the construction process	
Radon (O)	Measures must be taken during construction to ensure that the radon level adheres to national limits or requirements.
Material requirements (O)	The building manufacturer must be able to ensure that the material requirements in Section 3 are observed. If the licence applicant engages subcontractors for the entire or part of the construction project, it must be documented that the subcontractor is acquainted with and observes the material requirements.
Management of building waste (O)	There must be a waste management plan and procedures for waste management during the construction process that fulfils national and local regulations. This obligation may also be fulfilled by a third-party agreement. If the licence applicant engages subcontractors for the entire or part of the construction project, it must be documented that the subcontractor also observes these regulations.
Measurement of waste fractions (P)	One point is awarded if at least three waste fractions (including unsorted waste) from the building site are measured and documented. Two points are awarded if at least five waste fractions (including unsorted waste) from the building site are measured and documented.
Protection from damp (O)	Materials that are susceptible to damp must fulfil national recommendations for low moisture content to avoid problems related to damp in the finished building. The licence applicant must describe the provisions taken. The handling and storage of materials on the building site must be considered.
Approved water installations (O)	The licence applicant must describe how it is ensured that water installations and wet rooms are fitted according to national trade regulations and their method of self-inspection and documentation.
Quality control (O)	This requirement applies to the first Nordic Ecolabelled building and a subsequent 5% of the building stock.

5. Annex IV: Labels in third countries, criteria and benchmarks

In the present annex, tables and data from previously defined label are provided, section 5.4, of this document.

11.1 New Zealand

Table 43: GREEN STAR NZ label area and criteria proposed

Area	Criteria
Management	MAN-1 Green Star NZ Accredited Professional
	MAN-2 Commissioning Clauses
	MAN-3 Building Tuning
	MAN-4 Independent Commissioning Agent
	MAN-5 Waste Management
	MAN-6 Users' Guide Existing
	MAN-7 Environmental Management
Indoor Environment Quality	IEQ-1 Base Ventilation Rates
	IEQ-2 Ventilation Rates
	IEQ-3 Indoor Air Quality
	IEQ-4 Air Change Effectiveness
	IEQ-5 Tenant Exhaust Riser
	IEQ-6 Thermal Comfort
	IEQ-7 Thermal Comfort Control
	IEQ-8 Daylight
	IEQ-9 Daylight Glare Control
	IEQ-10 External Views
	IEQ-11 Electric Lighting Levels
	IEQ-12 High Frequency Ballasts
	IEQ-13 Internal Noise Levels
Energy	ENE-1 Energy
	ENE-2 Greenhouse Gas Emissions
	ENE-3 Carbon Dioxide Monitoring & Control
	ENE-4 Lighting
	ENE-5 Lighting control
	ENE-6 Electrical Sub-metering
	ENE-7 Peak Energy Demand Reduction
Transport	TRA-1 Car Park Minimisation
	TRA-2 Fuel Efficient Transport
	TRA-3 Cyclist Facilities
	TRA-4 Mass Commuting Transport
Water	WAT-1 Occupant Amenity Potable Water Efficiency

	WAT-2 Water Meters
	WAT-3 Landscape Irrigation Water Efficiency
	WAT-4 Heat Rejection - Water
Materials	MAT-1 Shell and Core or Integrated Fitout
	MAT-2 Building reuse
	MAT-3 Applied Coatings
	MAT-4 PVC
	MAT-5 Insulation
	MAT-6 Timber
	MAT-7 Concrete
	MAT-8 Steel
	MAT-9 Floor Coverings
	MAT-10 Recycling waste storage
Land use and ecology	ECO-1 Ecological Value of the Site
	ECO-2 Re-use of Land
	ECO-3 Reclaimed Contaminated Land
	ECO-4 Change of Ecological Value
	ECO-5 Topsoil and Fill Removal from Site
Emissions	EMI-1 Refrigerant ODP
	EMI-2 Refrigerant GWP
	EMI-3 Insulant ODP
	EMI-4 Watercourse Pollution
	EMI-5 Reduced Flow to Sewer
	EMI-6 Light Pollution
	EMI-7 Purge Control
	EMI-9 Legionella

11.2 Japan

This Japanese label has 5 different levels of compliance; they are based on BEE value which is calculated from SQ and SLR, the scores for Q and LR, according to the formula below:

BEE = Q: Building environmental quality 25×(SQ-1) / L: Building environmental load 25×(5-SLR)

With this value the rating system applied is the one listed in table 44.

Table 44: Correspondence between ranks based on BEE values and assessments

Ranks	Assessment	BEE value	Expression
S	Excellent	BEE=3.0 or more, Q=50 or more	＊＊＊＊＊
A	Very good	BEE=1.5~3.0	＊＊＊＊
B+	Good	BEE=1.0~1.5	＊＊＊

B-	Fairy Poor	BEE=0.5~1.0	* *
C	poor	BEE=less than 0.5	*

In table 45 some criteria from CASBEE are listed.

Table 45: CASBEE label area and criteria proposed

Area	Criteria		
Q: Environmental quality of the building	Q1. Indoor Environment	1. Sonic Environment	1.1 Noise
			1.2 Sound Insulation
			1.3 Sound Absorption
		2. Thermal Comfort	2.1 Room Temperature Control
			2.2 Humidity Control
			2.3 Type of Air Conditioning System
		3. Lighting & Illumination	3.1 Daylighting
			3.2 Anti-glare Measures
			3.3 Illuminance Level
			3.4 Lighting Controllability
		4. Air Quality	4.1 Source Control
			4.2 Ventilation
			4.3 Operation Plan
	Q2. Quality of Service	1. Service Ability	1.1 Functionality & Usability
			1.2 Amenity
			1.3 Maintenance Management
		2. Durability & Reliability	2.1 Earthquake Resistance
			2.2 Service Life of Components
			2.4 Reliability
		3. Flexibility & Adaptability	3.1 Spatial Margin
			3.2 Floor Load Margin
			3.3 Adaptability of Facilities
	Q3. Outdoor Environment on Site	1. Preservation & Creation of Biotope	--
		2. Townscape & Landscape	--
		3. Local Characteristics & Outdoor Amenity	3.1 Attention to Local Character & Improvement of Comfort
			3.2 Improvement of the Thermal Environment on Site
LR: Environmental load reduction of the building	LR1 Energy	1. Building Thermal Load	--
		2. Natural Energy Utilization	2.1 Direct Use of Natural Energy
			2.2 Converted Use of Renewable Energy
		3. Efficiency in Building Service System	3.1 HVAC System
			3.2 Ventilation System
			3.3 Lighting System
			3.4 Hot Water Supply System

			3.5 Elevators
			3.6 Equipments for Improving Energy
		4. Efficient Operation	4.1 Monitoring
			4.2 Operation & Management System
	LR2 Resources & Materials	1. Water Resources	1.1 Water Saving
			1.2 Rainwater & Gray Water
		2. Reducing Usage of Non-renewable Resources	2.1 Reducing Usage of Materials
			2.2 Continuing Use of Existing Structural Skeletons etc.
			2.3 Use of Recycled Materials as Structural Frame Materials
			2.4 Use of Recycled Materials as Non-structural Materials
			2.5 Timber from Sustainable Forestry
			2.6 Efforts to Enhance the Reusability of Components and Materials
		3. Avoiding the Use of Materials with Pollutant Content	3.1 Use of Materials without Harmful Substances
			3.2 Avoidance of CFCs and Halons
	LR3 Off-site Environment	1. Consideration of Global Warming	--
		2. Consideration of Local Environment	2.1 Air Pollution
			2.2 Heat Island Effect
			2.3 Load on Local Infrastructure
		3. Consideration of Surrounding Environment	3.1 Noise, Vibration & Odor
			3.2 Wind Damage & Sunlight Obstruction
			3.3 Light Pollution

Table 46: CASBEE Weighting Coefficients

Assessment Categories		
Q1 Indoor Environment	Non-factory	Factory
	0,4	0,3
Q2 Quality of Service	0,3	0,3
Q3 Outdoor Environment on Site	0,3	0,4
LR1 Energy	0,4	
LR2 Resources & Materials	0,3	
LR3 Off-site Environment	0,3	

11.3 United States

The rates are given as a result of the LEED matrix where weight of impacts and credits are mixed. Table 47 lists the credits as well as the methodology and criteria area.

Table 47: LEED offices Criteria and area

Area	Criteria
Sustainable Sites (SS)	Prerequisite 1 Construction Activity Pollution Prevention
	Credit 1 S ite Selection
	Credit 2 Development Density and Community Connectivity
	Credit 3 Brownfield Redevelopment
	Credit 4.1 Alternative Transportation—Public Transportation Access
	Credit 4.2 Alternative Transportation—Bicycle Storage and Changing Rooms
	Credit 4.3 Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles
	Credit 4.4 Alternative Transportation—Parking Capacity
	Credit 5.1 Site Development—Protect or Restore Habitat
	Credit 5.2 Site Development—Maximize Open Space
	Credit 6.1 Stormwater Design—Quantity Control
	Credit 6.2 Stormwater Design—Quality Control
	Credit 7.1 Heat Island Effect—Nonroof
	Credit 7.2 Heat Island Effect—Roof
	Credit 8 Light Pollution Reduction
	Water Efficiency (WE)
	Prerequisite 1 Water Use Reduction
	Credit 1 Water Efficient Landscaping
	Credit 2 Innovative Wastewater Technologies
	Credit 3 Water Use Reduction
Energy and Atmosphere (EA)	Prerequisite 1 Fundamental Commissioning of Building Energy Systems
	Prerequisite 2 Minimum Energy Performance
	Prerequisite 3 Fundamental Refrigerant Management
	Credit 1 Optimize Energy Performance
	Credit 2 O n-site Renewable Energy
	Credit 3 Enhanced Commissioning
	Credit 4 Enhanced Refrigerant Management
	Credit 5 Measurement and Verification
	Credit 6 Green Power
Materials and Resources (MR)	Prerequisite 1 Storage and Collection of Recyclables
	Credit 1.1 Building Reuse—Maintain Existing Walls, Floors, and Roof
	Credit 1.2 Building Reuse—Maintain Interior Nonstructural Elements
	Credit 2 Construction Waste Management
	Credit 3 Materials Reuse
	Credit 4 Recycled Content
	Credit 5 Regional Materials
	Credit 6 Rapidly Renewable Materials
	Credit 7 Certified Wood

Indoor Environmental Quality (IEQ)	Prerequisite 1 Minimum Indoor Air Quality Performance
	Prerequisite 2 Environmental Tobacco Smoke (ETS) Control
	Credit 1 Outdoor Air Delivery Monitoring
	Credit 2 Increased Ventilation
	Credit 3.1 Construction Indoor Air Quality Management Plan—During Construction
	Credit 3.2 Construction Indoor Air Quality Management Plan—Before Occupancy
	Credit 4.1 Low-Emitting Materials—Adhesives and Sealants
	Credit 4.2 Low-Emitting Materials—Paints and Coatings
	Credit 4.3 Low-Emitting Materials—Flooring Systems
	Credit 4.4 Low-Emitting Materials—Composite Wood and Agrifiber Products
	Credit 5 Indoor Chemical and Pollutant Source Control
	Credit 6.1 Controllability of Systems—Lighting
	Credit 6.2 Controllability of Systems—Thermal Comfort
	Credit 7.1 Thermal Comfort—Design
	Credit 7.2 Thermal Comfort—Verification
	Credit 8.1 Daylight and Views—Daylight
	Credit 8.2 Daylight and Views—Views
Innovation in Design (ID)	Credit 1 Innovation in Design
	Credit 2 LEED® Accredited Professional
Regional Priority (RP)	Credit 1 Regional Priority

11.4 GBTOOL

Table 48: GBTOOL Criteria and area proposal

Area	Subarea	Criteria	
A Site Suitability and Development	A1 Site Suitability	A1.1	Use of land with previously high ecological sensivity or value.
		A1.2	Use of land with previously high agricultural value.
		A1.3	Vulnerability of the site to flooding.
		A1.4	Use of previously contaminated land for development.
		A1.5	Proximity of site to public transportation of adequate service quality.
	A2 Urban Design and Site Development	A2.1	Development density of project
		A2.2	Provision of mixed uses within large projects.
		A2.3	Provision of green space within large projects for public use.
		A2.4	Provision of trees with shading potential.
B Energy and Resource Consumption	B1 Total Life Cycle Non-Renewable Energy	B1.1	Embodied non-renewable energy in original construction materials.
		B1.2	Embodied non-renewable energy in construction materials for maintenance or replacement(s).

		B1.3	Annual consumption of non-renewable energy used for all purposes in facility operations.
	B2 Electrical peak demand	B2.1	Electrical peak demand for facility operations.
	B3 Use of Materials	B3.1	Degree of re-use of suitable existing structure(s) where available.
		B3.2	Material efficiency of structural and building envelope components.
		B3.3	Use of virgin non-renewable materials.
		B3.4	Use of finishing materials.
		B3.5	Ease of disassembly, re-use or recycling.
	B4 Use of potable water, stormwater and greywater	B4.1	Annual use of water by building occupants.
		B4.2	Annual use of water for site irrigation.
		B4.3	Annual use of water for building equipment.
C Environmental Loadings	C1 Greenhouse Gas Emissions	C1.1	Annualized GHG emissions from energy embodied in original construction materials.
		C1.2	Annualized GHG emissions from energy embodied in construction materials used for maintenance or replacement(s).
		C1.3	Annual GHG emissions from primary energy used for all purposes in facility operations.
		C1.4	Annual GHG emissions from primary energy used for commuting transport
	C2 Other Atmospheric Emissions	C2.1	Annual emissions of ozone-depleting substances during facility operations.
		C2.2	Annual emissions of acidifying emissions during facility operations.
		C2.3	Annual emissions leading to photo-oxidants during facility operations.
	C3 Solid and Liquid Wastes	C3.1	Solid waste from the construction and demolition process sent off the site.
		C3.2	Annual solid non-hazardous waste from facility operations sent off the site.
		C3.3	Risk of hazardous waste resulting from facility operations.
		C3.5	Liquid effluents from facility operations that are sent off the site annually.
	C4 Impacts on Project Site	C4.1	Impact of construction process on natural features of the site.
		C4.2	Impact of construction process or landscaping on soil erosion.
		C4.3	Changes in biodiversity on the site.
		C4.4	Adverse wind conditions at grade around tall buildings.

	C5 Other Local and Regional Impacts	C5.1	Impact on access to daylight or solar energy potential of adjacent property
		C5.2	Impact of construction process on local residents and commercial facility users.
		C5.3	Impact of building user population on peak load capacity of public transport system.
		C5.4	Impact of private vehicles used by building population on peak load capacity of local road system.
		C5.5	Potential for project operations to contaminate nearby bodies of water.
		C5.6	Cumulative (annual) thermal changes to lake water or sub-surface aquifers.
		C5.7	Contribution to Heat Island Effect from roofing, landscaping and paved areas.
		C5.8	Degree of atmospheric light pollution.
D Indoor Environmental Quality	D1 Indoor Air Quality	D1.1	Pollutant migration between occupancies.
		D1.4	Volatile organic compounds concentration in indoor air.
		D1.5	CO2 concentrations in indoor air.
	D2 Ventilation	D2.1	Effectiveness of ventilation in naturally ventilated occupancies during Summer.
		D2.2	Effectiveness of ventilation in naturally ventilated occupancies during Spring/Fall.
		D2.3	Effectiveness of ventilation in naturally ventilated occupancies during Winter.
		D2.4	Air quality and ventilation in mechanically ventilated occupancies.
		D2.5	Air movement in mechanically ventilated occupancies.
		D2.6	Effectiveness of ventilation in mechanically ventilated occupancies.
	D3 Air Temperature and Relative Humidity	D3.1	Appropriate air temperature and relative humidity in mechanically cooled occupancies.
		D3.2	Appropriate air temperature in naturally ventilated occupancies.
	D4 Daylighting and Illumination	D4.1	Appropriate daylighting in primary occupancy areas.
		D4.2	Control of glare from daylighting.
		D4.3	Appropriate illumination levels and quality of lighting.
	D5 Noise and Acoustics	D5.1	Noise attenuation through the exterior envelope.
		D5.2	Transmission of facility equipment noise to primary occupancies.
		D5.3	Noise attenuation between primary occupancy areas.

		D5.4	Appropriate acoustic performance within primary occupancy areas.
E Service Quality	E1 Safety and Security During Operations	E1.2	Risk to occupants and facilities from flooding.
		E1.6	Occupant egress from tall buildings under emergency conditions.
		E1.7	Maintenance of core building functions during power outages.
		E1.8	Personal security for building users during normal operations.
	E2 Functionality and efficiency	E2.2	Sway of tall buildings in high wind conditions.
		E2.6	Efficiency of vertical transportation system.
		E2.7	Spatial efficiency.
		E2.8	Volumetric efficiency.
	E3 Controllability	E3.1	Effectiveness of facility management control system.
		E3.2	Capability for partial operation of facility technical systems.
		E3.3	Degree of local control of lighting systems.
	E4 Flexibility and Adaptability	E4.1	Ability for building operator or tenant to modify facility technical systems.
		E4.2	Adaptability constraints imposed by structure or floor-to-floor heights.
		E4.3	Adaptability constraints imposed by building envelope and technical systems.
		E4.4	Adaptability to future changes in type of energy supply.
	E5 Optimization and Maintenance of Operating Performance	E5.1	Commissioning and re-commissioning of key facility systems.
		E5.2	Adequacy of the design and construction of the building envelope for maintenance of long-term performance.
		E5.4	Existence and implementation of a maintenance management plan.
		E5.5	On-going monitoring and verification of performance.
		E5.6	Retention of as-built documentation.
		E5.7	Provision and maintenance of a building log.
		E5.8	Provision of performance incentives in leases or sales agreements.
		E5.9	Level of skills and knowledge of operating staff.
F Social and Economic Aspects	F1 Social Aspects	F1.1	Construction accident rate.
		F1.2	Access for mobility-impaired persons on site and within the building.
		F1.3	Access to direct sunlight from living areas of dwelling units.

		F1.4	Access to private open space from dwelling units.
		F1.6	Visual privacy in principal areas of dwelling units.
	F2 Cost and Economics	F2.1	Life-cycle cost.
		F2.2	Construction cost.
		F2.3	Operating and maintenance cost.
		F2.4	Affordability of residential rental or cost levels.
		F2.5	Impact of project on land values of adjacent properties.
		F2.6	Support for the local economy.
		F2.7	Investment risk
G Cultural and Perceptual Aspects	G1 Culture & Heritage	G1.1	Impact of the design on existing streetscapes.
		G1.3	Maintenance of the heritage value of an existing facility.
	G2 Perceptual	G2.1	Impact of tall structure on existing view corridors.
		G2.2	Quality of views from tall structures.
		G2.3	Aesthetic quality of site development.
		G2.4	Aesthetic quality of facility exterior.
		G2.6	Access to exterior views from interior.