

STUDY FOR THE DEVELOPMENT OF EUROPEAN ECOLABEL CRITERIA FOR BUILDINGS

Preliminary Report
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1. Introduction

(Stefania Minestrini)

In Autumn 2007 the Italian Competent Body with the technical support of the Italian National Agency for the Environment and for Technical Services (APAT) obtained the mandate for developing criteria for awarding the European Ecolabel to the product group “buildings”.

In December 2007 a first national meeting was organised from the Italian Competent Body and APAT in order to set up a pool of experts belonging to scientific institutions interested in carrying out the project with the coordination and supervision of APAT.

A number of experts coming from public research institutions and universities gave their availability to work.

The project officially started at the end of January 2008 when the working group was set up and the different tasks established.

This report is the results of the different contributions from the different experts which have been worked so far and to whom APAT’ special thanking is addressed.

The project to develop environmental criteria for awarding the European Ecolabel to a possible product group so called “buildings” was born as idea coming from the Italian Competent Body to put aside the mandatory energy certification, foreseen by the Directive 2002/91 of 16th December 2002 concerning the energy performance of buildings, a voluntary environmental certification system to be complementary to the energetic and mandatory ones.

In consideration of the increasing construction market and its weight in environmental terms not only for energetic aspects, together with the establishment at European level of sustainability principles, it becomes more and more relevant to integrate the energy certification with environmental criteria that consider environmental aspects in a wider approach.

The consideration of environmental impacts for buildings within a life cycle approach implies therefore the evaluation not only of energy aspects but also environmental aspects related to water use, construction materials, air quality, waste production, etc.

In this sense at international level interesting initiatives within certification systems and schemes (USA, Japon, etc.) are already in place, as well as the elaboration of standards for the evaluation of sustainable aspects in the construction sector and in particular standards related to construction materials under definition by standardisation body such as ISO and CEN; the European Commission itself is financing projects for the definition of quality environmental labels in the sector.

In this context the elaboration of environmental criteria for awarding the European Ecolabel is intended to create a tool with double purposes: to stimulate producers towards production of good and services with lower environmental impacts and to stimulate consumers towards more sound environmental choices.

But why using a tool such as the European Ecolabel for buildings? First of all the European Ecolabel is a tool which considers environmental aspects and impacts along the all life cycle of a product or service, establishing criteria for environmental improvement revised during time in order to guarantee the excellence of environmental performances. This is guaranteed by means of environmental performance levels which are established in the criteria, in particular by means of qualitative but above all quantitative limits.

Despite of the exiting initiatives and projects which have been focusing mainly on assessment methodologies for sustainability, or setting up general targets to reach, the European Ecolabel establishes limits to be acheived or not to be overpassed that guarantee the environmental performance levels of a product or service certified.

Moreover the Ecolabel Regulation 1980/2000 requires that the product or service certified shall have a fitness for use which is a criterion particularly important especially for products having a quite long lifetime.

In the case of buildings to set up a such requirement represents also a concrete and further guarantee for consumers which most of time are not able to measure or realise the existence of certain conditions or elements.

In the context of existing initiatives the European Ecolabel can play a role as a complementary tool especially referring to the international work made by ISO and CEN but also as reference tool for all the existing initiatives at local and national level in Europe; for example the Italian initiatives Casa Clima, Protocollo di Itaca, but also the certification systems Minergie, BREEM (*Building Research Establishment Environmental Assessment Method*), LEED (*Leadership in Energy and Environmental Design*), GBC (*Green Building Challenge*), and also Ecolabel schemes such as the Nordic Swan or the Catalonia Ecolabel.

As natural consequence this tool is clearly intended to enforce the European strategy towards a better sustainability of the construction sector.

Of course some specific issues need to be considered according to the peculiarity of this product group, for instance the product lifetime.

In this preliminary report a first consideration of the most relevant fields functional to the product group definition has been tackled and a first possible definition elaborated.

2. Market analysis

(Maiorino, Di Tivoli)

The purpose of this chapter is to provide a market snapshot of the buildings in UE. Because there is a wide spectrum of characteristics in this sector, it was not easy to carry out a comprehensive report of all categories and activities of buildings.

In this sense this market study was focused on the following aspects:

- Existing construction;
- Main construction activities (new constructions, demolitions and renovation);

The data were acquired from the available accredited sources, in order to provide a reliable scenario on the size and composition of the housing stock in UE. Most data has been extracted from the “Bulletin of Housing Statistics for Europe and North America 2004” and also from the 2006 version, produced by the United Nations Economic Commission for Europe (UNECE). Another source was Euroconstruct, one of the most important networks for construction, finance and business forecasting in Europe.

Because of different construction practices and priorities across Europe, it was decided to analyse the data by splitting the EU-27 (Fig.2.1) in four main geographical areas homogeneous as follows:

- Western Europe (Austria, Belgium, France, Germany, Luxembourg, Netherlands);
- Southern Europe (Cyprus, Greece, Italy, Malta, Portugal, Slovenia, Spain);
- Eastern Europe (Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovak Republic);
- Northern Europe (Denmark, Estonia, Finland, Ireland, Latvia, Lithuania, Sweden, United Kingdom).



Figure 2.1: European union countries (EU-27)

2.1 BUILDINGS MARKET COMPOSITIONS IN EUROPE

2.1.1 Definitions

Here are presented relevant definitions in order to aid understanding of analysis. The definitions concern the statistical data on construction used in the tables and graphs and are established jointly by the Conference of European Statisticians and the Committee on Housing, Building and Planning.

Building - A building is any independent structure comprising one or more rooms or other spaces, covered by a roof, enclosed with external walls or dividing walls, which extend from the foundations to the roof, and intended for residential, agricultural, industrial, commercial, cultural, etc., purposes.

Dwelling - A dwelling is a room or suite of rooms and its accessories in a permanent building or structurally separated part thereof which by the way it has been built, rebuilt, converted, etc., is intended for private habitation. It should have a separate access to a street (direct or via a garden or grounds) or to a common space within the building (staircase, passage, gallery, etc.). Detached rooms for habitation which are clearly built, rebuilt, converted, etc., to be used as a part of the dwelling should be counted as part of the dwelling. (A dwelling may thus be constituted of separate buildings within the same enclosure, provided they are clearly intended for habitation by the same private household, e.g. a room or rooms above a detached garage, occupied by servants or other members of the household.)

Dwelling stock - The dwelling stock includes only conventional (permanent) dwellings, whether occupied or not. The simple term "dwelling" is generally used instead of "conventional dwelling". The dwelling stock does not include rustic (semi-permanent) and improvised housing units (e.g. huts, cabins, shanties), mobile housing units (e.g. trailers, caravans, tents, wagons, boats) and housing units not intended for human habitation but in use for the purpose (e.g. stables, barns, mills, garages, warehouses).

Residential and non-residential buildings - A building should be regarded as residential when the major part of the building (i.e. more than half of its gross floor area) is used for dwelling purposes. Other buildings should be regarded as non-residential.

In dwelling construction four types of building activity are distinguished, defined as follows:

New construction - The erection of an entirely new structure, whether or not the site on which it is built was previously occupied.

Restoration - Repairs by which at least one dwelling or other structure is effectively reinstated and where substantial parts of the existing structure are used.

Extension - The enlargement of buildings by which space is added.

Conversion - Structural changes carried out within a building.

Decreases in the dwelling stock consist of the following components:

- dwellings becoming definitely empty (e.g. because they are declared unfit for habitation or because it is evident that they will not again be occupied permanently), whether demolished or not, included in this category are also dwellings which, after having become unfit for habitation, are subsequently restored and effectively reinstated (as indicated above, the restoration of the dwelling should be recorded as an increase in the dwelling stock);

- dwellings fit for habitation but demolished, e.g. to make way for the construction or extension of factories, the construction of new roads or the widening of existing roads;
- dwellings destroyed by fire, floods, subsidence or other catastrophes;
- decreases in the number of dwellings resulting in the conversion of two or more dwellings into one dwelling or of one or more dwellings into non-residential accommodation (with or without building activity).

New non-residential buildings completed

The following definitions, shown in the United Nations Yearbook of Construction Statistics 2/ are used:

Industrial buildings - All buildings which are used to house the production, assembly and warehousing activities of industrial establishments, i.e. factories, plants, workshops etc.

Commercial buildings - Office buildings and all buildings which are intended for use primarily in wholesale, retail and service trades, i.e. hotels, restaurants, shops, warehouses, public garages etc.

Educational buildings - All buildings which are intended for use directly in the instructional activities, furnishing academic and technical courses, i.e. schools, universities etc. as well as museums, art galleries, libraries etc.

Health buildings - All buildings which are primarily engaged in providing hospital and institutional care, i.e. hospitals, infirmaries, sanatoria etc.

Other buildings - Buildings which are not included in any of the above classifications i.e. public, religious, amusement, sport, recreational and community buildings, non-residential farm buildings etc.

In fine, the definition of gross domestic product:

Gross domestic product (GDP) is the central aggregate of National Accounts. At market prices is the final result of the production activity of resident producer units (ESA¹ 1995, 8.89). It is defined as the value of all goods and services produced less the value of any goods or services used in their creation

2.1.2 General

Before beginning the market analysis, it is necessary to define frame of reference of the UE. The combined population of the 27 member countries has been estimated at 497.198.740,000 in January 2008, while the population density amounts to 114/km² (2006). The total area is 4,324,782 km². The following diagrams (Fig. 2.2, 2.3) show the partition of population and GDP in Europe (source: Eurostat), while Tab. 2.1 shows the distribution of the population divided into the 4 main European areas.

Total population
At 1 January

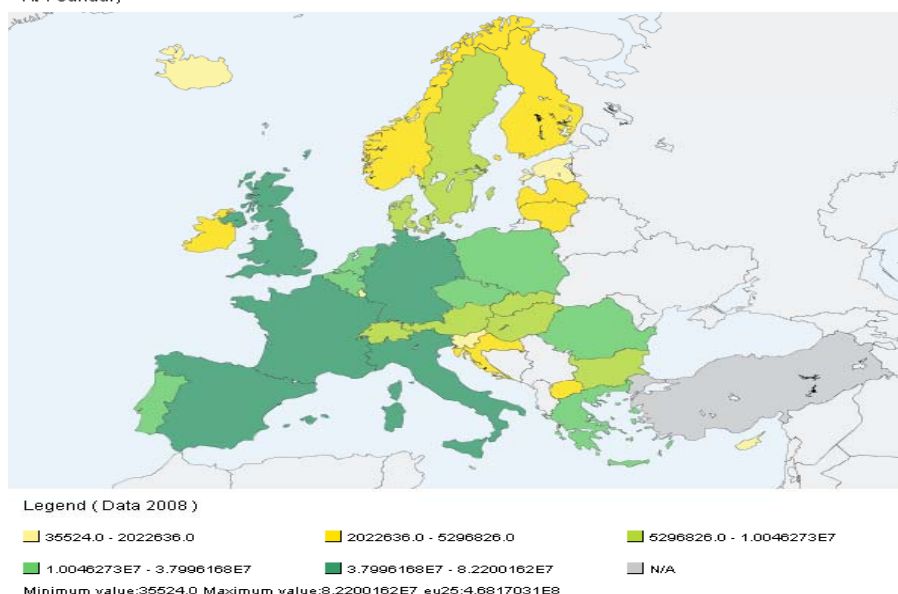


Figure 2.2: The share of total population in Europe

¹ European System of National and Regional Accounts

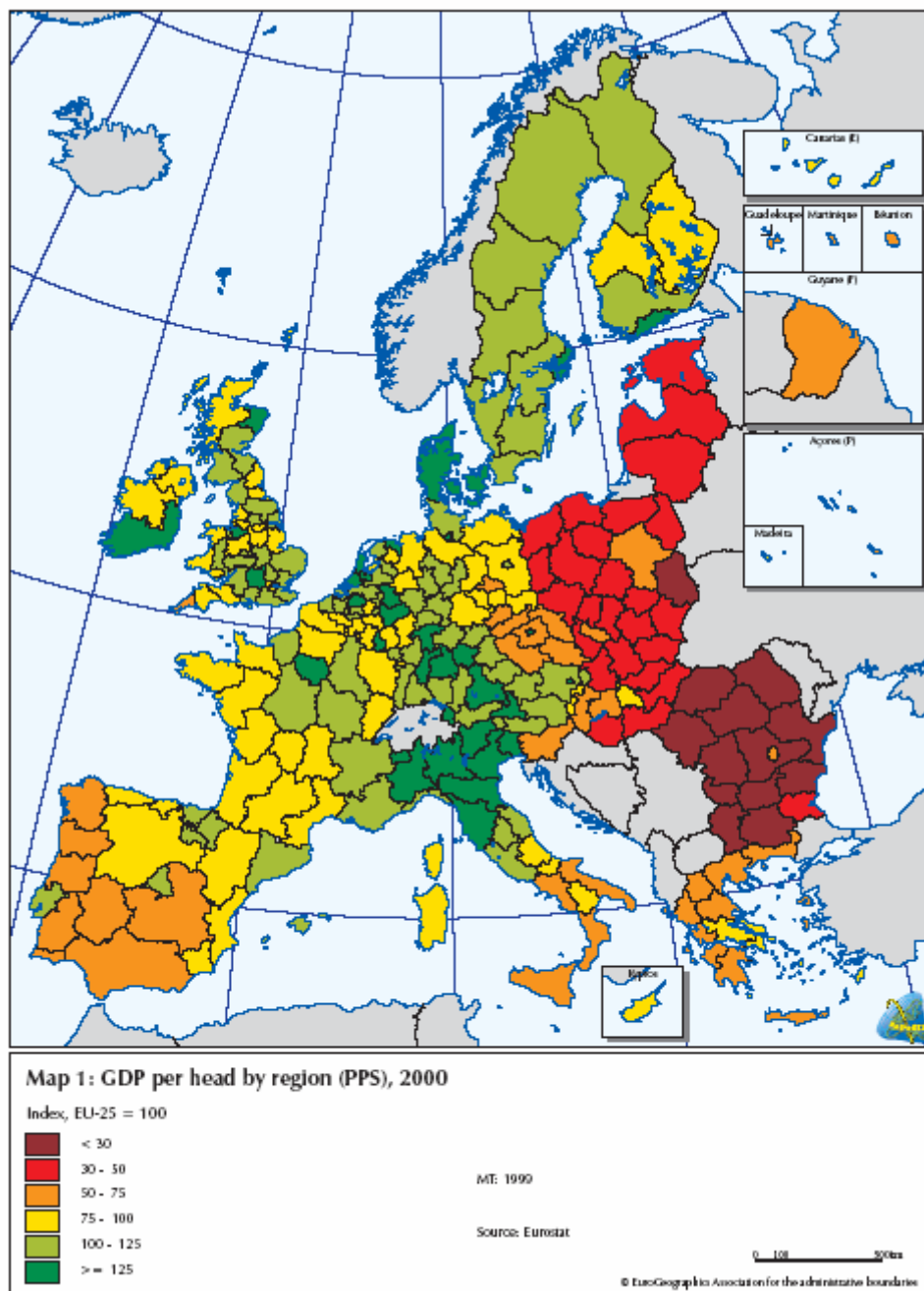






Figure 2.3: The share of GDP in Europe

Table 2.1: The share of total population in UE-27 areas (2001)

POPULATION			%
	Western Europe	1,75E+08	36
	Southern Europe	1,22E+08	25
	Eastern Europe	93647785	20
	Northern Europe	89292226	19

(source: Eurostat 2001)

2.1.3 Existing construction

The assessment of existing construction may be carried out by splitting the sector into two main categories: building and civil engineering. Buildings are sub-divided into residential and non-residential buildings. Civil engineering works are not classified as buildings: for example, railways, roads, bridges, highways, airport runways, dams.

The study was completed with additional information published by Euroconstruct. Euroconstruct is established by a number of specialised research institutes and consulting organisations as a study group for construction analysis and forecasting. It has since expanded from the core group to include almost all Western European countries (the European Union and EFTA) and a number of Eastern European states (EU-Accession countries). At present, EUROCONSTRUCT has member institutes in 19 European countries (Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, United kingdom).

According to the document of Press Conference "The European Construction Market 1990-2009" published by Euroconstruct, during 14 years from 1991 to 2005 the total volume of construction increased on average by 1,2% p.a. in the 19 Euroconstruct countries. Fig. 2.4 shows the positive trend in Europe for total construction output. In the first half of 1990s the output was basically stationary, but in the following years it is possible to observe a meaningful growth.

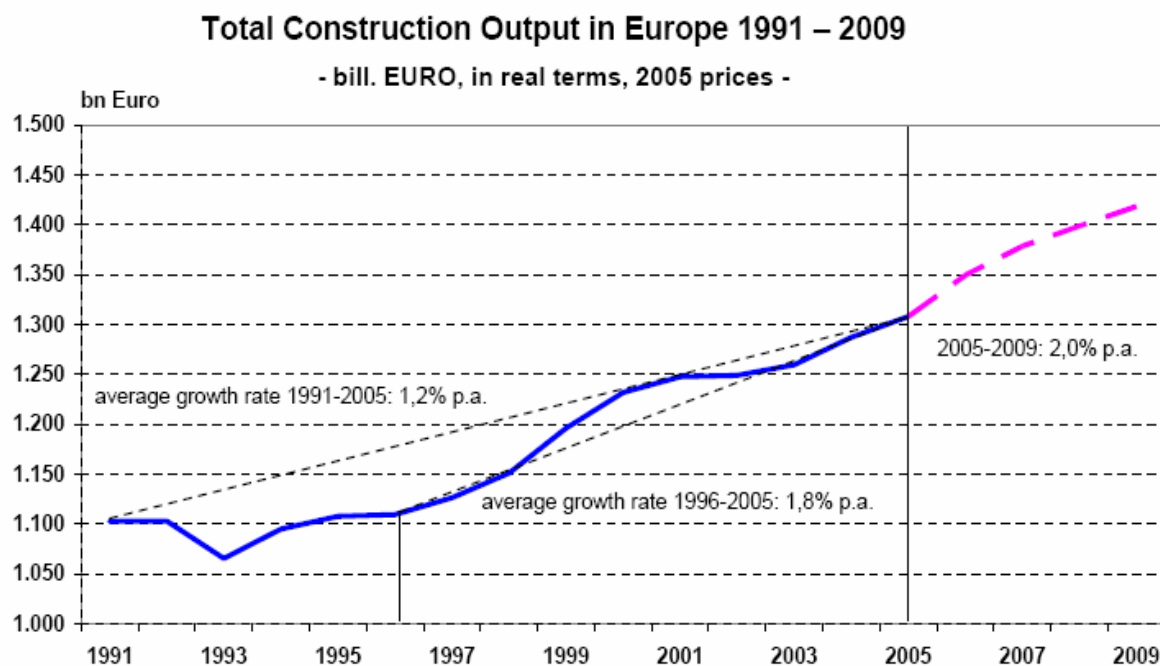


Figure 2.4: Total Construction Output in Europe 1991-2005 (source: Euroconstruct)

Fig.2.5 shows the evolution of output concerning specific construction sectors. Analysing the trend lines in the graph, it is possible to observe that the residential construction (+2% p.a.) is clearly outperforming the average, while civil engineering reaches a growth rate around 0,8% p.a., the same value for non residential construction is 0,5% p.a..

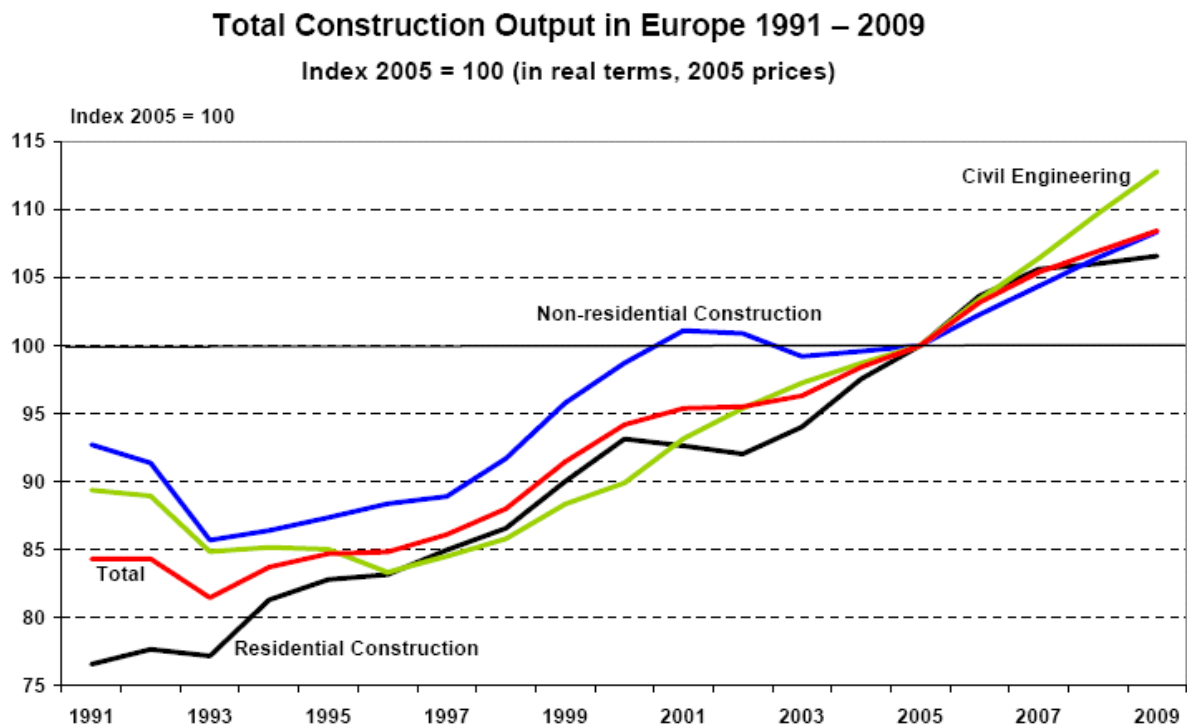


Figure 2.5: Total Construction Output in Europe for the various sectors (source: Euroconstruct)

The residential and non-residential construction sectors are analysed by assessing the output partition in 2005. Fig.2.6 shows the output of new residential construction, residential renovation, civil engineering, new non-residential construction and non-residential renovation.

Total Construction Output in Europe by Sectors in 2005

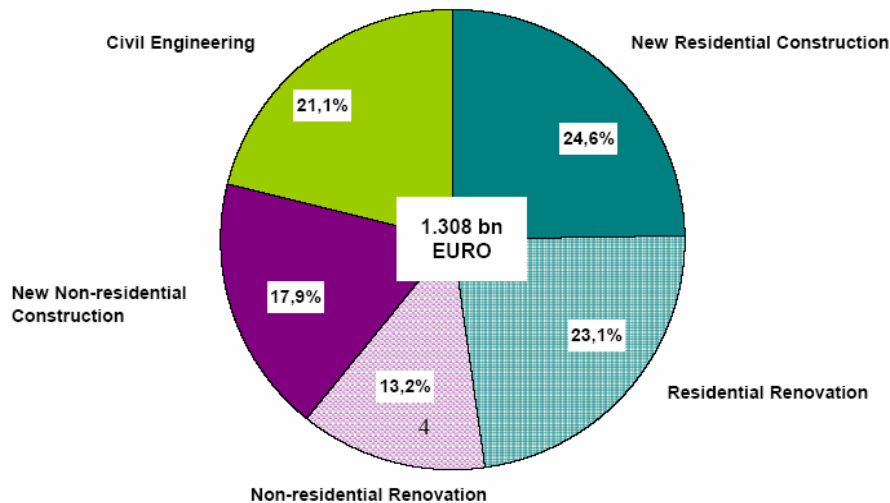


Figure 2.6: Total Construction Output in Europe for the various sectors in 2005
Source: Euroconstruct

Generally the focus of construction activities is still the residential sector, with 642 billion Euros in 2005, which is nearly half (47.7%) the total construction output of 1308 billion Euros. The new residential construction with 322 milliards of euro outpaced slightly the total output for Repair and Maintenance (R&M) (302 milliards of euro)

In addition, in order to characterize the existing buildings, the total number of apartments and the age of housing were identified. The relevant identified data concerning Europe were divided into four main areas, as follows:

- Western Europe;
- Southern Europe;
- Eastern Europe;
- Northern Europe.

The number of the dwellings refers to 2001 (Fig.2.7). Total is 182.818 million. The age distribution of housing stock analyses a ranges from 1919 to 2001 (Fig.2.7, 2.8). It is important to point out that the data used for the graphs are published by UNECE and present significant incompleteness, providing a consistent limit in the conclusions. In the following graph (Fig. 2.7) there is data missing from Belgium, Italy and Malta.

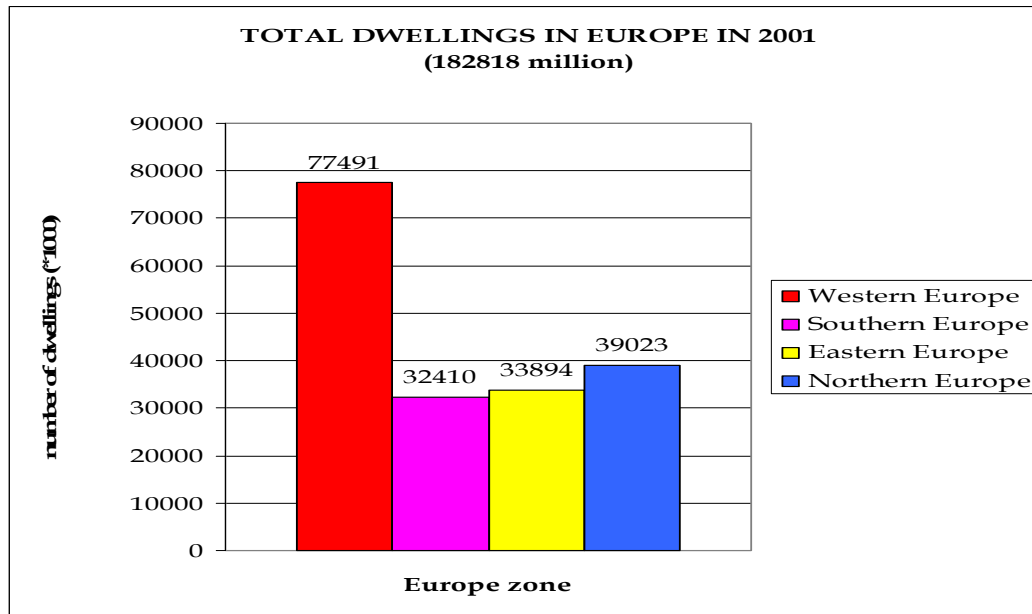


Figure 2.7: Number of buildings in the European areas (2001) (source: UNECE)

The absence of data for Italy affects the computation of the Southern European total and doesn't permit to conclude that this European area truly counts the least number of dwellings in respect to the other totals.

In following graph (Fig.2.8) there is data missing from Belgium, Germany and Luxembourg for Western Europe; from Italy, Greece, Portugal, Cyprus and Malta for Southern Europe; from Czech Republic, Hungary, Poland and Romania for Eastern Europe; and from Sweden and United Kingdom for northern Europe.

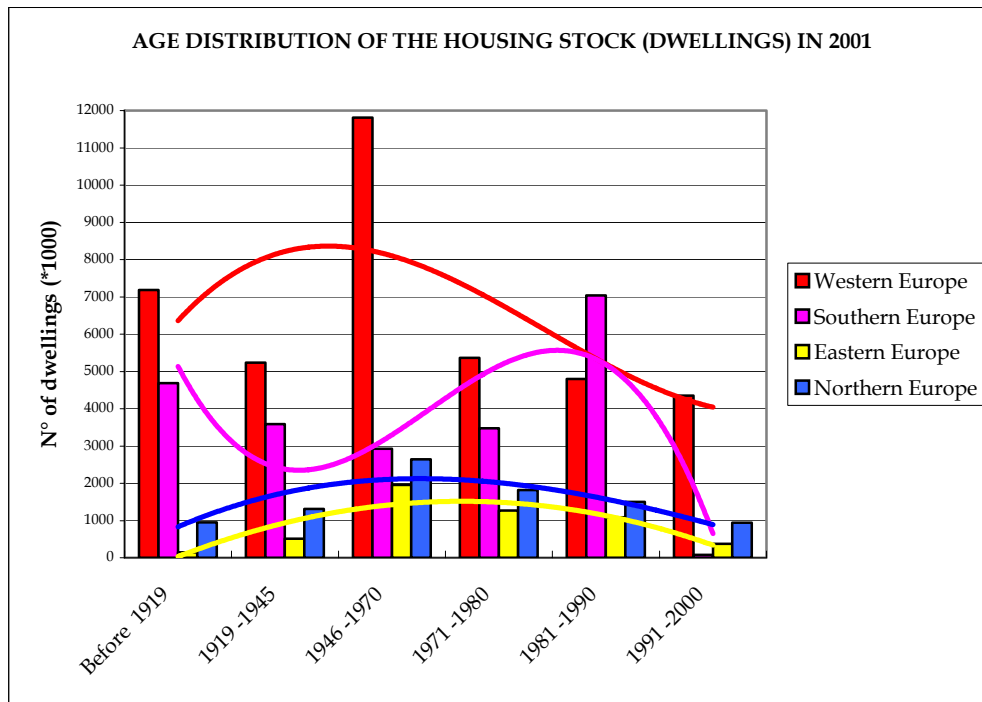


Figure 2.8: Age distribution of the housing stock (dwellings) (1919-2001) (source: UNECE)

In the graph shown in Fig.2.8 to each group of homogeneous histograms (Europe zone) has been added a polynomial regression line (cubic equation) in order to describe the variation in the age distribution of housing stock trends. The curve of Western Europe (red line) shows a peak in correspondence for the period 1946-1970. The absence of German data should not introduce a variation of trend, but only a change of total. The Southern Europe (fuchsia line) peak is shifted in respect to the Western Europe age distribution of housing stock toward the period 1981-1990. This trend is affected by Spanish data that are characterized just in that temporal range (1981-1990) by an important economic prosperity and as consequence by a building activities increment. The Eastern Europe curve (yellow line) follows a smooth parabolic trend, probably due to the absence information for many countries, even if it is possible to assume that the missing data introduction doesn't cause a consistent trend variation. The curve peak is placed in correspondence of the temporal range 1946-1970. The same considerations may be extended to the age distribution of housing stock in Northern Europe (blue line). In this case, the information absence of United Kingdom is significant in quantitative terms, but it should affect only the total and not the trend.

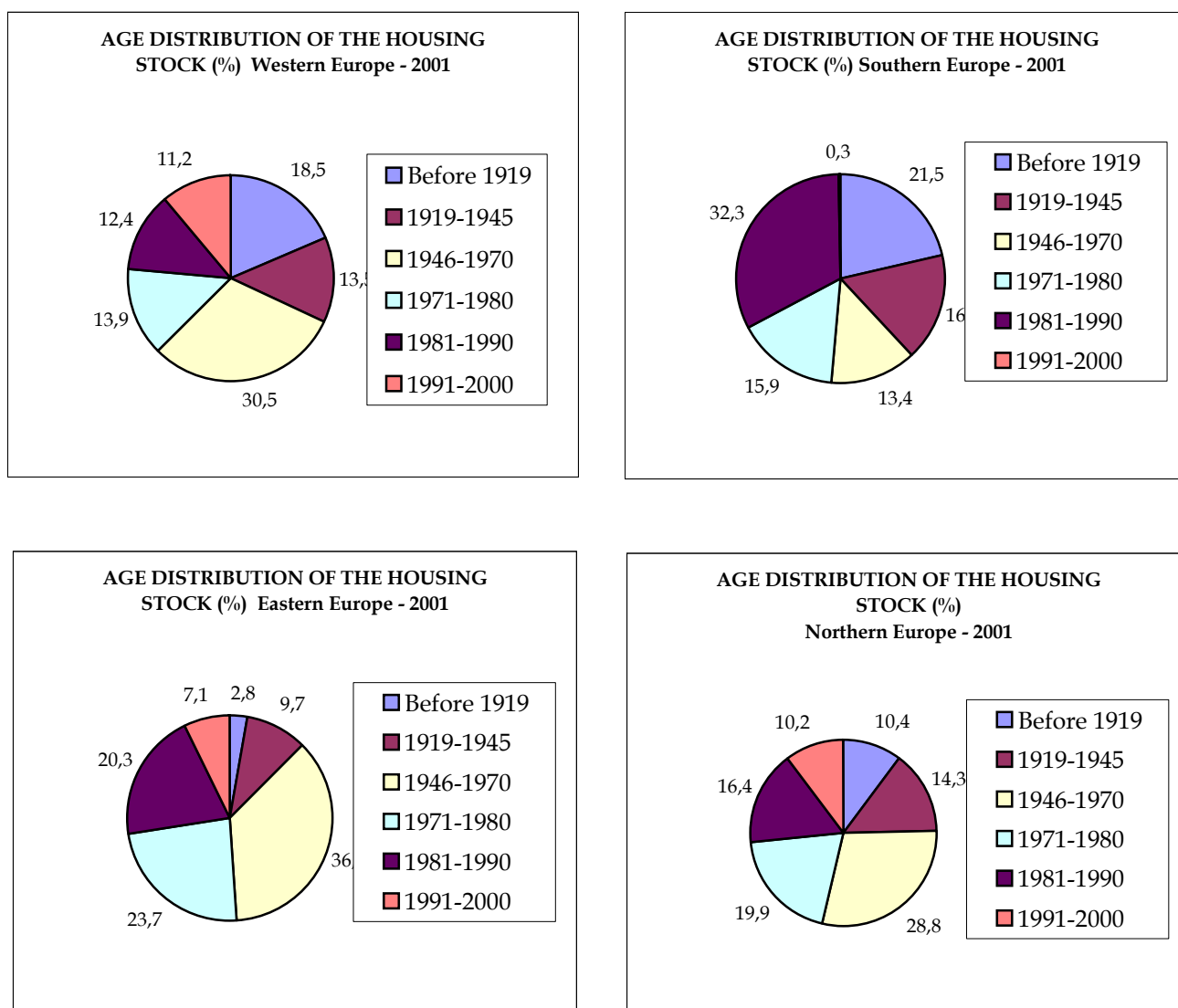


Figure 2.9: Age distribution of the housing stock concerning the main EU 27 areas (1919-2001)

Observing the age distribution of the housing stock in UE 27 (Fig. 2.9) and putting in mind the limits introduced by the absence of data, as mentioned before, it is possible to conclude that:

- Western Europe presents the higher and, at the same time, the older housing stock (dwellings) probably due to the higher population (36% of total population relatively to UE-27 in 2001; source: Eurostat);
- In general, the most conspicuous housing stock is realized during 1946-1970, probably due to the post war reconstruction;
- The area of Southern Europe contains the newer housing stock, probably due to the economic growth in Spain (the absence of data for Italy computation affects the total).

Fig.2.10 shows, in detail, the total construction output share in Europe by the most important countries in 2005. The total construction output of 1308 milliards of Euro was realized in the 19 countries, analysed by the Euroconstruct network. Nearly three-fourth (73%) came from the 5 largest countries: Germany, Great Britain, Italy, France and Spain. The remaining 10 Western European countries had a share of 24%, the 4 Eastern European countries only of 4%.

Total Construction Output in Europe by Country in 2005

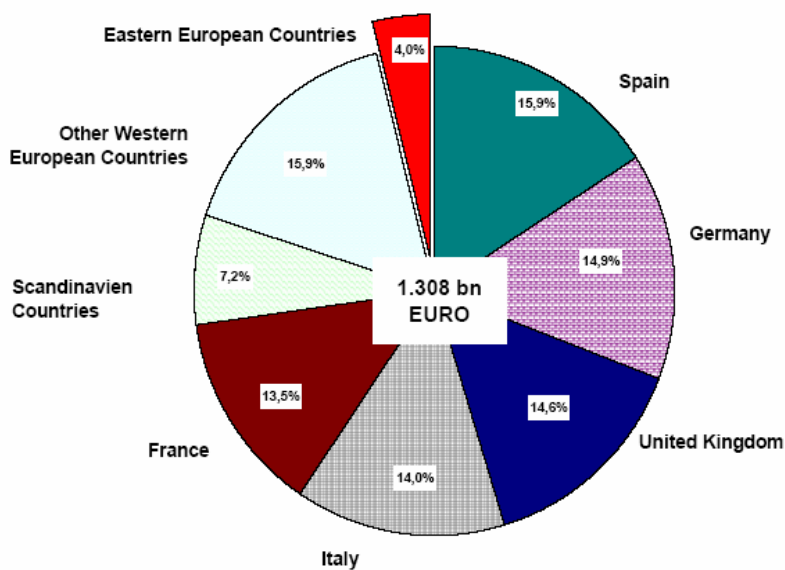


Figure 2.10: Total Construction Output in Europe by most important countries in 2005 (source: Euroconstruct)

2.1.4 New constructions and demolitions

The scenario analysis of new construction and demolition can be analysed using some convenient parameter. The change in the construction production index in EU-27 is particularly suitable for furnishing global information about building activities.

The graph in the Fig.2.11 shows the construction production index. It is particularly difficult to compile a production index for construction, given that it is difficult to measure output in physical quantities, as almost every project is unique in terms of the building being constructed and the site being used; equally it is difficult to obtain reliable output prices to use as a deflator in the event that output is measured in value terms. Because of this, a wide variety of approaches are used in different countries, including the use of hours worked as a proxy.

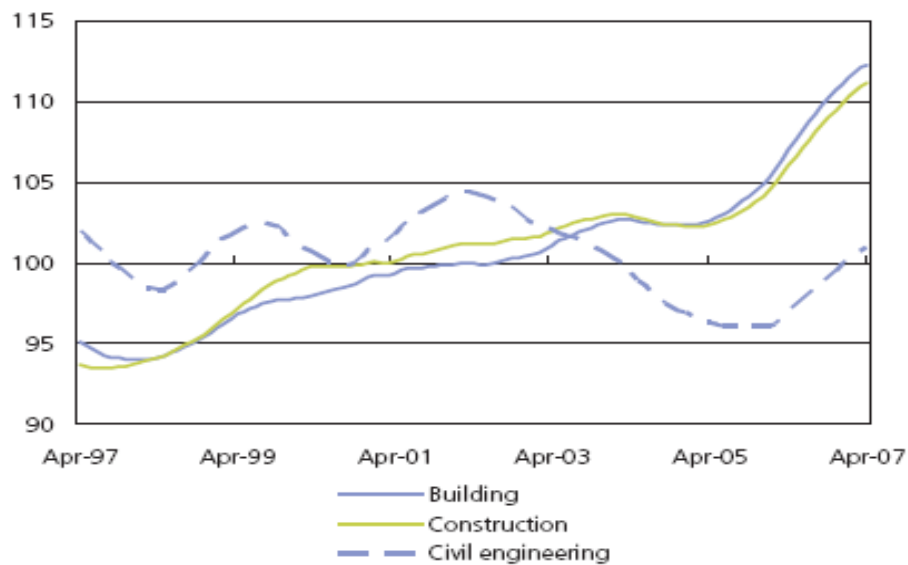


Figure 2.11: The construction production index EU-27 (2000=100) (source. Eurostat)

In the graph (Fig.2.11), it is possible to observe the greater continuity in the positive trend of building index growth as opposite to the more discontinuous trend of the civil engineering index.

The number of new construction and demolition can be useful to investigate quantitatively the turnover of buildings. Tab 2.2 reports data concerning new construction and demolition of each countries in EU-27.

Again there are data missing, in this case for: Luxembourg, Netherlands, Italy, Malta, Slovak Republic, Denmark, Finland and United Kingdom; while it has partly information about Austria, Belgium, Greece, Portugal, Bulgaria, Hungary, Poland, Estonia, Lithuania and Sweden. Every conclusion inherent to this data must put in mind the consistent limits due to these absences.

Table 2.2: Number of new construction and demolition in the UE Member Countries (1993, 2001, 2002)

	1993		2001		2002	
	New	demolitions	New	demolitions	New	Demolitions
Austria	...	...	...	...	34,2	...
Belgium	44,8	2,6	...	...	...	...
France	287,0	25,0	310,0	...	334,0	...
Germany	395,7	17,6	291,4	29,1	258,8	46,8
Luxembourg	...	...	...	...	...	...
Netherlands						
Cyprus	7,8	0,2	6,6	0,1	6,1	0,1
Greece	61,3	...	...	...	...	...
Italy						
Malta						
Portugal	63,0	...	106,6	...	...	...
Slovenia	7,7	0,2	6,1	0,2	7,0	0,1
Spain	212,5	6,4	394,7	14,0	403,8	13,6
Bulgaria	11,0	1,0	6,0	...	6,0	...
Czech Republic	31,5	...	23,0	1,2	25,8	1,8
Hungary	18,5	4,5	...	...	...	...
Poland	89,7	5,6	100,8	...	93,2	...
Romania	30,1	1,7	27,0	4,6	27,7	4,4
Slovak Republic	...	...	...	...	...	...
Denmark	...	...	...	...	...	...
Estonia	...	...	0,6	...	1,1	...
Finland	...	...	...	...	...	...
Ireland	21,0	6,5	52,2	7,0	57,3	7,4
Latvia	3,8	1,0	1,0	1,0	0,8	1,0
Lithuania	8,2	...	3,8	0,1	4,6	0,1
Sweden	35,1	...	15,4	3,8	19,9	2,2
United Kingdom						

Legend of Tab.2

	Western Europe
	Southern Europe
	Eastern Europe
	Northern Europe

The following histograms (Fig.2.12-2.13), made using data from Tab.2.2, offer an immediate picture of the difference in distribution of building activities (new construction and demolition) within the Europe zone concerning three temporal references (1993, 2001, 2002). Western Europe offers the highest concentration of building activity, followed by Southern Europe. The difference in building activities (the missing data here, especially for Italy and United kingdom, is likely distorting) also reflects the distribution of total population in the EU-27. The GDP distribution in EU-27 might offer another key to analysing the graphs. In fact, as mentioned before, the 5 largest countries, which are Germany, Great Britain, Italy, France, and Spain, gather most of the buildings activities and, where these countries are counted, the total column offers the higher value.

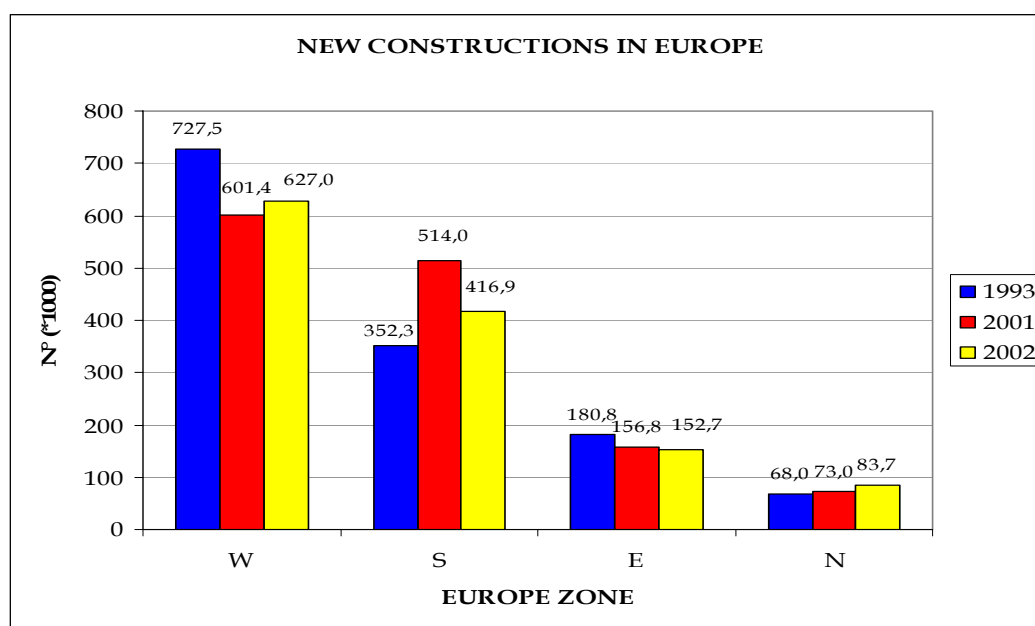


Figure 2.12: Number of new construction in Europe (1993, 2001, 2002)

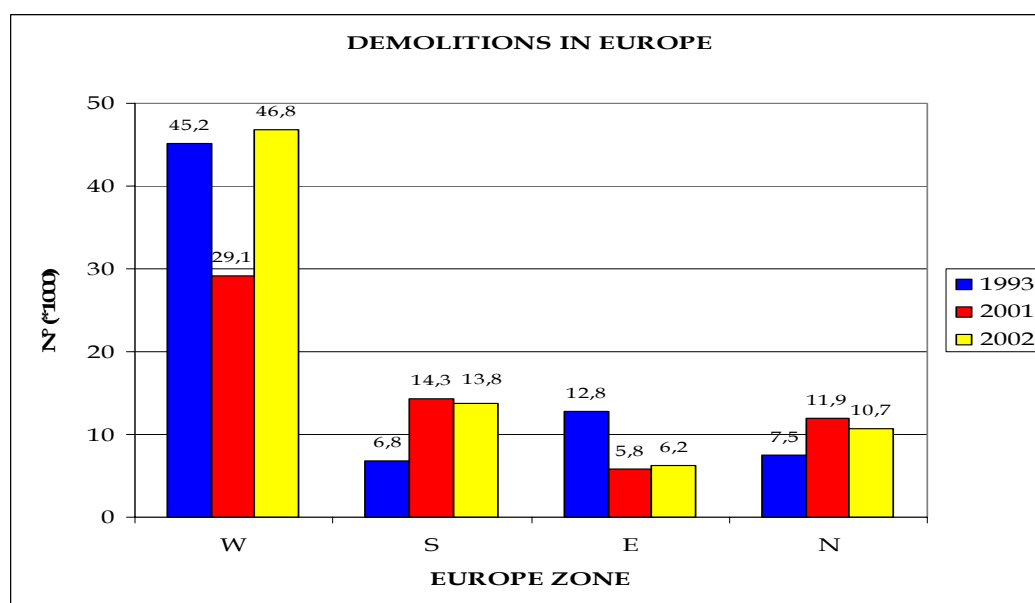


Figure 2.13: Number of demolitions in Europe (1993, 2001, 2002)

There is a relevant difference between the demolition and new construction for the whole Europe zone, even if when analysing the available data for Northern Europe the gap between the two measures is less evident. Accordingly, Fig.2.14 shows a histogram of the variance between new construction and the demolition, which generally represents a tiny part.

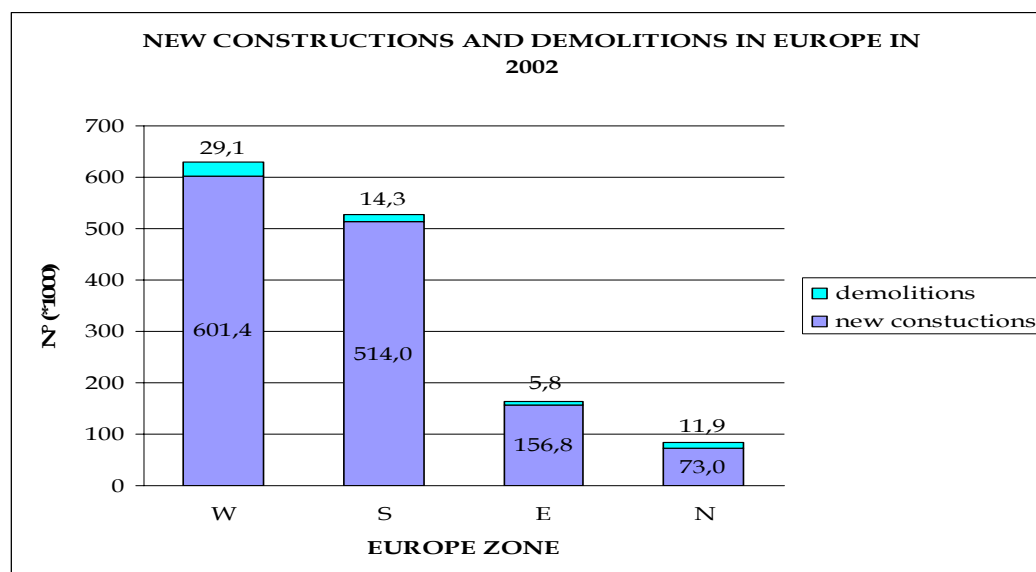


Figure 2.14: Share of new construction and demolition in main European areas (2002)

The construction activities furnish a slight portion of existing stock, as is possible to observe in Fig. 2.15 where the concentrations of new construction and demolition are compared to existing stock.

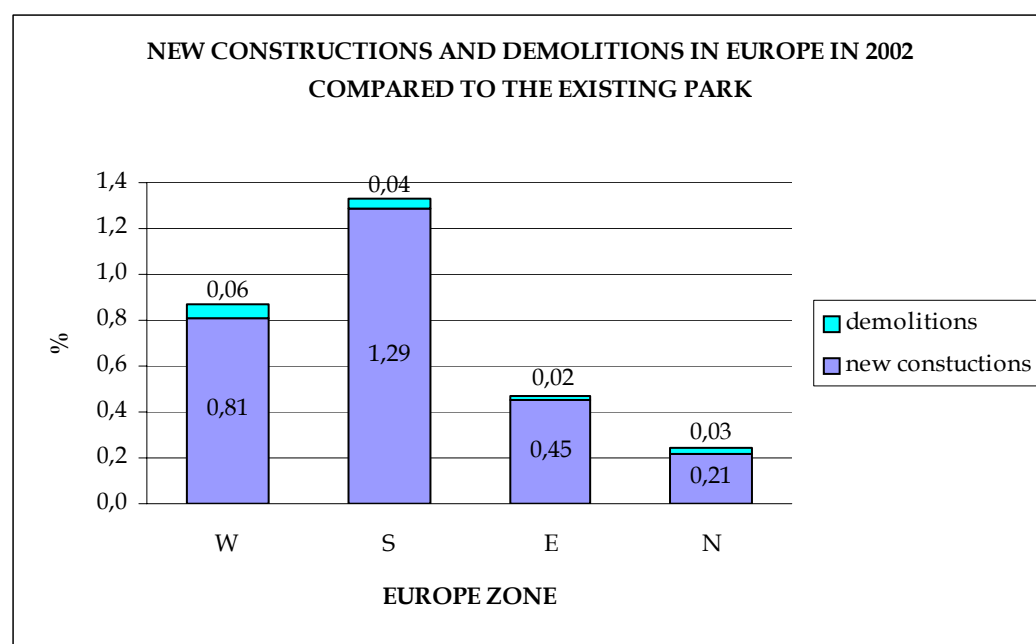


Figure 2.15: Percentage of new construction and demolition compared to existing stock in main European areas (2002)

The graphs of Fig. 2.14-2.15 bring to the light the impact that the buildings activities (new construction and demolition) cause in the variation of stock housing (about 1% p.a.). In spite of its small value, this percentage might play a significant role in turn over of housing stock, in a long-term scenario.

2.1.5 New non-residential building in Europe (where available) 1997-2001

In this section, the data of non-residential buildings have been examined. Non-residential play a significant role in building sector both quantitative and qualitative point of view. This category includes the following typologies: industrial, commercial, educational, hospital and any other buildings not designated to residential purposes. The parameters analysed are: the total number, the area occupied and the total volume, as shown in the following tables (Tab.2.3-2.5)

Table 2.3: Number of total new non-residential building in Europe zone (1997-2000)

	N° of new non-residential buildings *1000			
	1997	1998	1999	2000
Austria				
Belgium	4976	4074		
France	63492	70643	78421	
Germany	39239	38967	40473	39312
Luxembourg	49	78	97	
Netherlands				
Cyprus				
Greece	7499	7504	7604	
Italy	19488	18295	18308	
Malta				
Portugal	6955	8028	7755	6857
Slovenia	2356	2426	1502	1311
Spain		14497		
Bulgaria				
Czech Republic				
Hungary				
Poland	24096	22905	16357	18054
Romania				
Slovak Republic				
Denmark	46328	45285	46034	38572
Estonia	916	1063	1194	841
Finland	28456	28354	27242	28026
Ireland				
Latvia				
Lithuania	813	1378	1125	1229
Sweden				
United Kingdom				

Table 2.4: Area of total new non-residential buildings in Europe zone (1997- 2000)

	area (m ²) of new non-residential buildings *1000			
	1997	1998	1999	2000
Austria				
Belgium	4804,281	4268,439		
France	33434,590	39769,362	46616,117	
Germany	37128,000	34088,000	34837,500	34370,100
Luxembourg	93,100	353,252	240,142	
Netherlands	20666,000	23601,000	25614,000	19502,000
Cyprus	521,000	465,000	538,000	436,000
Greece	3006,000	3503,000	3451,000	
Italy				
Malta				
Portugal				
Slovenia	764,138	1062,144	911,314	820,057
Spain		12782,000		
Bulgaria				
Czech Republic				
Hungary				
Poland				
Romania				
Slovak Republic				
Denmark	5355,076	5761,800	6250,100	5580,500
Estonia	201,100	413,900	303,900	324,200
Finland	3757,503	3870,398	4218,157	4223,800
Ireland				
Latvia				
Lithuania	370,863	641,604	480,000	704,200
Sweden	2588,000	3024,000	3149,000	3692,000
United Kingdom				

Table 2.5: Volume of total new non-residential buildings in Europe zone (1997- 2000)

	volume (m ³) of new non-residential buildings *1000			
	1997	1998	1999	2000
Austria				
Belgium	28773,027	25743,522		
France				
Germany	212828,000	207392,000	208257,000	208878,000
Luxembourg	454,744	1628,733	1083,893	
Netherlands	107314,000	120434,000	131033,000	98362,000
Cyprus				
Greece	15405,000	17428,000	17206,000	
Italy	70254,900	72966,400	86420,600	
Malta				
Portugal				
Slovenia	2977,862	4360,662	4121,935	3570,682
Spain		61886,000		
Bulgaria				
Czech Republic				
Hungary				
Poland	26162,064	33125,824	39827,500	41504,799
Romania				
Slovak Republic				
Denmark				
Estonia	879,100	2085,500	1604,700	1738,400
Finland	22190,760	21022,535	23448,603	22457,800
Ireland				
Latvia				
Lithuania	1616,631	3036,645	2106,000	2822,900
Sweden				
United Kingdom				

In Europe, according to Experian, the global leader in providing information, industrial buildings constitute the greatest market segment of non-residential, followed by commercial. Approximately 80% of demand comes from the private sector. This market appears highly cyclical as well as concentrated.

2.1.6 Renovation works

The renovation works play an important role in achieving the goal of improving energetic and environmental performance of building, also because existing buildings represent most of building stock. The buildings renovation as well as the new buildings construction, offer an important opportunity to promote initiatives of various kind (legislative, fiscal,...) for the improvement of buildings performance.

Preliminary to the analysis it must be taken into account that the procedures and tendering stages followed for renovation work vary across Europe depending on the type of renovation work, but it is not the scope of this report to investigate the variety of the all-possible practises.

In 2005, the overall output of R&M activities on existing buildings (Fig.2.6) represented a share of 36% (23.1% in residential plus 13.2% in non-residential). In addition, the following figure (Fig.2.16) shows data also published by Euroconstruct pertaining to the contribution of the various market (civil engineering, new housing construction, building renovation, new non-residential construction) to the total construction output percentage value by the 19 European countries (Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, United Kingdom) in 2005. The building renovation curve offers an increasing trend, suggesting the importance of this sector in the building market.

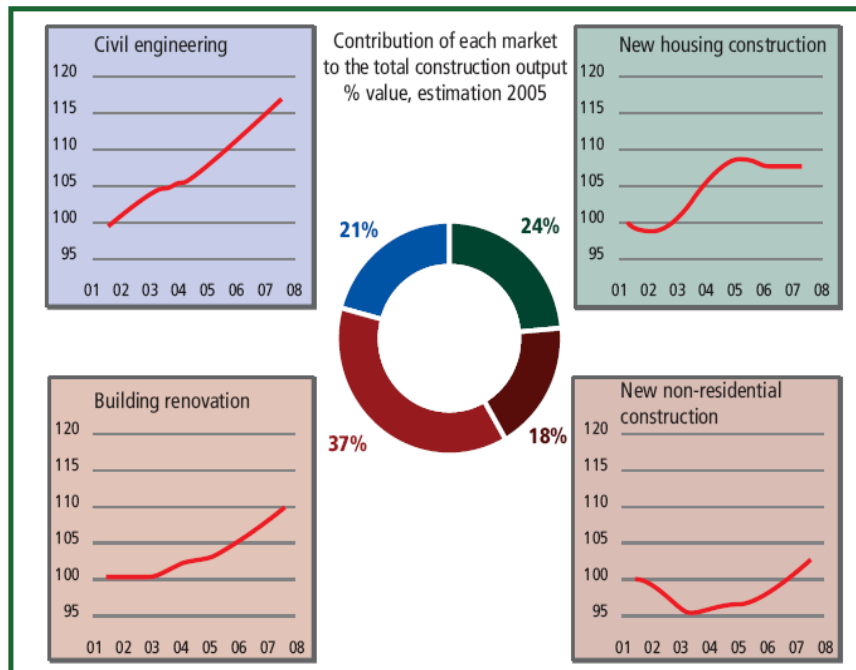


Figure 2.16: Evolution of different markets in 19 countries of European Union (Index 2001=100, constant prices)

(Source: Euroconstruct Nov. 2005)

The following table (Tab.2.6) shows the annual change of construction output in market segments analysed concerning the share of Europe in Western and Eastern (source: Euroconstruct).

Table 2.6: Annual change in market segment (% by volume)

Western Europe	2002	2003	2004	2005	2006	2007	2008
New residential	-1,4	2,6	5,4	3,8	3,5	-0,1	-0,6
Residential R&M	0,3	1,5	2,3	0,7	1,8	1,9	2,1
New non-residential	-1,0	-3,6	1,0	-0,6	2,0	2,0	2,5
Non-residential R&M	0,9	0,3	-0,4	1,1	1,4	1,6	1,6
Civil engineering	2,1	1,8	0,6	1,1	2,8	2,4	2,3
Eastern Europe	2002	2003	2004	2005	2006	2007	2008
New residential	0,3	4,9	10,4	0,9	4,6	6,8	10,3
Residential R&M	6,5	4,5	8,0	6,4	4,6	5,7	6,2
New non-residential	3,5	-1,2	5,4	5,2	5,4	2,9	4,2
Non-residential R&M	-17,1	-0,2	3,9	3,1	3,4	2,3	3,6
Civil engineering	3,9	4,1	7,1	11,4	11,3	11,6	11,9

Analysing data (Tab.2.6) it is possible to observe that the rate of growth was much greater in the Central and Eastern countries than in Western Europe. The renovation market is extremely important in Europe, accounting for over a third of total input. Excluding civil engineering, the renovation market in Europe accounts for nearly half the value of the building market in Europe, due largely to the important role of renovation in Germany, France, Italy, and United Kingdom. These are the largest markets by volume in the Euroconstruct region. In the renovation market, total renovation (buildings completely renovated) accounts for 15 to 20%; partial renovation (a functional portion of a building renovated) account for 33%; and smaller renovations, primarily by private individuals, account for the remainder. Long-term prospects are good, as 150 million European dwellings are at least 25 years old (source: UNECE/FAO Forest Products Annual Market Review, 2005-2006).

2.2 SUMMARY

The construction sector represents a strategically important sector for the European Union, providing building and infrastructure on which all sectors of the economy depend. The economic relevance of the EU-27 construction market is estimated at about 10% of GDP (1305 billion €) and 7,3% of total workforce (13,2 million people). Buildings account for the largest share of the total EU final energy consumption (42%) and produce about 35% of all greenhouse emissions (source: extracted from document SEC (2007) 1730 - Commission of the European Communities). The sector is significant in terms of employment and provides constructed assets representing 49.6% of the gross fixed capital formation (GFCF) (Source: www.eurofound.eu.int). Its impact is not just limited to economic issues, in fact the quality of buildings and building activities reflect the environmental and social requirements of citizens.

Productivity in the construction sector increased by 3% over the period 2000-2003 in Europe, whereas the rest of the industry experienced no growth over the same three-year period. The generalised 3% growth rate during this period hides important differences between the individual Member States, with the new Member States experiencing a somewhat lower growth than the EU15.

There is also a difference in growth between building and construction. At EU level, civil engineering has a slightly higher growth rate than building. The differences are significant in some countries (such as the Czech Republic, Ireland, and Latvia), while others, such as Hungary, experienced a more important growth in building than civil engineering.

The residential construction will have a significant impact on future construction demand, even though civil engineering is forecasted to grow strongly in the upcoming years too. A useful parameter to estimate the relevance of this construction sector is given by the housing completions budget, which represents construction work for the completion and finishing of buildings. The following diagram (Fig.2.17) shows the growth of housing completions from 1992 onwards.

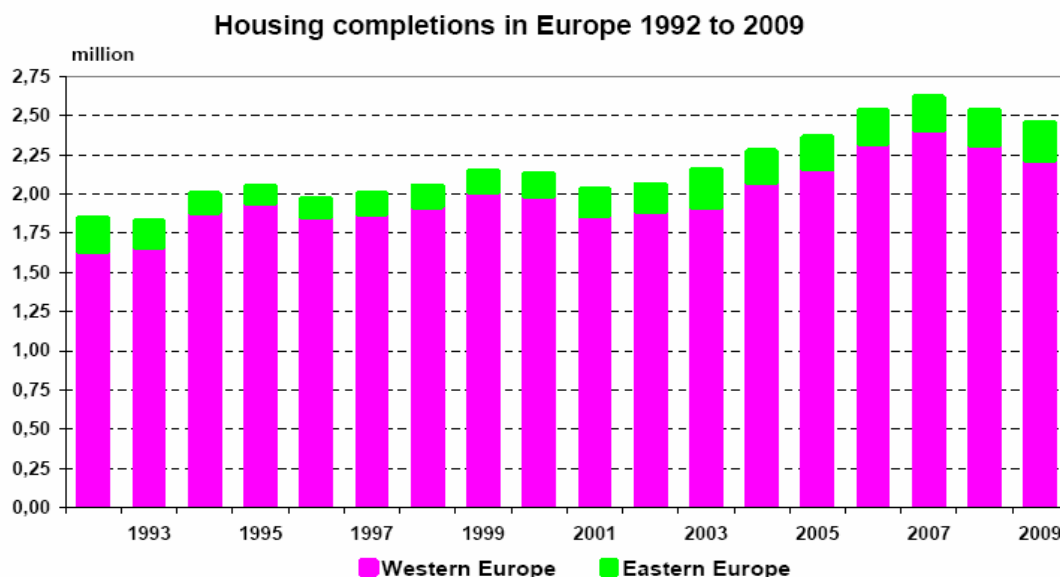


Figure 2.17: Housing completions in Europe 1992 to 2009 (source: Euroconstruct)

For the EU, productivity in the construction sector has been in general considerably lower than in the manufacturing sector over the last 10 years. This is related to the fact that the sector is very home-market oriented and so less exposed to international competition.

A more competitive domestic market, driven by higher productivity levels, is thus essential for the sector. Various factors impact on the sector's productivity level, such as the development and use of technology, increases in R&D investment, as well as public initiatives regarding procurement incentives and sector improvement programmes.

In the future, demographic development will play a key role in driving development in the construction sector, as well as in most other economic sectors in the EU.

The ageing of the population involves changing needs in the housing sector which cannot be met solely by new construction activities - it requires also the renewal of existing buildings. Structural requirements of the population have to be considered (doors that open in a different direction, location of light switches, differences in heights, etc) as well as services targeted at senior citizens living in their homes (cleaning services, nursing, etc). In addition, the busy lives that people lead today and an increasing awareness of energy costs are driving forces to build more intelligently in the future. For example, buildings that can be pre-programmed or reprogrammed remotely, and are able themselves to detect and turn off excess use of energy, are likely to be developed in the future. This development will require additional skills among workers in all phases of the construction process in relation to building management systems, networks and electronics.

3. EU legislation analysis

3.1 *EU LEGISLATION*

3.1.1 Foreword

[Pietro Novelli]

The European Union has currently individualized, as priority objective in the actions of adaptation to the current climatic changes, the reduction of energy consumptions through the diffusion of a greater energy efficiency of the end users.

The improvement of energy efficiency can sensitively prevent the waste of energy and contemporarily to operate for the respect of the goals established in the protocol of Kyoto on climatic changes.

The possibilities of reducing the actual consumptions are remarkable, particularly in sectors currently using elevated energy consumption, such as the home building sectors, the manufacturing industries, the conversion of the energy and transports.

The contributions to the development of an economy directed to a greater sustainability of the productive activities and the relative services should, also, not be ignored.

The UE is committed to reduce 20% of the annual consumption of primary energy within 2020. To achieve this objective, has to operate in dark sectors defining least norms of energetic output and rules in subject of labelling, applicable to the products, to the services and the infrastructures but also informing and responsibly the citizens, the political persons responsible and the operators of the market.

This strategy is defined by the followings political documents of reference:

- Plan of action 2000-2006
Communication of the Committee to the Board, to the European Parliament, to the economic and social Committee and the Committee of the regions, of April 26th 2000, entitled": Plan of action that aims to strengthen the energetic effectiveness in the European Community" [COM(2000, 247 - not published in the official Gazette].
- Green book on the energetic efficiency
Green book of the Committee, of June 22nd 2005", The energetic effectiveness - or As to consume better with less [COM(2005) 265 endings - not published in the official Gazette].
- World Fund for the promotion of the energetic efficiency and the renewable sources of energy
Communication of the Committee to the Board and the European Parliament, of October 6th 2006, was established to mobilize some semi-public and private bodies to finance a world access to a secure energy services, at accessible costs and without negative impacts on the climate: the world Funds for the promotion of the energetic effectiveness and the renewable energies [COM(2006) 583 endings - not published in the official Gazette].
- Plan of action for the energetic efficiency 2007 2012
Communication of the Committee, of October 19th 2006," Plan of action for the energetic efficiency: to concretize the potentialities" [COM(2006) 545 - Not published in the official Gazette].
- Program" intelligent Energy - Europe" 2007-2013
Decision 1639/2006 of the European Parliament and of the Board, of October 24th 2006, that establishes a program for innovation and competitiveness (2007-2013).

In reference to the house building sector, the principal normative provisions that effect the aforesaid political orientations are:

- Directive 89/106/CEE of the Board, of December 21 st 1988, related to the approximation of the legislative, regulation and administrative dispositions of State members regarding the construction products. [Official gazette n. L 40 of the 11.2.1989,]
- Directive 92/42/CEE of the Board, of May 21 st 1992, regarding the demands of output for the new water boilers warm fed or in gaseous liquid fuels [official Gazette n. L 167 of 22.06.1992]
- Directive 92/75/CEE of the Board, of September 22 nd 1992, regarding the indication of the energy consumption and other resources of the domestic instruments, through the labelling and information you conform related to the products [official Gazette n. L 297 of 13/10/1992]
- Directive 2001/77/CE of the European Parliament and of the Board of September 27th 2001 related to the promotion of the electricity produced starting with the increase of renewable energy of electricity on the internal market [official Gazette L 283 of 27.10.2001].
- Directive 2002/91/CE of the European Parliament and of the Board, of December 16 th 2002, on the energy output in the house building. [Official gazette L 1 of 4.1.2003,]
- Directive 2003/54/CE of the European Parliament and of the Board of June 26 2003 regarding the common rules for the internal market of the electricity, replacing the directive 96/92/CE [official Gazette L 176 of 15.07.2003].
- Directive 2003/55/CE of the European Parliament and of the Board of June 26 2003 regarding the common rules for the internal market of the natural gas, replacing the directive 98/30/CE [official Gazette L 176 of 15.07.2003].
- Directive 2004/8/CE of the European Parliament and of the Board of February 11 2004 regarding the promotion of cogeneration on the base of the question of warm profit in the internal market of the energy and amending the directive 92/42/CEE. (from transpose within 21.02.2006) [official Gazette L 52 of 21.2.2004,]
- Directive 2005/32/CE of the European Parliament and of the Board, of July 6 th 2005, related to the institution for the elaboration of specific requirements for the ecological planning of products that consumes energy and include modifies some directive 92/42/CEE of the Board and of the directives 96/57/CE and 2000/55/CE of the European Parliament and of the Board. (from transpose within 11.08.2007) [official Gazette L 191 of 22.07.2005].
- Directive 2006/32/CE of the European Parliament and of the Board, of April 5 th 2006, regarding the efficiency of the end uses of energy, energetic services and includes the abrogation of the directive 93/76/CEE of the Board (from transpose within 17.05.2008) [official Gazette L 114 of 27.4.2006].

3.1.2 The Energy Performance of Buildings Directive (2002/91/EC)

(Dall'O' - Galante)

The Directive 2002/91/EC on energy efficiency of buildings ("Energy Performance of Buildings Directive", EPBD) was adopted on 16th December 2002 and came into force on 4th January 2003. EPBD is considered a very important legislative component of energy efficiency activities of the European Union designed to meet the Kyoto commitment and respond to issues raised in the Green Paper on energy supply security.

The Directive is set to promote the improvement of energy performance of buildings with the following requirements to be implemented by the Member States:

- the general framework for a methodology of calculation of the integrated energy performance of buildings;
- the application of minimum requirements on the energy performance of new buildings;
- the application of minimum requirements on the energy performance of large existing buildings that are subject to major renovation;
- energy performance certification of buildings;
- regular inspection of boilers and of air-conditioning systems in buildings and in addition an assessment of the heating installation in which the boilers are more than 15 years old;
- requirements for experts and inspectors for the certification of buildings, the drafting of the accompanying recommendations and the inspection of boilers and air-conditioning systems.

Within these general principles and objectives, it is the individual responsibility of each EU Member State to choose measures that corresponds best to its particular situation (subsidiarity principle). However, it is clear that collaboration and information exchange can highly facilitate the implementation.

The 4th of January 2006 was the official deadline by which the 25 Member States had to transpose the Directive into national law. For the two new Member States Bulgaria and Romania, this date is January 2007. Only for the 2 last requirements (certifications and inspections), Member States may, because of lack of qualified and/or accredited experts, have an additional period of three years (before January 2009) to apply fully.

The theme of Certification procedures deals with the setting up of the Energy Performance Certificate for new and existing buildings. It comprises issues such as: which methodologies are suitable for existing buildings (data collection), how quality assurance of tools is handled, information on effectiveness and public acceptance of certificate schemes (information on costs, benefits, information as function of building age and type), the effectiveness of energy saving recommendations. The Energy performance certificate is stated in article 7 of the directive.

Member States shall ensure that, when buildings are constructed, sold or rented out, an energy performance certificate is made available to the owner or by the owner to the prospective buyer or tenant, as the case might be. The validity of the certificate shall not exceed 10 years.

The energy performance certificate for buildings shall include reference values such as current legal standards and benchmarks in order to make it possible for consumers to compare and assess the energy performance of the building.

The certificate shall be accompanied by recommendations for the cost-effective improvement of the energy performance.

The objective of the certificates shall be limited to the provision of information and any effects of these certificates in terms of legal proceedings or otherwise shall be decided in accordance with national rules.

Article 10 of EPBD states that "Member States shall ensure that the certification of buildings, the drafting of the accompanying recommendations are carried out in an independent manner by qualified and/or accredited experts, whether operating as sole traders or employed by public or private enterprise bodies".

This theme of calculation procedures deals with article 3 of the directive on the Adoption of a methodology.

The EPBD provides the general framework for the calculation procedures. A mandate (N° 343) has been given to the CEN committee to develop appropriate calculation procedures to support Member States in the national application of this article. This theme includes the assessment of the relevant EN (CEN) and EN ISO standards, in particular under Mandate 343, the way they are or will be implemented at national level, options for quality assurance of calculation methods, differences between methods or data input for new versus existing buildings, legal aspects (e.g. national versus CEN options), practicability (as "simple" as possible and yet sufficiently accurate and distinctive,

methodologies for innovative technologies, further needs and possibilities for further harmonisation and more.

Member States shall apply a methodology, at national or regional level, of calculation of the energy performance of buildings on the basis of the general framework that shall be adapted to technical progress taking into account standards or norms applied in Member State legislation. The energy performance of a building shall be expressed in a transparent manner and may include a CO₂ emission indicator.

In order to facilitate application of article 3 of EPBD, a mandate has been given to the CEN committee to develop appropriate calculation procedures to support member states for the national implementation of minimum energy performance requirements

According with EPBD Member States shall take the necessary measures to ensure that minimum energy performance requirements for buildings are set, based on the methodology referred to in Article 3. When setting requirements, Member States may differentiate between new and existing buildings and different categories of buildings. These requirements shall be reviewed at regular intervals which should not be longer than five years and, if necessary, updated in order to reflect technical progress in the building sector.

As regard new buildings Member States shall take the necessary measures to ensure that buildings meet the minimum energy performance requirements referred to in Article 4 of EPBD.

For new buildings with a total useful floor area over 1 000 m², Member States shall ensure that the technical, environmental and economic feasibility of alternative systems such as:

- decentralised energy supply systems based on renewable energy,
- CHP,
- district or block heating or cooling, if available,
- heat pumps, under certain conditions,
- is considered and is taken into account before construction starts.

As regard existing buildings Member States shall take the necessary measures to ensure that when buildings with a total useful floor area over 1.000 m² undergo major renovation, their energy performance is upgraded in order to meet minimum requirements in so far as this is technically, functionally and economically feasible. Member States shall derive these minimum energy performance requirements on the basis of the energy performance requirements set for buildings in accordance with Article 4. The requirements may be set either for the renovated building as a whole or for the renovated systems or components when these are part of a renovation to be carried out within a limited time period, with the abovementioned objective of improving the overall energy performance of the building.

The process of transposition of EPBD is non easy. Member States encountered many difficulties to integrate EPBD requirement in the local national or regional laws and other difficulties to develop calculation procedures methodologies. At the moment the transposition process of EPBD in most of the Member States is not completed. In the succession some examples of EPBD transposition in Eu will be illustrated (the information source is EPBD Building Platform website).

EPBD implementation in Italy

The implementation of the EPBD in Italy is the responsibility of the Ministry of Economic Development, in collaboration with the Ministry of Environment and the Ministry of Infrastructures. Before approval, the opinion of the Committee of Regions is compulsory, through the Conference Stato-Regioni.

On 19 August 2005 the Council of Ministers approved a first Legislative Decree (D. Lgs. n. 192/2005), representing a general framework for the transposition of all EPBD articles in the national legislation, except art. 9 (inspection of air conditioners) where a three year delay was requested.

On 29 December 2006, the Council of Ministers has adopted a new Legislative Decree (D. Lgs. n.311/2006) regarding modifications and extensions of the articles included in the previous D. Lgs. 192/2005. The following implementation decrees are the responsibility of the Ministry of Economic Development.

All calculation procedures are based on national or translated European standards.

Also on 29 December 2006, the Government of Italy revised the minimum requirements for all new buildings. The Energy Performance (EP) requirements are modulated in three steps, corresponding to buildings, whose permit requests are presented respectively after 1st January 2006, 1st January 2008 and 1st January 2010.

The type and level of EP requirements for heating differ according to the function of the building: the residential (except community buildings), which express the EP in kWh/m², and the non-residential, which express the EP in kWh/m². All EP values are expressed as a function of the climatic zone and of the shape factor, represented by the ratio (envelope surface)/(building volume).

Similar tables have been published for EP limits for residential buildings which will come into force from 1st January 2008 and 1st January 2010.

The designers have also to consider additional minimum parameters such as maximum U-value of vertical or inclined opaque walls, horizontal surfaces (roofs and floors) and transparent glazing and average global seasonal efficiency of the thermal systems.

A proof of compliance must be made after completion of the building, under legal responsibility of the director of works. Control of the regulation is the responsibility of the Municipality where the building is located.

The Italian Government adopted the EP minimum requirements also for building major renovation, through a gradual approach.

The requirements regarding the certification of buildings have been adopted by the Government on 29 December 2006, art. 6. The certification of new buildings started 30 days after publication of the new Decree (1st February 2007), using existing methods (limited to heating and DHW, for cooling new methods will come later) to express the numerical value of the EP, under responsibility of the building designer, confirmed by the works director, until the new governmental guidelines on certification will come into force.

The new certification will gradually become mandatory for all new buildings, when property is transferred or when rented, in three steps: July 2007 for buildings above 1000 m² useful surface; July 2008 for buildings below 1000 m² (excluding single flats), and July 2009 for all flats.

Moreover, the energy certification is required in order to have access to any type of public incentive for improving energy performance.

It is expected that the guidelines for building certification, now at the stage of draft document, will be published in the next months. After 12 months from their publication, the present procedure for new building energy qualification will expire. The guidelines will allow certification to be implemented in all the Country, even in case of delay of the regional legislation.

Even if no methods for summer cooling performance have been imposed, some requirements have been introduced to limit the energy wastes in air conditioning (9 million new systems sold since year 2000): the designers have to consider the shading of windows, that a sufficient mass of walls is available and provide natural ventilation in all new buildings; the external shading devices are compulsory for new buildings and for renovations over 1000 m² useful surface.

The implementing decree for the inspection of air conditioning systems will be adopted by the Government before the end of 2008, and will come into force from 1st January 2009.

The Italian Constitution foresees that the Regions can promulgate laws on the matter of Energy. Due to the delay of the publishing of the Italian guidelines on Building Energy Certification some Regions promulgated regional laws. In Lombardy region, for example, an energy certification

scheme is compulsory starting from 1st September 2007. The worry is that in Italy many calculation procedures and many classification schemes for energy labeling of buildings will be implemented.

EPBD implementation in Denmark

Denmark has implemented the EPBD since January 1st, 2006. Denmark has for many years had fairly strict energy requirements in the building regulations, obligatory labelling scheme for buildings and obligatory inspection scheme for boilers. Denmark has now tightened the energy requirements in the building regulations further and developed new labelling and inspection schemes.

In Denmark the implementation of EPBD is the responsibility of the Danish Energy Authority (Articles 3, 5, 7, 8, 9 and 10) and of the Danish National Agency of Enterprise and Construction (articles 3, 4, 5 and 6).

The Danish calculation procedure is described in SBI-direction 213: Energy demand in building. This publication also includes a PC calculation program. The calculation core from this program is to be used by all other programs to ensure identical calculation of energy demand of buildings.

The new energy requirements for new buildings in relation to the EPBD (Article 5) are in Addendum 12 to the Danish Building Regulations 1995, BR 95 and in Addendum 9 to the Danish Building Regulations for Small Dwelling 1998, BR-S 98. The energy requirements in both regulations are identical. Minor adjustments or additions to the energy requirements are included in Addendum 13 and 14 to BR 95 and in Addendum 10 and 11 to BR-S 98.

The new energy requirements were issued June 16, 2005. The requirements came into force January 1, 2006 with a transition period of 3 months until April 1, 2006 when the new requirements must be fulfilled in order to obtain a building permit. The new energy requirements are not only an implementation of the EPBD. They also impose stricter energy performance requirements in accordance with current Danish action plans for an increased 25 % energy saving in new buildings, compared to requirements before 1. January 2006.

An energy performance target is the main requirement for all types of buildings heated to at least 15 °C. The target is based on the supplied energy needed for operating the building. There are separate targets for housing (not including lighting) and non-domestic buildings (including lighting). An extra allowance to the basic target is given to non-domestic buildings with high ventilation requirements for IAQ purposes, high lighting requirements, long operation hours or large hot water demand.

For all type of buildings the new energy requirements also include two classes of low energy buildings. Class two has an energy demand of 75 % or less compared to a normal house, and class one has an energy demand of 50 % or less compared to a normal house. Low energy buildings may be exempted from connecting to public networks with natural gas or district heating, which is otherwise obligatory in some areas.

The energy frame is supplemented by specific requirements for U-values, minimum boiler efficiency, pipe insulation, heat recovery, fan power efficiency etc.

Proof of compliance with the energy requirements must be made after the completion of the building in order to obtain the permit to use the building. Control of compliancy with building regulations is the responsibility of the commune where the building is located. In practice the control of the building in relation to the energy requirements is performed by the energy consultants who also issue the energy label, see later.

The requirements for existing buildings undergoing renovation (Article 6) are presented in the same addendums to the Building regulations as the requirements to new buildings and with the same enforcement schedule.

In BR 95 covering multi-family houses and non-domestic buildings the 25 % rule (preamble 13) in the EPBD applies to all buildings, independent of floor area. Cost efficient energy saving measures are required if renovation of the building shell, or the energy installations is higher than 25 % of the value of the building, excluding the value of the land, or if more than 25 % of the building shell undergoes renovation. Also cost efficient energy saving measures not included in the original

renovation plan have to be installed. Only churches, museums or protected or those buildings worthy of preservation are exempted from the requirement.

“Cost efficient energy saving measures” are defined as measures that by simple calculation bring at least 33 pct overhead over a standard life time (dependent on the type of the measure). The cost efficient energy saving measures are identified by the energy consultant as part of the labelling of a building, see later.

To all buildings (also to small dwellings covered by the BR-S 98 regulations) there is a requirement to perform cost efficient energy saving measures to the specific component in the case of renovation of roof, renovation of climate shield on external walls, renovation or change of windows, installation of a new boiler or change of heat supply.

Improvement of the energy performance is required at renovation if "the total cost of the renovation is higher than 25 % of the value of the building, excluding the value of the land, or more than 25 % of the building shell undergoes renovation." This has been the most debated issue during the implementation of the EPBD in Denmark. The government's original plan was to implement the same rule for small dwellings, too. This was dropped at a late phase of the implementation due to severe problems regarding legal responsibilities.

The requirements regarding the energy labelling (certification) of buildings (Article 7) has been adopted by the Danish Parliament by Act no. 585 of June 24, 2005 on Energy Savings in Buildings (in Danish). Based on the act by Parliament the Danish Energy Authority has issued Decree no. 1294 of December 13, 2005 on Energy labelling of Buildings (in Danish). Minor adjustments to the original decree are in decree no. 218 of March 20, 2006 and in decree no. 339 of April 19, 2006.

In the new energy labelling scheme buildings need an energy label:

- when they are new constructed,
- when they are sold,
- if rented out.

In the case of new buildings the building needs to have a sufficient energy label to fulfill the energy requirements in the building regulations to be granted a permit for use.

In the case of existing buildings being sold or rented out, the buildings must have an energy label of not more than 5 years old. This also applies to blocks of flats, where individual flats are rented out or sold. In blocks flats the labelling is done on the building, but with an individual sub label for each flat stating the heating demand.

There are 14 classes on the labelling scale from A1 to G2, where A1 is the highest. The decision to have 14 classes on the labelling scale is based on the need to have a sufficient number of classes to make it possibly to improve the label by performing relevant energy saving measures in buildings of different ages and energy standards. New buildings must at least be labelled as class B1 to get the permit for use. Class A1 and A2 are for low energy buildings class 1 and 2.

The daily operation of the labelling scheme is delegated to a secretariat also operating the other schemes related to the EPBD.

The specific rules for labelling to be used by the energy consultants are in: Handbook for Energy Consultants. The handbook is available to the public on www.femsek.dk (in Danish). The handbook also includes tabular data for typical constructions and installation in building to facilitate the uniformity of the labels being given by different consultants.

The energy consultant is supposed to identify two types of energy saving measures:

- immediately feasible measures and
- measures that are only feasible if carried out as supplement to ongoing renovation.

Energy labelling of existing buildings must conform to the new standards from September 1, 2006. Until then, the energy labelling conformed to the existing Danish energy labelling scheme. The reason for a transition period was to allow time needed to incorporate the labelling system into computer programs.

EPBD implementation in Germany

The implementation of the EPBD in Germany in general is the responsibility of the Bundesministerium für Verkehr, Bau und Stadtentwicklung (Federal Ministry of Transport, Building and Urban Development) and the Bundesministerium für Wirtschaft und Technologie (Ministry of Economics and Technology) and Article 8 is the responsibility of the Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (Ministry for the Environment, Natural Conservation and Nuclear Safety).

The EPBD is implemented in the legal context of the Energy Saving Act, which originally came into force in 1976 and has since then been used to set up the requirements for:

- the thermal insulation of buildings,
- the energy performance and maintenance of heating appliances and
- the billing of heating cost according to individual consumption of the tenants.

On this basis the current Energy Saving Ordinance (EnEV 2002 - amended 2004) sets up requirements for new buildings and the refurbishment of building stock. These are mainly based on an energy balance of the whole building taking into account most of the aspects given in the annex of the EPBD. For normally heated new buildings the overall requirement is based on primary energy, an energy certificate (Energiebedarfsausweis) has to be issued for these new buildings as well as for buildings in the course of major refurbishments.

In future, this approach will apply to residential buildings only - except those equipped with air conditioners (very few because of strict limits for solar shading).

To implement the aspects "lighting" and "cooling", the Energy Saving Act had to be amended. This was also necessary for the implementation of energy certificates for existing buildings, which are not subject to renovation.

The German Federal Parliament adopted the amendment; it came into force on 1st September 2005. Thus, for the amendment of the Energy Saving Ordinance the Government now only needs the consent of the Second Chamber of Parliament (Bundesrat).

The calculation procedures for residential buildings will stay in force. They are based on two German pre-standards, which are mainly transpositions of EN 832. The current versions are DIN V 4108-6: 2003-06 and DIN V 4701-10: 2003-08.

In 2005, the German Standardisation Institute (DIN) published under the Title "DIN V 18599 (Part 1 - 10)" the results of an interdisciplinary standardisation work as the calculation method for overall energy performance of buildings including all aspects of the EPBD. The standardisation works were initiated by the federal government in order to have a universal method covering all aspects primarily for non residential buildings.

The draft amendment of the Energy Saving Ordinance is currently subject to political negotiations concerning some details of energy certification. The official procedures are due to start soon, but the whole process will take a few months.

The requirements for residential buildings will be kept at the present level as will the requirements for refurbishment of parts of the building's fabric. For non-residential buildings the requirements will be transposed without significant changes to the new model taking into account the different uses of these buildings and the new aspects. In general, there will be no changes in the level of requirements after the current amendment comes into force. The level of requirements will be revised later, not before people have got familiar with the new methods for non-residential buildings and the energy certificates for existing buildings.

The level of requirements for new buildings is governed by the function and the type of building (residential / non-residential with detailed conditions of use) and also the Surface/Volume-Ratio.

They consist of:

- a maximum primary energy demand,
- a maximum average u-value

- maximal u-values of each element of the building's fabric
- several requirements on quality of boilers, controls and pipe insulation
- building air-tightness and
- the prevention of thermal bridges.

The requirements in cases of refurbishment consist of either

- a maximum primary energy demand (140% new buildings) and
- a maximum average u-value (140% new buildings) or
- maximum u-values (=state of the art) for each element of the refurbishment.

The requirements have to be met, if more than 20% of the element in question is subject to refurbishment.

Certification of buildings Certification is already obligatory for new buildings since February 2002. Certification and qualification of the assessors is subject to the amended Energy Saving Ordinance and will come into force in three steps in relation to the date of the final issue of the ordinance.

The amended Energy Saving Ordinance will be accompanied by several directives about simplification of procedures to keep the cost of certification low.

A revision of the level of requirements is envisaged in a few years.

EPBD implementation in Austria

In Austria the implementation of the EPBD is mainly in the responsibility of the Bundesländer (building codes and inspection of heating, aeration and cooling systems) and the Ministry of Economy and Labour (selling and renting of buildings).

On May 24th 2006 the Austrian Parliament passed the Energy Certification Providing Act which sellers and landlords providing energy certificates for buildings when they are sold or rented. The obligation for providing energy certificates for new buildings will come into force on January 1st 2008 and for existing buildings on January 1st 2009. Energy certificates have to be issued according to the technical rules which to be set by the Austrian federal provinces by December 2007.

A sophisticated calculation system has been developed amalgamating the nine building codes based on more than 200 mathematic algorithms allowing a differentiated description taking care of most of the details used in conventional and special purpose buildings. The methodology is included in the "OIB-Guideline" (finished in May 2007).

The user of this system can do the calculation either using all available details or using default values based on the experience of more than 100.000 already existing energy certificates.

As far as they have already been available all CEN-standards have also been implemented and will guarantee a high compatibility of the Austrian calculation methodology to a future harmonised European methodology.

Requirements for new buildings are set in the mentioned "OIB-Guideline", including mainly

- maximum annual final energy consumption per m² of floor area,
- maximum u-values of different elements of the building,
- building air-tightness,
- prevention of thermal bridges,
- requirements on the quality of boilers, aeration systems and chillers as well as on systems for storage and distribution.

The proof of compliance must be made before (planning finished) and after completion of the building. Control of the regulation is the responsibility of the municipal authorities.

Residential buildings have to fulfil special requirements. Additional requirements may be fixed by the Bundesländer.

Requirements for existing buildings are also set in the mentioned "OIB-Guideline", including mainly

- maximum annual final energy consumption per m² of floor area,
- maximum u-values of different elements of the building,
- prevention of thermal bridges,
- requirements on quality of boilers, aeration systems and chillers

Control of the regulation is in the responsibility of the municipal authorities.

Residential buildings have to fulfil special requirements. The simplified methodology for existing buildings basically does not differ from the above mentioned one but uses mainly default values. Additional requirements may be fixed by the Bundesländer. The requirements will be strengthened on 1st January 2010.

The requirements regarding the certification of buildings have been agreed on by the Bundesländer; this agreement has been fixed in the aforementioned "OIB-Guideline" which has been adopted in April 2007.

Certification is obligatory for new buildings with a building permit after the OIB-Guideline come into force in a Bundesland, on 1st January 2008 at the latest. The certificate of public buildings has to be publicly displayed from 1st January 2009, unless a Bundesland introduces it earlier by (regional) law (building code). Other buildings when rented or sold must have an energy performance certificate from 1st January 2009.

It is intended to strengthen the requirements for residential and non-residential buildings and to introduce the use of renewable energies by law, step by step (some Bundesländer have already introduced a mandatory "passive house" standard or mandatory use of solar energy for some residential buildings).

As for independent experts, Austria has many consultants and institutions having done "conventional" energy consulting for new and existing buildings, but usually many of them have not been concerned with heating, aeration and cooling. Therefore a common system of information and formation has been put in place starting to enlarge the number of independent experts in order to guarantee a high level of expertise when the issuing EPBD certificate is mandatory.

EPBD implementation in France

The implementation of the EPBD in France is the responsibility of the Ministry of Labour, Social Cohesion and Housing (all Articles except Articles 8 and 9) and the Ministry of Economy, Finances and Industry (Articles 8 and 9).

After the vote of the parliament, the French Government has promulgated, on 13 July 2005, the program Law defining the scope of the energy policy, regarding the main points for the transposition of the EPBD into French legislation. The execution orders are the responsibility of the Government.

Calculation procedures pre-existed: they had been introduced by the preceding regulation on new buildings (RT2000). They had been based on the same principles as prEN 13790.

They have been developed between 2000 and 2005, to be ready at the end of 2005. The new calculation procedures were adopted by the Government on 24 July 2006 (decree of the 19th of July 2006 relating to the calculation procedures Th-C-E 2005). There are specific procedures for dwellings and for other buildings.

On 24 May 2006, the French Government adopted the minimum requirements for new buildings. The requirements came into force for building permits requested after 1 September 2006.

The type and level of requirements are governed by the function of the type of building (dwellings, office buildings schools, ...) and may cover:

- Maximum U-values for windows, walls, roofs and ceilings;
- Requirement on average insulation level;
- Maximum primary energy consumption per m² of floor area;
- Maximum interior temperature in summer.

Table 3.1: Maximum consumption expressed in primary energy for heating, cooling and production of sanitary hot water

Type of heating	Climatic zone*	Maximum consumption
Fossil fuels	H1	130 kWh primary/m ² /year
	H2	110 kWh primary/m ² /year
	H3	80 kWh primary/m ² /year
Electric heating (including heat pumps)	H1	250 kWh primary/m ² /year
	H2	190 kWh primary/m ² /year
	H3	130 kWh primary/m ² /year

* the climatic zones are defined in the Decree (H: North, to H3: Mediterranean zone) In France, it is considered that :

1 kWh primary = 2.58 kWh final, for electric energy;

1 kWh primary = 1 kWh final, for other energy sources.

The calculation procedures includes in particular:

- Influence of climate ;
- Position and orientation of buildings, including outdoor climate ;
- Passive solar systems and solar protection ;
- Indoor climate conditions, including the designed indoor climate;
- Active solar systems and other heating and electricity systems based on renewable energy sources;
- Natural lighting.

The energy performance certificate, which will be issued after completion of the building, will constitute proof of compliance.

The French Government is going to adopt minimum requirements for new building components when building renovation is done and for extensions to existing buildings. These minimum requirements concern in particular:

- Boilers fired by non-renewable liquid or solid fuel;
- Electric heating systems;
- Air-conditioning systems;
- Hot water production systems;
- Windows and glazed walls (with or without closing);
- Equipments of energy production using renewable energy sources;
- Insulation materials of opaque walls;
- Ventilation systems;
- Lighting systems.

The levels of these requirements are now decided. These requirements will have to be respected from the end of 2007.

Moreover, from 2008, buildings over 1000 m², which undergo major renovation, will have to meet global performance requirements.

The implementation of the certification activity has been transposed into French legislation though the Building Code (amended by laws in 2005 and an ordinance in 2006).

The French Government published in September 2006 regulations which define how the energy performance certificate applies when dwellings or buildings are sold.

The energy performance certificate labels both following aspects:

- The energy consumption of the dwelling or building;
- The impact of this consumption on greenhouse effect.

Energy consumption is either calculated according to one of the declared assessment methods or with an operational rating based on invoices (consumption noted over the last 3 years). The certificate also includes technical recommendations for the cost-effective improvement of the energy performance so that the owner is able to locate the most effective works to save energy.

Certification is compulsory since the 1st of November 2006, when dwellings or buildings are sold in France, except overseas areas. From this date, the certificate has to be available to the owner and by the owner to each prospective buyer, since the building or parts of the building are placed for sale.

For other buildings, certification will be needed from the 1st of July 2007, when buildings are rented and it will be obligatory for new buildings with a building permit required after the 1st of July 2007.

Moreover, the certificates will have to be displayed in public buildings over 1000 m² from January 2008.

Inspection of boilers and air conditioning

The Government will lay down different measures to establish a regular inspection of boilers and air conditioning systems. However, these procedures are still under discussion.

EPBD implementation in United Kingdom

The implementation of the EPBD in England and Wales is the responsibility of the Department for Communities and Local Government, supported by the Department for the Environment, Food and Rural Affairs.

In March 2006, regulations were laid before Parliament to implement Articles 3-6 of the EPBD. In March 2007 and June 2007, regulations were laid before Parliament to implement Articles 7-10 of the EPBD.

In Scotland implementation of the EPBD is the responsibility of the Scottish Building Standards Agency (SBSA). The SBSA has been set up as an executive agency of the Scottish Executive to undertake the national functions related to the building standards system.

Articles 3-7, 9 and 10 of the Directive are implemented through The Building (Scotland) Act 2003 and Regulations laid before the Scottish Parliament in 2004, 2006 and 2007.

The implementation of the EPBD in Northern Ireland is the responsibility of the Department of Finance and Personnel, supported by the Department for Social Development.

In August 2006, new building regulations were made to implement Articles 3-6 of the EPBD. Work is currently in hand to make regulations to implement Articles 7-10 of the Directive but this has been delayed slightly due to the reinstatement of devolved administration through the new Northern Ireland Assembly. However, it is planned to make the new regulations by Autumn 2007 and to bring them into effect through a phased implementation beginning early next year.

The procedures for a national calculation methodology for building energy performance applying throughout the UK have been established. This is based on calculating CO₂ emission per m² for an actual design and comparing this with the CO₂ emissions per m² for a notional building which corresponds to the 2002 building standards. Additionally in Scotland improvement factors and low and zero carbon technology benchmark have been incorporated.

Software tools have been developed by Government (SBEM and SAP); however other software packages, dynamic simulation models and SBEM interfaces can be used provided these are approved by Government. See for instance the Notice of Approval on the Communities and Local Government web-site.

The requirements for new buildings in England and Wales came into force in April 2006. The building complies with the regulations if it satisfies the following tests:

- CO₂ emissions per m² lower than the target (The building design is acceptable if the emissions are below a target level which is set at between 20% and 28% below the notional building

standard, depending on the type of building and the level of servicing provided. The more intensely the building is serviced, the greater the improvement required (20% for dwellings, 28% for air conditioned buildings)). This approach provides maximum flexibility to the designer but focuses attention on energy efficiency to reduce CO₂ emissions as the main compliance target.

- Limits on design flexibility for building fabric and energy systems.
- Limits on solar gains for non air-conditioned buildings (the cooling load calculation procedures address solar gain in air conditioned buildings)
- Construction quality - including air tightness and commissioning tests
- Satisfactory provision of operating and maintenance instructions

In Scotland new energy standards came into force on 1 May 2007, Section 6 of the SBSA Technical Handbooks. The standards and guidance provided in these documents are intended to achieve an improvement of around 23-28% fewer emissions on the previous standards, design and construction methods which exceed these efficiency ratings and which make greater use of Low and Zero Carbon Technologies would be encouraged.

In addition to compliance with new building standards, all new buildings must be provided with an Energy Performance Certificate (EPC) as part of the building warrant completion process.

In Northern Ireland the requirements for new buildings came into effect in November 2006 and the technical standards are set by Technical Booklet F1 for dwellings and Technical Booklet F2 for all other buildings. The building complies with the regulations if it satisfies criteria very similar to those listed for England and Wales above.

In England and Wales the requirements for existing buildings came into force in April 2006.

When work is carried out on existing buildings, all such work is expected to meet minimum energy efficiency standards defined at the elemental level. For certain types of major improvement works in buildings with floor areas over 1.000 m² where the work has the potential to increase energy intensity (e.g. extending the building or installing air conditioning), there is a further requirement for additional improvements to energy efficiency, provided these are technically, functionally and economically feasible.

In Scotland the new energy standards and guidance within the SBSA Technical Handbooks 2007 which came into force on 1 May 2007 apply to conversions and also on work to existing buildings, such as extensions, alterations and replacements.

In Northern Ireland the new technical standards which came into effect on 30 November 2006 set standards for conversions and for work to existing buildings, such as extensions and alterations. For certain types of major improvement works in buildings with floor areas over 1.000 m² where the work has the potential to increase energy intensity (e.g. extending the building or installing air conditioning), there is a requirement for additional improvements to energy efficiency, provided these are technically, functionally and economically feasible.

In England and Wales the requirements regarding the certification of buildings will be implemented progressively between August 2007 and October 2008.

Energy performance certificates (EPCs) will be produced for buildings on construction, sale and rent. They will include environmental (CO₂) ratings on an A-G scale similar to that used for white goods. These ratings will be produced by elements of the national calculation methodology. The information for these calculations will typically be collected through site surveys using plans and specifications where they are available. The certificate is accompanied by recommendations on how to improve the energy performance of the building. All certificates will be valid for ten years except that a new certificate will be required for each private marketed sale of a dwelling to fit with other Government legislation.

Display energy certificates (DECs) will be produced by public authorities and institutions providing public services to large numbers of persons where they occupy buildings with floor areas greater than 1000 m². They will also include environmental impact (CO₂) ratings on an A-G scale. Unlike EPCs however DECs will give information about actual energy usage and they will be updated

annually. A report of recommendations to improve the building's energy performance will be required every 7 years.

In Scotland Energy performance certificates (EPCs) are being produced for new buildings on construction, and will be introduced for those being sold and for rent. The EPC provides an indication of the (CO₂) emitted and an indication of potential emissions expressed in kg of CO₂ per m² of floor area per annum. Ratings are shown on an A-G scale similar to that used for white goods. These ratings will be produced by elements of the national calculation methodology and will be accompanied by recommendations on cost effective improvements to the energy performance of the building. Validity of the EPC will not exceed 10 years.

EPCs will be produced and displayed in a prominent place in all public buildings greater than 1000 m². Ratings are rated from 'Carbon Neutral' through to poor performance on an A-G scale.

In Northern Ireland Energy Performance Certificates (EPCs) will be introduced for new buildings from early next year and EPCs for buildings being sold or rented out will be phased in during 2008. The ratings will be on an A-G scale similar to that used for white goods. The EPC will be accompanied by recommendations for the cost effective improvement of the energy performance of the building.

EPCs for public buildings greater than 1.000 m² in floor area will have to be displayed in a prominent place clearly visible to the public.

In England and Wales any energy assessor must be a member of a specialist accreditation scheme approved by the Government. Each accreditation scheme is responsible for ensuring that energy assessors are suitably qualified to conduct energy assessments and for ensuring the quality of the assessments and any certificates or reports produced (including their independence).

In Scotland Any energy assessor must be a member of a specialist professional body selected by the Government. Each professional body is responsible for ensuring that energy assessors are suitably qualified to conduct energy assessments and for ensuring the quality of the assessments and any certificates or reports produced (including their independence).

In Northern Ireland the intention is to adopt a similar approach to that in England and Wales.

EPBD implementation in Ireland

The legal transposition of the EPBD in Ireland is the responsibility of the Department of the Environment, Heritage and Local Government -DEHLG (all Articles except 8 and 9) and the Department of Communications, Marine and Natural Resources - DCMNR (Articles 8 and 9).

The EC Energy Performance of Buildings Regulations 2006 (S.I. No. 666 of 2006) were published in December 2006. This transposes elements of Article 5 [consideration of alternative/renewable energy systems during the design of large buildings] and Article 7 - [Building Energy Rating (BER)] of the EPBD into national legislation.

The Building Regulations (Amendment) Regulations 2005 (S.I. No. 873 of 2005) amended Building Regulations Part L, which deal with the minimum energy performance requirements for new buildings. These were published by DEHLG in December 2005 and came into operation from 1 July 2006 and, inter alia, gave legal effect to Articles 3- 6 of the EPBD.

The above regulations had been enabled by the EC (Energy Performance of Buildings Regulations 2005 (S.I. No. 872 of 2005), published in December 2005, which enabled the making of national regulations to give effect to the EPBD.

Outline details of a proposed campaign to encourage the voluntary inspection/servicing of boilers was forwarded to the EU Commission on 31 August 2006 - Article 8(b) of the EPBD.

Regulations (S.I. No. 346 of 2006) regarding the mandatory inspection of air-conditioning systems were published by DCMNR in June 2006 - Article 9 of EPBD.

Following a process of public consultation, the "Action Plan for Implementation of the EPBD in Ireland" was published on 1 August 2006.

This sets out the suite of proposed tasks, responsibilities and timescales required to achieve full implementation in a workable and cost-effective manner.

The calculation procedure for new residential buildings (Article 3) has been developed (Dwellings Energy Assessment Procedure (DEAP)) and was published by SEI in June 2006. Specific procedures will be developed for existing dwellings and for non-residential and public buildings.

It is expected that an operational rating may be used for the energy rating of public buildings and pilot projects will be carried out to test and evaluate this approach.

Technical Guidance Document Part L advising designers and builders on how to comply with the amended Part L Building Regulations (S.I. No. 873 of 2005) was published in May 2006. The requirements come into force for planning applications submitted after 1 July 2006.

The type and level of requirements are a function of the type of building (dwellings, office buildings, schools, ...) and cover:

- Limitation of Heat loss through the building fabric
- Limitation of CO₂ Emissions
- Controls for space heating and hot water supply systems
- Insulation of hot water storage vessels, pipes and ducts

From 1991, the Government of Ireland adopted minimum requirements for new building components when building renovation is done and for extensions to existing buildings. These requirements have to be respected since 1 June 1992 and have been strengthened from 1 July 2006.

Certification will be obligatory for new residential buildings from 1 January 2007. For new non-residential - including public - buildings, a Building Energy Rating (BER) will be needed from 1 July 2008. Existing buildings (residential, non-residential and public buildings) when rented or sold must have a Building Energy Rating (i.e. an energy performance certificate) from 1 January 2009.

Following a consultation process with key stake holders, the format of the BER label for dwellings was finalized in December 2006 and was published in the First Schedule of S.I. No. 666 of 2006.

EPBD implementation in Spain

The existing Spanish legislation regarding energy saving in buildings dates from 1979 and the last regulation on thermal building installations from 1998. Both needed extensive reviewing and updating. The EPBD gave the Spanish Government the chance to include more stringent energy criteria into this review, not just for the fulfilment of the EU obligations but also for the implementation of other National Energy Policies such as the Energy Strategy E4 and the Renewable Energy Plan.

The EPBD was transposed in Spain by means of three royal decrees:

- Royal Decree approving the 'Technical Code of Buildings (CTE)'. It was approved by the Council of Ministers on 17th of March 2006 and published in the Official Gazette on 28th March 2006.
- Royal Decree approving the review of the current 'Regulations for thermal installations on Buildings (RITE)', approved by the Council of Ministers on 20th of July 2007 and published in the official Gazette on 29th August 2007.
- Royal Decree on the Basic Procedure for Energy Performance Certification of new buildings approved by the Council of Ministers on 17th January 2007, and published in the Official Gazette on 31st January 2007.

All of these are the responsibilities of the Ministry of Housing, and the revised RITE and Energy Certification is the responsibility of the Ministry of Industry, Tourism and Trade also.

The calculation procedure for the buildings energy efficiency (named "Energy Efficiency qualification") is expressed by the estimated energy consumption necessary to satisfy the building energy demand in occupational and standard running conditions.

This can be calculated by a simplified prescriptive option or by a general option, described in the following section, using an official software tool or by any alternative method validated by the Government.

More information about the technical specification of the calculation procedure for the energy efficiency qualification is found in the Annex I of the Royal Decree 47/2007, dated 19th January, by which the Basic Procedure for the new buildings Energy Efficiency Certification is approved.

The Building Code (CTE) has set minimum energy requirements for new buildings. The requirements come into force for building permits requested after 17th September of 2006.

The type and level of performance requirements depend on the climatic zone (in total, there are 12 in all the Spanish territory) where there is building work, and they cover:

- Maximum U-values for different building elements;
- Solar factor for windows, roof lights, etc;
- Minimum Efficiency performance for thermal installations;
- Minimum Efficiency performance for lighting installations;
- Minimum natural lightning contribution;
- Minimum solar contribution to Domestic Hot Water;
- Minimum photovoltaic contribution to electric power.

The compliance with requirements on 'Energy demand limitation' (HE1) could be checked using a simplified procedure, (for each orientation, the real values are compared with the limit values for the roof, facade walls and floors in contact with ground) or by using a complex procedure.

The complex procedure requires the use of software tools. LIDER is the official one; it has been developed by the Government and is available for free.

EPBD implementation in Portugal

Portugal has adopted a series of measures to implement the directive into the national law: on 4 April 2006, the Government has adopted three Decrees that, together, constitute the transposition of the EPBD into national law:

- Decree 78/2006 - It creates and defines the operational rules for the System for Energy and Indoor Air Quality Certification of Buildings (SCE) - articles 7 and 10;
- Decree 79/2006 - It establishes the new revision of the Regulations for HVAC systems, including requirements for regular inspection of boilers and air-conditioners (RSECE) - articles 8 and 9;
- Decree 80/2006 - It establishes the new revision of the Thermal Regulations for Buildings (RCCTE) - articles 3 to 6.

In Portugal, the implementation of the EPBD is the overall responsibility of the Ministry of the Economy, Directorate General for Geology and Energy, who coordinated the legal procedures and is responsible for the Certification system. The direct responsibility for the two regulations belongs to the Ministry of Public Works, who updated them under request from the Ministry of the Economy.

The calculation procedures (art. 3) are included in the Building regulations for residential buildings and in the HVAC regulations for non-residential buildings.

The new requirements are mandatory for building permits requested after 3 July 2006. The type and level of requirements are function of the type of building (dwellings, office buildings, schools, etc.) and cover:

- Maximum Heating and Cooling needs per m² of floor area (residential only);
- Maximum U-value;
- Minimum shading requirements for all windows;
- Minimum requirements for thermal bridges;
- Maximum consumption for production of hot water, including mandatory installation of solar water heaters (all buildings);
- Maximum primary energy consumption per m² of floor area (all buildings);
- Minimum efficiency and quality requirements for heating and cooling components (non-residential buildings).

The proof of compliance must be made when requesting the building permit and after completion of the building. Control of the regulation is the responsibility of the City where the building is located, based on a Declaration of Compliance with the building regulations issued by an accredited expert registered in the SCE (Building Certification System).

Requirements for existing non-residential buildings larger than 1000 m² If the primary energy consumption of a building exceeds a certain level, fixed by type by the HVAC regulations RSECE, an energy plan must be prepared and all measures with payback shorter than 8 years must be implemented over three years.

These requirements shall start in 2008 or 2009, depending on the size of the building.

Certification of buildings is mandatory for all new buildings requesting a use permit after mid 2007. The exact date shall be decided by the Government by 4 December 2006. For public buildings, a certification is needed from 1 January 2008 or 2009, depending on size. Other buildings when rent or sold must have an energy performance certificate from 1 January 2009.

EPBD implementation in Sweden

The implementation of the EPBD in Sweden is the responsibility of the Ministry of Enterprise, Energy and Communications and the National Board of Housing, Building and Planning (Boverket).

On June 21, 2006, the Parliament of Sweden adopted the Law regarding the transposition of the EPBD in national law, which came into force on October 1, 2006. The Government then adopted the ordinance, which came into force on February 1, 2007. On March 1, 2007, the regulations from the National Board of Housing, Building and Planning came into force.

How the energy performance is presented is regulated by the National Board of Housing, Building and Planning (Boverket). Operational rating (measured rating) will be used for all types of buildings. In cases where no measured value is available, calculation may be used. There is no general calculation method and software tool for energy calculations in Sweden.

The Government of Sweden first adopted minimum requirements for all new buildings in 1942. Revised requirements were adopted 1960, 1967, 1975, 1980, 1988 and 2006. The latest requirements came into force for building permits requested after 1 July 2006.

The type and level of requirements are different for residential and nonresidential buildings. A maximum energy consumption per m² of tempered floor area is given (for heating, cooling and domestic hot water demand) along with other advice about comfort and indoor environment. There are two climate zones.

The proof of compliance must be made within 24 months after completion of the building. Control of this regulation is the responsibility of the municipality where the building is located.

The requirements for existing buildings are under revision. The existing regulations state that if the building is renovated or extended the changed part of the building should fulfill the requirements for new buildings. There may be exceptions from this for e.g. Cultural or listed buildings.

Certification is obligatory for new buildings after 1 January 2009. For public buildings and multi-family houses, a certification is mandatory from the 31st December 2008. Other buildings, when rented or sold must have an energy performance certificate from 1st January 2009.

EPBD implementation in Poland

The implementation of the EPBD in Poland is the responsibility of the Ministry of Construction Council of Ministries will consider, in September 2006, new version of the project of the Act on buildings and apartments energy assessment system and inspection of installations within a scope of energy efficiency. Texts of the Act and related secondary legislation, together with public consultations can be seen on Ministry of Construction web site

Project of fore mentioned Act and secondary legislation the Ordinance about the scope and form of energy certificate for building and apartments are introducing one assessment method for all types of buildings (new and old - modernized and nonmodernized but rented and sold).

The new requirements are the subject of being amended Ordinance of Ministry of Infrastructure from 12 of April 2002 on Technical requirements to be fulfilled by buildings and their localization.

The requirements are on following type: on maximum permissible insulation level, infiltration coefficients for windows and doors, and fenestration areas. The type and level of requirements are same regardless of building functions and types (dwellings, office buildings schools, ...).

The energy rank is not regulated it is a result of application of specific solutions fulfilling primary (listed above) requirements.

After the amendment of Ordinance about the scope and form of building design, every design that will be a basis for obtaining a building permit - filed by designer - must be accompanied by the table confirming compliance of fulfillment of energy requirements according to building technical regulations. Upon issuing building permit and permit for building operation the authorities in Poland are not verifying the design; they collect and check only the completeness of all documents and their compliance with spatial regulations. For the energy assessment and certificate the verification of building design compared with the construction objectives will be performed before the operational permit is issued.

Requirements for existing, modernized or extended buildings will be same as for the new ones.

From 1st of January 2008 all new buildings should have an energy certificate. From 1st of January 2009 all existing buildings that are sold, rented or modernized should have an energy certificate.

It is expected that the legislative will end in November 2006 and execution inspection will be adopted by the and to become into force from 1st January 2009 for the others.

3.1.3 Energetic efficiency of products

[Pietro Novelli]

- ✓ Energy output of the boilers
Directive 92/42/CEE of the Board, of May 21 st 1992, regarding the requisite of output for the new water boilers warm you feed with liquid or gaseous fuels [official Gazette n. L 167 of 22.6.1992,]
- ✓ Appliances: labelling of the energy consumption
Directive 92/75/CEE of the Board, of September 22 nd 1992, regarding the indication of energy consumption and other resources of the domestic instruments, through the labelling and information related to the products [official Gazette n. L 297 of 13/10/1992]
- ✓ Energy output of the refrigerators
Directive 96/57/CE of the European Parliament and of the Board of September 3 rd 1996 on the requirement of energy output for refrigerators, freezers and combinations of them [official Gazette n. L 236 of 18/09/1996]
- ✓ Reactors for fluorescent lamps
Directive 2000/55/CE of the European Parliament and of the Board, of September 18 th 2000, on the requirement of energy efficiency of the fluorescent lamps feeders[official Gazette n. L 279 of 01/11/2000]
- ✓ Ecological conception of the instruments that consumes energy
Directive 2005/32/CE of the European Parliament and of the Board, of July 6 th 2005, related to the institution for the elaboration of specific requirement for the ecological planning of products that consume energy and include modifies some directive 92/42/CEE of the Board and of the directives 96/57/CE and 2000/55/CE of the European Parliament and of the Board [official Gazette n. L 191 of 22/07/2005]
- ✓ Equipments of office: program ENERGY Star
Decision 2006/1005/CE of the Board, of December 18 th 2006, related to the conclusion of the accord between the governments of the United States of America and the European Community regarding the coordination of labelling programs of related to the energetic effectiveness of the office equipments [official Gazette n. L 381 of 28.12.2006].

- ✓ Accord between the governments of the United States of America and the European Community regarding the coordination of labelling programs related to the energetic effectiveness of the office equipments [official Gazette n. L 381 of 28.12.2006].

3.2 TECHNICAL NORMS

3.2.1 Work in progress

(Dall'O' - Galante)

CEN is the European Association of national standardization institutes, the so called National Standards Bodies (NSB's). These NSB's are responsible for contacts with the interested market parties and experts preparing the CEN standards as they do when preparing national standards. Members of CEN-Technical Committees (CEN-TC's) are nominated by the NSB's. The TC's decide scope and content of a standard. The actual work is done in smaller CEN-TC-Working Groups whose expert members are nominated by NSB's. In most countries the NSB organizes a national mirror group to monitor and support the work of a CEN-TC. This was also done in the EPBD program of CEN. As in this case the work covers 5 CEN-TC's, some NSB's organized a special mirror group to follow the work on the total EPBD CEN program.

There is an agreement between CEN and the national standards bodies that before starting national standardization work CEN standardization work shall be considered. If it appears that CEN work has started, this work will be followed and the national work should not be implemented. It is called a "Stand still".

After the EN's are published, existing and possibly conflicting national standards shall be withdrawn within a certain time frame. If national legislation refers to these national standards, and time can be extended to the NSB to comply with it. A period of three to five years is considered as the maximum deviation period in which national standards shall be withdrawn.

To support the open EU market, more and more standards have been prepared as EN's. For building products this is a requirement based on EU mandates to CEN according to the EU-CPD (Construction Product Directive). To stimulate an open EU market, construction products shall only be specified according to mandatory, so called "harmonized" EN (or EN-ISO) standards.

The EPBD stimulates EN standards for the energy calculation procedures for buildings and their systems, and all related performance prescriptive standards needed to specify buildings and systems in relation to the Energy Performance of Buildings Directive. The European Commission gave a mandate to CEN in order to speed up the development of standards needed for the EPBD implementation.

CEN did not start this work from scratch. Existing CEN Technical Committees have been already quite active during the last 15 years preparing international standards in this field. These TC's have been involved in developing the CEN program to support the implementation of the EPBD.

The process is being overseen by CEN/BT WG 173, Energy performance of buildings project group. Its task is to coordinate the work and to ensure that standards prepared in different committees interface with each other in a suitable way.

The European Commission decided after a consultation with the Member States experts, interest groups and CEN, that there was an urgent need for standards to support the EPBD. The aim is to offer within a short period (2004-2006) a clear and consistent set of standards as basis for the national procedures in the Member States. In particular, the Member States with a very limited experience in the field of the EPBD could benefit from this.

On the long term, harmonisation of the standards will also be attractive for all Member States. The maintenance and further development costs will be lower compared with the situation where all NSB's have to do this on their own. In addition, there is great advantage in having harmonized standards throughout Europe. The wide scale implementation of new technical solutions, equipment

and systems will become easier if the performance is calculated in a similar way. This means that the industry may have a bigger market throughout Europe which may also benefit their opportunities on the world market.

The development of CEN standards may lead to CEN-ISO standards. The ISO standards are widely accepted and may even increase the market opportunities of the European industry.

Regional differences in climate, building tradition and user behavior in Europe will have impact on the input data and consequently on the energy performance. These differences will also lead to different choices when it comes to finding the optimum balance between accuracy and simplicity.

The standards developed under the EPBD have to be flexible enough to accommodate these differences.

The set of CEN-EPBD standards consists of 43 titles or parts and can be grouped as follows:

1. The building physics standards, e.g. describing the calculation of heat transfer by transmission and ventilation, load and summer temperature, solar transmittance and the calculation of the energy need for heating and cooling of the building.
2. In the second group there are standards related to the description and properties (classification) of ventilation systems plus cooling and air conditioning systems.
3. The third group is focusing on the description of space heating and domestic hot water systems:
 - The generation efficiency.
 - The emission efficiency.
 - Domestic hot water systems
 - Low temperature heating and cooling systems integrated in building elements (embedded systems).
4. A series of supporting standards on:
 - Lighting systems for buildings (including the effect of daylight)
 - Controls and automation for building services
 - Classification of the indoor environment
 - Financial economic evaluation of sustainable energy applications.
5. A set of standards on inspection:
 - Boilers and heating systems
 - Cooling- and AC systems
 - Ventilation systems.
6. And, last but not least, the two key standards on expressing energy performance and for energy certification of buildings, the overall energy use, primary energy and CO₂ emissions, the assessment of energy use and definition of energy performance ratings.

3.2.2 CEN 350

(Cutaia)

Scope of the TC 350

The TC 350 shall be responsible for the development of voluntary horizontal standardised 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 standards will describe a harmonized methodology for assessment of environmental performance of buildings and life cycle cost performance of buildings as well as the quantifiable performance aspects of health and comfort of buildings.

The Business Environment

- Buildings and the built environment uses 50% of the materials taken from the Earth's crust.

- During their life cycles buildings comprise the largest energy consuming sector with the almost half of the primary energy used and generating about 40 % of all greenhouse gas emissions in Europe.
- Waste produced from building materials are the source of 25 % of all waste generated.
- The building sector also has a major economic impact (10 % of the GDP of the EU).
- People spend almost 90 % of their time inside buildings.

In order to assess the integrated performance of buildings it is necessary to regard a building as a whole with required performance and functions to fulfill. Consequently, during its life cycle, from raw material supply of building products to the final disposal of building components, a building has environmental and economic impacts as well as impacts on the health and comfort of the users.

To get an overall picture on the integrated performance of a building, these impacts must be analyzed within the building as an object of the assessment in terms of environmental performance, economic performance and health and comfort performance of building.

Benefits

- Avoidance of potential barriers to trade can be achieved by drafting these standards both in the European market area and in the global market area.
- The standards of the TC 350 will provide the means for the quantification of the impacts in order to understand the effects of decisions taken in the construction sector.
- The standards will ensure the utilization of the salient features of all relevant ISO standards.

Priorities

The work will be phased

- The first phase within the scope of the mandate M/350
- The second phase dealing in detail with the other defined aspects of integrated performance, i.e. health & comfort performance and life cycle cost performance of buildings.

The TC 350 will initially create six standards under the mandated work. At the highest level there is a standard that will describe the means for the integration of all three above mentioned performance aspects of building above mentioned. Other standards will describe the means for the environmental assessment of buildings, the requirements for the use of Environmental Product Declarations, the rules governing their declaration and detail of their evaluation for products, the communication of data and the generic data necessary for compilation of environmental declarations.

Table 3.2: CEN 350 - Sub-structure

SC/WG	Title
CEN/TC 350/WG 1	Environmental performance of buildings
CEN/TC 350/WG 2	Building Life Cycle Description
CEN/TC 350/WG 3	Products Level

Table 3.3: CEN/TC 350- Standards under development

Project reference	Title	Current status	DAV
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prEN 15643-1	Sustainability of construction works - Integrated assessment of building performance - Part 1: General framework	Under Approval	
CEN/TC 350 /WG1 N015rev1	Sustainability of construction works - Assessment of environmental performance of buildings - Calculation methods	Under Development	2008-11
prEN 15804	Sustainability of construction works - Environmental product declarations - Product category rules	Under Approval	2010-02
	Sustainability of construction works - Environmental product declarations - Communication formats	Under Development	2010-04
	Sustainability of construction works - Environmental product declarations - Methodology and data for generic data	Under Development	2009-01
	Sustainability of construction works - Description of the building life cycle	Under Development	2009-10
prEN 15643-2	Sustainability of construction works - Integrated assessment of building performance - Part 2: Framework for the assessment of environmental performance	Under Development	2011-01

3.2.3 ISO TC 59 - Building construction

(Cutaia)

Scope of the TC 59: Standardization in the building field and civil engineering:

- general terminology for building and civil engineering;
- organization of information in the design processes, manufacture and construction;
- general geometric requirements for building, building elements and components including modular coordination and its basic principles, general rules for joints, tolerances and fits;
- general rules for other performance requirements for buildings and building elements including the coordination of these with performance requirements of building components to be used in building and civil engineering;
- geometric and performance requirements for components that are not in the scope of separate ISO technical committees.

Excluded:

- acoustic requirements (ISO / TC 43);
- fire tests on building materials, components and structures (ISO / TC 92);
- bases for design of structures (ISO / TC 98);
- calculation of thermal properties (ISO / TC 163).

Table 3.4: ISO TC 59 - Subcommittees

Subcommittee	Subcommittee Title
TC 59/SC 2	Terminology and harmonization of languages
TC 59/SC 3	Functional/user requirements and performance in building construction
TC 59/SC 4	Dimensional tolerances and measurement
TC 59/SC 8	Joining products
TC 59/SC 13	Organization of information about construction works
TC 59/SC 14	Design life
TC 59/SC 15	Performance criteria for single family attached and detached dwellings
TC 59/SC 16	Accessibility and usability of the built environment
TC 59/SC 17	Sustainability in building construction

TC 59/SC 17 Sustainability in building construction

Table 3.5: ISO TC 59/SC 17 - Subcommittees/Working Groups

Subcommittee/Working Group	Title
TC 59/SC 17/WG 1	General principles and terminology
TC 59/SC 17/WG 2	Sustainability indicators
TC 59/SC 17/WG 3	Environmental declaration of products
TC 59/SC 17/WG 4	Environmental performance of buildings
TC 59/SC 17/WG 5	Civil engineering works

Table 3.6: Standards and projects under the direct responsibility of TC 59/SC 17 Secretariat.

UD	ISO/FDIS 15392 Sustainability in building construction -- General principles
P	ISO/TS 21929-1:2006 Sustainability in building construction -- Sustainability indicators -- Part 1: Framework for development of indicators for buildings
P	ISO 21930:2007

	Sustainability in building construction -- Environmental declaration of building products
UD	ISO/CD 21931-1 Sustainability in building construction -- Framework for methods of assessment for environmental performance of construction works -- Part 1: Buildings
P	ISO/TS 21931-1:2006 Sustainability in building construction -- Framework for methods of assessment for environmental performance of construction works -- Part 1: Buildings
UD	ISO/AWI TR 21932 Buildings and constructed assets -- Sustainability in building construction -- Terminology

Note: UD = Under development, P = Published.

ISO/FDIS 15392 - Sustainability in building construction -- General principles

ISO 15392:2008 identifies and establishes general principles for sustainability. It is based on the concept of sustainable development as it applies to the life cycle of buildings and other construction works, from their inception to the end of life.

ISO 15392:2008 is applicable to buildings and other construction works individually and collectively, as well as to the materials, products, services and processes related to the life cycle of buildings and other construction works.

ISO 15392:2008 does not provide levels (benchmarks) that can serve as the basis for sustainability claims. It is not intended to provide the basis for assessment of organizations or other stakeholders.

ISO/TS 21929-1:2006 - Sustainability in building construction -- Sustainability indicators -- Part 1: Framework for development of indicators for buildings

ISO/TS 21929-1:2006 provides a framework, makes recommendations, and gives guidelines for the development and selection of appropriate sustainability indicators for buildings.

The aim of this part of ISO/TS 21929-1:2006 part of is to define the process that shall be followed when addressing the economic, environmental and social impacts of a building using a common framework and a set of indicators. This part of ISO/TS 21929-1:2006:

- adapts general sustainability principles for buildings;
- includes a framework for the assessment of economic, environmental and social impacts of buildings;
- shows indicators as examples;
- shows how to use sustainability indicators with regard to buildings and shows the process of using sustainability indicators;
- supports the process of choosing indicators;
- supports the development of assessment tools;
- defines the conformity with this specification.

ISO 21930:2007 - Sustainability in building construction -- Environmental declaration of building products

ISO 21930:2007 provides the principles and requirements for type III environmental declarations (EPD) of building products.

ISO 21930:2007 contains specifications and requirements for the EPD of building products. Where this International Standard contains more specific requirements, it complements ISO 14025 for the EPD of building products.

ISO 21930:2007 provides a framework for and the basic requirements for product category rules as defined in ISO 14025 for type III environmental declarations of building products. Type III environmental declarations for building products, as described in ISO 21930:2007, are primarily intended for use in business-to-business communication, but their use in business-to-consumer communication under certain conditions is not precluded.

ISO 21930:2007 does not define requirements for developing type III environmental declaration programmes. Requirements for type III environmental declaration programmes are found in ISO 14025.

The working environment is not included in ISO 21930:2007 because it is normally a subject for national legislation.

ISO/CD 21931-1 - Sustainability in building construction -- Framework for methods of assessment for environmental performance of construction works -- Part 1: Buildings

ISO/TS 21931:2006 provides a general framework for improving the quality and comparability of methods for assessing the environmental performance of buildings. It identifies and describes issues to be taken into account when using methods for the assessment of environmental performance for new or existing building properties in the design, construction, operation, refurbishment and deconstruction stages. It is intended to be used in conjunction with, and following the principles set out in, the ISO 14000 series of International Standards.

Revised by: ISO/CD 21931-1

3.2.4 Construction Products Directive

(Santonico)

The Construction Products 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.

CPD Directive compulsorily provides the CE marking of all the main products used in "Building Construction", ranging from base elements (panels, etc.) to finite components (doors, windows, etc.), to devices against fires (fireplugs, etc.). The CE marking is applied on the products or on the packagings, is accompanied by the CE conformity declaration and the manufacturer is legally engaged to supply the market with a product complying with the requirements by the specific harmonized norm; the minimal requirements provided by the European Commission are the same in all the EU Countries and then the product can freely circulate all over the European Union market. Some important implications of the CE marking are: the national norms already existing for some products such as those concerned with fires prevention (essentially the fire reaction and the fire resistance homologations) are in fact replaced by the new European norms. This allows the circulation of the products without the need of further homologations at local level of other Union Countries.

The procedures of AoC certification (Attestation of Conformity) are stated by the European Commission on the basis of criteria regarding the use destination of the products and the use safety.

See § 10.1.

4. Existing initiatives

(Olivetti)

Since the second half of the 80's there were growing movements towards sustainable construction through the development of several methods to assess the buildings environmental performance which have attracted worldwide a strong interest, such as: BREEAM (Building Research Establishment Environmental Assessment Method) in the United Kingdom, LEED (Leadership in Energy and Environment Design) in the USA, and GBT (Green Building Tool) an international project.

Aspects to be considered

- ✓ Energy
- ✓ Atmospheric emissions
- ✓ water
- ✓ construction materials
- ✓ impact site
- ✓ waste
- ✓ environmental comfort

4.1 INITIATIVES IN THE EU

(Cutaia)

4.1.1 United Kingdom - BREEAM: BRE Environmental Assessment Method

The BREEAM assessment methods and tools family are all designed to help construction professionals understand and mitigate the environmental impacts of the developments they design and build.

BREEAM Buildings and BREEAM Tools act at different stages of the construction process; i.e. for the manufacture of building materials (life cycle analysis of materials in BREEAM Specification: The Green Guide) through design stage (BREEAM Envest and BREEAM Buildings) during construction (BREEAM Smartwaste) and post construction (BREEAM Buildings).

The methods and tools also cover different scales of construction activity. BREEAM Developments is useful at the master planning stage for large development sites like new settlements and communities. BREEAM Buildings assesses the operational and the embodied environmental impacts of individual buildings.

BREEAM Specification and BREEAM LCA look at the environmental impacts of construction materials.

All the BREEAM products are regularly updated to take advantage of new research and technology to reflect changing priorities in regulations and to ensure that BREEAM continues to represent best practice.

BREEAM Buildings can be used to assess the environmental performance of any type of building (new and existing). Standard versions exist for common building types and less common building types can be assessed against tailored criteria under the Bespoke BREEAM version. Buildings outside the UK can also be assessed using BREEAM International that can be used to assess a single development or BRE can also assist in creating a BREEAM version for a country or region.

BREEAM Buildings:

- BREEAM Bespoke can assess buildings that fall outside the standard BREEAM categories, including leisure complexes, laboratories, higher & further education buildings and hotels at the design stage and post construction.

- BREEAM Courts can assess both new build and the major refurbishment of court buildings. BREEAM Courts assessments are certified through the Bespoke BREEAM.
- The code for sustainable homes. In April 2007 the Code for Sustainable Homes replaced Ecohomes for the assessment of new housing in England. The Code is an environmental assessment method for new homes based upon BRE's Ecohomes and contains mandatory performance levels in 6 key areas.
- BREEAM Ecohomes can assess new homes, apartments/flats, and houses, apartments and flats undergoing major refurbishment at the design stage and post construction. Ecohomes is a version of BREEAM for homes. It provides an authoritative rating for new, converted or renovated homes, and covers houses, flats and apartments. Ecohomes Assessments can be carried out at both the design stage or post construction for:
 - o New build
 - o Major refurbishment projects
- BREEAM ECOHOMES XB. A tool for housing associations and housing stock managers as a stock management aid for existing buildings.
- BREEAM Industrial can assess storage and distribution, light industrial units, factories and workshops at the design stage and post construction. BREEAM Industrial can be used to assess the environmental impact of storage and distribution, light industrial units, factories and workshops. BREEAM Industrial assessments can be carried out for:
 - o New buildings
 - o Design stage and post construction stages
 - o Buildings undergoing major refurbishment
- BREEAM International can assess a single development or BRE can also assist in creating a BREEAM version for a country or region outside of the UK.
- BREEAM Multi-Residential can assess student halls of residence, sheltered housing for the elderly, supported housing and hostel type accommodation at the design stage and post construction.
- BREEAM Prisons can assess high and standard security prisons, young offenders institutions, local prisons and women's prisons at the design stage and post construction. BRE has developed BREEAM Prisons in association with and findings from National Offender Management Service. BREEAM Prisons can be used to assess the environmental impacts of new build and major refurbishments projects that form a part of one of the following types of prison establishments:
 - o High security prisons; normally holding category A prisoners
 - o Standard secured prison; normally holding category B and/or C prisoners
 - o Young offender institutions
 - o Local prisons; that receive prisoners directly from court on remand or newly sentenced
 - o Women's prisons; closed prisons only
- BREEAM Offices can assess new build or major refurbishment and existing offices, at the design stage, post construction and in use. BREEAM Offices is the world's most widely used means of reviewing and improving the environmental performance of office buildings. BREEAM Offices assessments can be carried out on both new and existing office buildings - non occupied or occupied, as follows:
 - o New build or refurbishment: design and procurement
 - o Existing office (occupied): management and operation

- BREEAM Retail can assess new build or major refurbishment, post construction, tenant fit-out, existing (occupied), management and operation.
- BREEAM Schools can assess new schools, major refurbishment projects and extensions at the design stage and post construction. BREEAM Schools helps schools and LEAs to set environmental targets for new and refurbished school buildings. It also serves as a useful tool for designers by demonstrating the environmental performance of their designs. Assessments can be carried out at the design stage and verified post construction for primary and secondary schools including the following:
 - o New Schools
 - o Major refurbishment projects
 - o Extensions

The BREEAM assessment process was created in 1990 with the first two versions covering offices and homes. Versions are updated regularly in line with UK Building Regulations and different building versions have been created since its launch to assess various building types.

These versions essentially look at the same broad range of environmental impacts:

- Management
- Health and Wellbeing
- Energy
- Transport
- Water
- Material and Waste
- Landuse and Ecology
- Pollution

Credits are awarded in each of the above areas according to performance. A set of environmental weightings then enables the credits to be added together to produce a single overall score. The building is then rated on a scale of:

- ✓ PASS, GOOD, VERY GOOD or EXCELLENT
- ✓ and a certificate awarded to the development.

BREEAM provides also Tools for assessing environmental performances of buildings:

- ✓ LCA Environmental profiles: Certified system for providing information about the environmental impacts of construction materials measured over the whole life cycle of the product
- ✓ The Green Guide to Specification: is an easy-to-use publication outlining the relative environmental impacts of over 250 elemental specifications for roofs, walls, floors etc.
- ✓ Envest - the whole building LCA software: is a web-based tool that simplifies the otherwise very complex process of designing buildings with low environmental impact and whole life costs.

4.1.2 Italy - ITACA

The ITACA Protocol has been developed by ITACA (Istituto per l'innovazione e trasparenza degli appalti e la compatibilità ambientale, in the framework of the Federal association of Regions and Autonomous Provinces of Italy).

ITACA standard enables to estimate the buildings environmental quality levels during the project phase, through the measure of their performances in respect with 12 criteria and 8 sub-criteria that are sub-divided in 2 main evaluation areas according to:

- 1 Resources consumption (energy, materials, water, drinking water);
- 2 Environmental loads (greenhouse gas emissions, solid waste, liquid waste, territory)

In particular, the requirements are related with the following topics:

- Exterior environmental quality (external environmental Comfort, local pollution, inclusion in the surrounding areas);
- Resources consumption (energetic consumption, land use, drinking water, material consumption);
- Environmental loads (greenhouse gas emissions, liquid waste, C&D waste, waste, relation with the neighbouring);
- Environmental internal quality (Visual, acoustic and thermal comfort, air quality);
- Service quality (Maintenance and service plants, consumption monitoring, common areas).

According to the specific performance, for each criteria and sub-criteria, the building receives a score which can vary between -1 and 5. "Zero" represents the benchmark, referring to the normal practice used for buildings, with respect to legislations and technical norms.

In details, the evaluation scale is determined as indicated below:

- ✓ -1 represents a low performance compared to the present standards and practices;
- ✓ 0 represents the minimum standard as defined by laws or present regulations or, if any regulation is in force, as executed by current practices;
- ✓ 1 represents a moderate performances improvement with respect to the present regulations and practices;
- ✓ 2 represents a performances improvement with respect to the present regulations and practices;
- ✓ 3 represents a significant performances improvement with respect to the present regulations and practices; this has to be considered as the best current practice.
- ✓ 4 represents a moderate improvement of the best current practice;
- ✓ 5 represents a very significant improvement of the best current practice, experimental.

4.1.3 Italy - CASACLIMA/KLIMAHOUSE

"KlimaHaus/CasaClima" is a term developed to describe **energy-saving construction and dynamic living**. Economic factors are increasingly important in building and renovation in a time when oil and gas reserves are being depleted.

KlimaHaus has found a way to fuse well-being and savings. The **category of energy saving**, rather than architectural style, determines if a building is classified as a KlimaHaus. A practical calculation system is used to determine a building's energy requirement, making the KlimaHaus programme simple and user-friendly.

The **energy index** and **KlimaHaus placard** are the fundamental pillars of the organisation, and the positive image associated with KlimaHaus has inspired builders' imitation. Significantly, KlimaHaus not only focuses on new construction, but also on the lasting renovation.

In addition with KlimaHaus it has been developed the certification "KlimaHaus plus".

The highest KlimaHaus certification is KlimaHausplus. Awarded to residential buildings distinguished not only by energy-saving construction, but also by ecological construction methods and use of

renewable energy for heat production. To qualify for KlimaHausplus certification, a building must fulfil the following criteria:

- ✓ Heating energy consumption under 50 kWh/m²a
- ✓ Heating fuelled by renewable energy sources
- ✓ Use of environmentally-friendly, non-health-damaging building materials
- ✓ Inclusion of at least one of the following measures: A photovoltaic system, solar panels for water heating and/or integrated with heating system, rainwater usage, green roof.

All buildings certified with KlimaHaus categories Gold, A or B may display the corresponding KlimaHaus placard directly at the entrance, testifying its low energy class. This increases the image, together with the value, of the property.

The placard is provided by an independent authority, namely the KlimaHaus Agency.



A Energy performance certificate helps estimate its energy efficiency and the expected level of its energy-based operating cost.

It is thus a key for measuring the saving potential of the housing field. The assignment of energy classification to buildings provides transparency for everyone involved. This certification is stipulated by an EU guideline that is mandatory in all member states, and within it, the Energy Performance certificate plays a special role as quality sign. The Energy Performance certificate is issued by an independent, authorised agency. An important aspect is that the assignment of an energy index, according to consumption levels, takes place after the examination of the construction or the completion of the building.

The Energy Performance certificate shows at a glance how high a building's heat consumption is. It contains two energy classifications: First, the building's thermal protection class, and second, an

expression of its construction quality. With the aid of a graduated table coloured from green (low energy requirement) to red (higher consumption), even laymen can tell immediately if a building uses a great deal of energy or very little. The heat value is based upon the submitted documents related to energy usage, using a uniform computation method. Owners can calculate building's average heat and energy requirements and compare them to the requirements of other buildings.

4.1.4 Germany - Guideline for Sustainable Building

In Germany the environmental assessment of buildings is based on the "Guideline for Sustainable Building" edited on behalf of the Ministry of Transport, Building and Housing in 2001.

This document provides indications on how to design, construct and manage the buildings, focusing mainly on economic and environmental impacts.

Currently there is no certification scheme for the buildings construction but the interest of both public and private investors is expected to grow rapidly together with the creation of a certification system.

The Guideline is intended to implement integrated principles for the sustainable planning, construction, operation, maintenance and use of buildings and landholdings.

Sustainable building strives to minimise the consumption of energy and resources for all phases of the life-cycle of buildings - from their planning and construction through their use, renovation and to their eventual demolition. It also aims to minimise any possible damage to the natural environment.

This can be achieved by applying the following principles during the entire building process:

- Lowering the energy demand and the consumption of operating materials
- Utilisation of reuseable or recyclable building products and materials
- Extension of the lifetime of products and buildings
- Risk-free return of materials to the natural cycle
- Comprehensive protection of natural areas and use of all possibilities for space-saving construction

The early implementation of sustainable planning measures can considerably improve the overall economic efficiency of buildings (costs of construction, operation, use, environment, health as well as non-monetary values).

When assessing economic efficiency, not only the overall economic efficiency of the project must be guaranteed, but, also, the economic efficiency of every individual planning step must be assessed.

In order to do so, the design team should consist of experts from the various disciplines under the leadership of the planner responsible for the overall co-ordination, and they should work closely together towards the aims of sustainability. Users and operators of the building must also be involved in the design phase.

Quality assurance includes measuring, documenting and monitoring the results of the construction and the use of the building, and reconciling these results with the design requirements (monitoring).

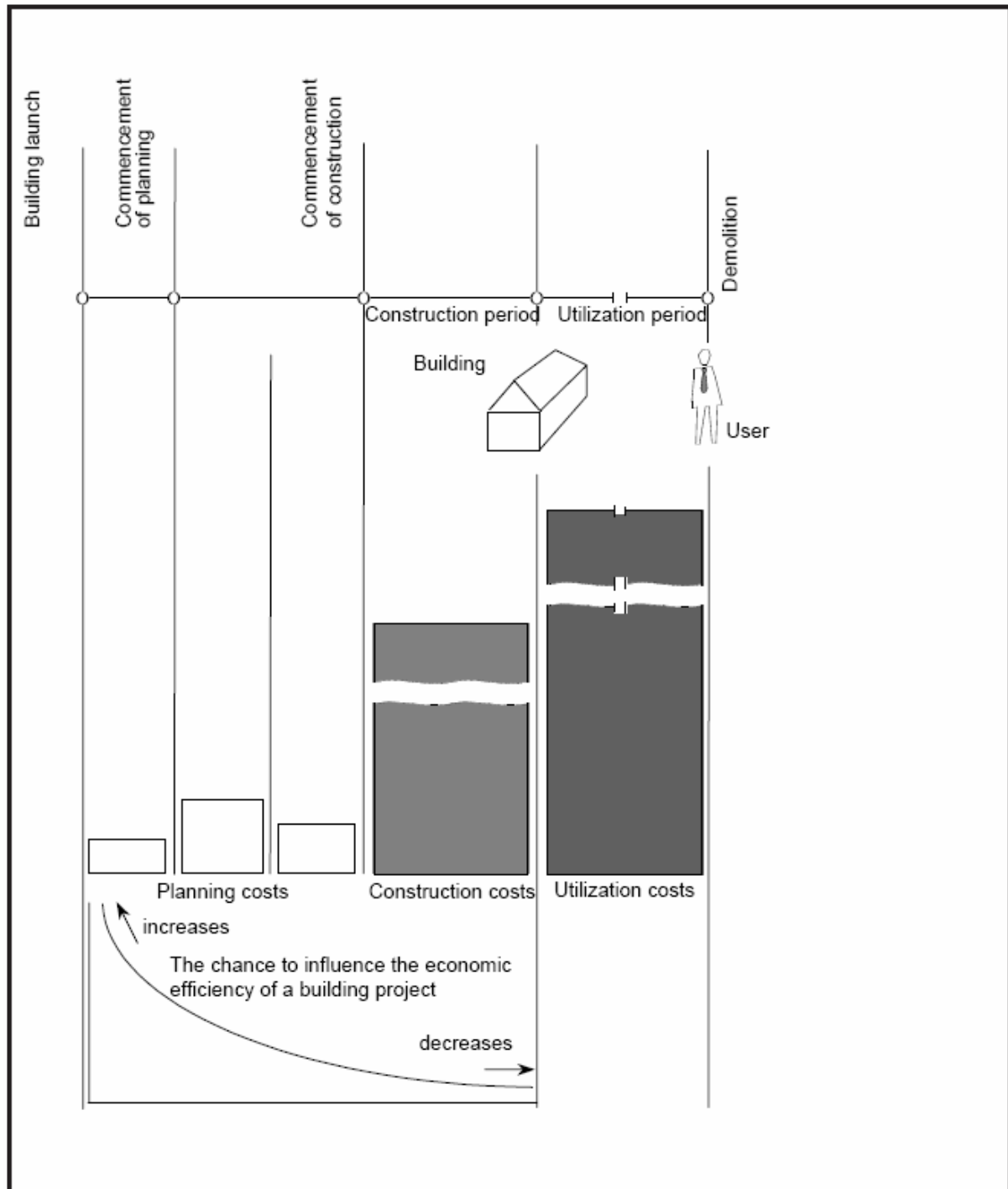


Figure 4.1: The Cost Blocks during the Planning, Construction and Utilisation Phases and the opportunity to influence these.

The opportunities for modifying the costs of a project are higher at the beginning of the project. To a large extent, the cost-effective decisions will have been made during the definition of the programme and the initial concept phase. The same is also true for the impacts to the environment. Questions such as site development as well as planning law, function, urban planning, architecture and building regulations (especially stability and fire safety) must be fully assessed and optimised in terms of sustainability during the preliminary design and architecture and engineering competition stages.

Sustainable planning requires that equal consideration is given to the socio-cultural effects of the building project. Besides integration into the urban and natural environments, consideration must also be given to those aspects that affect people, such as the design of the building and the preservation of historic buildings and monuments.

Usually, buildings are used for long periods of time (on average 50 - 100 years). The temporal criteria, which are to be applied in the framework of the ecological and economical assessments, should be designed accordingly.

Sustainable building cannot be achieved by following a rigid concept. Instead, a specific concept or partial concepts must be developed for each individual project, and these concepts should include different approaches, alternatives and measures for the project.

The Guidelines explains criteria sustainable buildings criteria through the following topics:

- Planning principles
 - o General
 - o The design
 - o Specific requirements
- Ecological assessment - construction, operation, use and demolition
- Economic efficiency
- Health, comfort and socio-cultural aspects
- Project tender and construction
- Operation / use / building maintenance
- Quality assurance
 - ✓ **Appendix 1:** Checklist
 - ✓ **Appendix 2:** Planning Principles for the Design of Buildings and Landholdings
 - ✓ **Appendix 3:** Requirements for Health Protection and Comfort
 - ✓ **Appendix 4:** Energy and Building Service
 - ✓ **Appendix 5:** Design Principles for Outdoor Facilities
 - ✓ **Appendix 6:** Assessment of the Sustainability of Buildings and Landholdings
 - ✓ **Appendix 7:** Building Certification

At present, it does not exist a proper national rating system for buildings, but it is rapidly growing an interest coming from private and public investors.

4.1.5 France (Demarchi Haute Qualité Environnementale- HQE®)

The Haute Qualité Environnementale or HQE® (High Quality Environmental standard) is a standard for green building in France, based on the principles of sustainable development first set out at the 1992 Earth Summit. The standard is controlled by the Paris based Association pour la Haute Qualité Environnementale (ASSOHQE).

The standard specifies criteria for the following:

- Managing the impacts on the external environment
 - o Harmonious relationship between buildings and their immediate environment
 - o Integrated choice of construction methods and materials
 - o The avoidance of nuisance by the construction site.
 - o Minimizing water use

- Minimizing construction waste
 - Minimizing building maintenance and repair
- Creating a pleasant interior environment
 - Hyrdothermal control measures
 - Acoustic control measures
 - Visual attractiveness
 - Measures to control smells
 - Hygiene and cleanliness of the interior spaces
 - Air quality controls
 - Water quality controls

The HQE standard was tested since 1994 on projects of residential buildings and not, and it was officially adopted in 1997 from HQE association. The HQE standard is based on the voluntary environmental certification systems according to the ISO 14000 norms.

The HQE standard has two main topic of application:

- ✓ The environmental management system of the building project
- ✓ The environmental performances of buildings analysed through 14 “cibles” sub-divided into 4 groups:
 - Operations on the exterior environment (G1: Eco-Building; G2: Eco-Management);
 - Operations on the indoor environment (G3: comfort; G4: Health).

Criteria for construction products take into account the technical quality, the durability, the adaptability, the lowering of impacts during the renovation works, the ease to clean and maintenance.

Environmental impacts of construction products are known using EPDs of products themselves, provided by the French association of construction products. A France DB (named I NIES) is available with public information on the French EPD.

The HQE system - “les cibles”

Operations on exterior environment

Group 1, Eco-Building

Cible 1: Building harmonisation in the environment;

Cible 2: Selection of procedures and products for the construction works;

Cible 3: Low polluted construction site;

Group 2, Eco-management

Cible 4: Selection and management of energies;

Cible 5: Management of drinking and raining water;

Cible 6: Waste management;

Cible n7: Maintenance

Operations on interior environment

Group 3, comfort

Cible 8: Comfort igro - termic

Cible 9: Acoustic

Cible 10: Compliance with external surroundings

Cible 11: Smelling

Group 4, Health and sanitary conditions

Cible 12: Health and sanitary conditions

Cible 13: Air quality

Cible 14: Water quality

The Démarche HQE® certification system is applied as follows:

- on one hand the environmental management system is done on the building site phase conducted under the responsibility of the chief foreman,
- on the other hand the environmental criteria are established in the project, according to the context and the priorities laid down by the chief foreman"

4.1.6 Spain

Spain, has recently adopted two resolutions for environmental criteria of buildings used as office or office networks:

- ✓ RESOLUTION MAH/1390/2006, of 24 April, establishing the environmental criteria for the awarding of the Emblem of Guarantee of Environmental Quality to buildings intended for use as offices.
- ✓ RESOLUTION MAH/1389/2006, of 27 April, establishing the environmental criteria for the awarding of the Emblem of Guarantee of Environmental Quality to office networks with customer services.

Resolution MAH/1390/2006 - Offices

Office category includes "all buildings, in their entirety, of a permanent nature and whether public or private, intended for use as offices. Use as offices is understood to be the use of the building for administrative and bureaucratic activities of a public or private nature and for professional offices".

To obtain the Emblem of Guarantee of Environmental Quality, the building shall have the corresponding authorisations and must comply with valid environmental legislation for the area in which it is located, as well as the environmental criteria specified in this annex, the aim of which is to minimise the environmental impact of office buildings during the phase of use and to foster environmental awareness among their users.

The implementation of recognised environmental management systems such as the EMAS system or ISO 14001 standard, or the establishment's possession of any other label of this type and in accordance with ISO 14024 standard, may be taken into account for the evaluation of applications or to verify compliance with the criteria given in this annex, although the implementation of these systems does not guarantee that the establishment will obtain the Emblem.

The environmental criteria for office buildings are divided into 10 sections, each of which contains basic criteria of which fulfilment is obligatory and optional criteria, which are assigned points from 1 to 9. To obtain the Emblem of Guarantee of Environmental Quality, the building must fulfil every basic criterion and must obtain a minimum of 80 points in the total mark for the relevant optional criteria, corresponding to a minimum of 3 sections.

Buildings constructed after the date of publication of the Resolution must obtain a minimum of 90 points in the total mark for optional criteria, corresponding to a minimum of 3 sections.

Following table shows, as an example, environmental criteria adopted for offices.

Table 4.1: SPAIN - Environmental criteria adopted for offices.

1 Environmental criteria for the service category	
1.1 Energy efficiency and saving	
	1.1.1 Basic criteria
	1.1.1.1 Quantitative control
	1.1.1.2 Lighting
	1.1.1.3 Air conditioning
	1.1.1.4 Publicity
	1.1.2 Optional criteria
	1.1.2.1 Insulation.
	1.1.2.2 Lighting.
	1.1.2.3 Air conditioning
	1.1.2.4 The use of renewable energy sources and energy efficiency.
	1.1.2.5 Bioclimatic architecture
	1.1.2.6 Other systems leading to savings in energy
	1.1.2.7 User involvement
	1.1.3 Assessment of compliance
1.2 Saving water	
	1.2.1 Basic criteria
	1.2.1.1 Water flow to showerheads
	1.2.1.2 Water flow to taps
	1.2.1.3 Lavatories
	1.2.1.4 Maintenance
	1.2.1.5 Quantitative control
	1.2.1.6 Information signs
	1.2.2 Optional criteria
	1.2.2.1 Other systems
	1.2.2.2 Pressure reduction systems
	1.2.3 Assessment of compliance
1.3 Waste management	
	1.3.1 Basic criteria
	1.3.1.1 Waste segregation
	1.3.1.2 Space for waste segregation
	1.3.1.3 Identification signs on waste containers

	1.3.2 Optional criteria
	1.3.2.1 Waste segregation
	1.3.3 Assessment of compliance
	1.4 Construction materials
	1.4.1 Basic criterion
	1.4.1.1 Families of products with eco-labels
	1.4.2 Optional criteria
	1.4.2.1 Families of products with eco-labels
	1.4.2.2 Use of prefabricated construction elements
	1.4.3 Assessment of compliance
	1.5 Purchasing
	1.5.1 Basic criterion
	1.5.1.1 Refrigeration equipment
	1.5.2 Optional criterion
	1.5.3 Assessment of compliance
	1.6 Integration with the landscape
	1.6.1 Basic criterion
	1.6.2 Assessment of compliance
	1.7 Design of outdoor spaces
	1.7.1 Basic criteria
	1.7.1.1 Selection of the appropriate plant species
	1.7.1.2 Consumption of water for watering plants
	1.7.2 Optional criteria
	1.7.2.1 Reduction of heat islands
	1.7.2.2 Water consumption for watering plants
	1.7.3 Assessment of compliance
	1.8 Noise and vibrations
	1.8.1 Basic criterion
	1.8.2 Assessment of compliance
	1.9 General management
	1.9.1 Optional criteria
	1.9.1.1 EMAS registration or ISO 14001 certification
	1.9.1.2 EMAS registration or ISO 14001 certification of suppliers
	1.9.2 Assessment of compliance
	1.10 User information
	1.10.1 Basic criteria
	1.10.2 Assessment of compliance
	2 Compliance assessment system and documentation

	2.1 Documentation
	2.2 Selection of the collaborating body
	2.3 Control system

Resolution MAH/1389/2006 - Office networks

Office networks includes “all those organisations that have a network of offices with customer services (for example: networks of offices of financial institutions, post offices, travel agents, insurance companies, etc.) in both urban and rural locations, constructed and managed by the organisation responsible. The main occupation of the employees of such offices must be customer services”.

To obtain the Emblem of Guarantee of Environmental Quality, office networks with customer services shall have the corresponding authorisations and must comply with valid environmental legislation for the area in which the offices are located, as well as the environmental criteria specified in this annex, the aim of which is to minimise the environmental impact and to foster environmental awareness among users.

The implementation of recognised environmental management systems such as the EMAS system or ISO 14001 standard, or the establishment's possession of any other label of this type and in accordance with ISO 14024 standard, may be taken into account for the evaluation of applications or to verify compliance with the criteria given in this annex, although the implementation of these systems does not guarantee that the establishment will obtain the Emblem.

The environmental criteria for office networks with customer services are divided into 5 sections, each of which contains basic criteria of which fulfilment is obligatory and optional criteria, which are assigned points from 1 to 8. To obtain the Emblem of Guarantee of Environmental Quality, the office network must fulfil every basic criterion and must obtain a minimum of 60 points in the total mark for the relevant optional criteria, corresponding to a minimum of 3 sections.

4.1.7 Swan Ecolabelling - Nordic Ecolabelling for Small houses

With the version 1.5 (valid until the 31st of march 2010), the Nordic Ecolabelling has published the latest version of the Ecolabel criteria for Small houses adopted in Denmark, Norway, Sweden, Finland and Iceland.

A Swan-labelled house is a small house produced in accordance with requirements regarding the building process, materials and energy consumption. The house has a small impact on the environment as well as a good indoor environment. Consideration is paid to all environmental aspects, from the raw materials to the end product. Requirements on the indoor environment are made by setting criteria for:

- ✓ constituent materials.
- ✓ good ventilation.
- ✓ the construction phase.
- ✓ material and quality controls to prohibit built-in damp damage.

There are also requirements regarding impact on the external environment covering:

- ✓ the prohibition of environmentally hazardous substances.
- ✓ energy efficiency in running the house.
- ✓ the environmentally suitable disposal of construction waste.
- ✓ a service and maintenance plan for the house.

The criteria for Small houses comprise a combination of obligatory requirements and point score requirements. The letter "O" and a number indicate obligatory requirements. These requirements must be fulfilled. Environment and quality management requirements are marked with the letter "M" and a number, and are also mandatory.

The letter "P" and a number distinguish point score requirements. Each requirement of this type gives a points score. These scores are then totalled. A minimum total score must be achieved to fulfil the licence constraints.

The requirements section can also be used as a checklist. Each requirement is followed by two checkboxes for Yes and No to indicate whether the requirement is met.

To be awarded a Swan licence:

- ✓ All obligatory requirements (O) must be fulfilled.
- ✓ A minimum of 40% of the total point score (P) must be achieved which means 16 out of 40 possible points;
- ✓ All requirements regarding environment and quality management (M) must be fulfilled.

Requirements of Swan labelling

- 1 Overall requirements for the licence applicant
- 2 Energy and ventilation
- 3 Material requirements
 - 3.1 Overall requirements
 - 3.2 Chemical products
 - 3.3 Wood and wood-based products
 - 3.4 Other building products, materials and interiors
- 4 Quality management and control for the building process
 - 4.1 Requirement on the building process
 - 4.2 Points score
 - 4.3 Quality management
- 5 Instruction for residents
 - 5.1 Maintenance plan for the house
 - 5.2 Running and maintenance of the heating and ventilation systems.

4.1.8 Swiss - Minergie ®

MINERGIE® is a sustainability brand for new and refurbished buildings. It is mutually supported by the Swiss Confederation, the Swiss Cantons along with Trade and Industry and is registered in Switzerland and around the world and defended firmly against unlicensed use.

Comfort is at the heart of MINERGIE® - the comfort of the users living or working in the building. A wholesome level of comfort is made possible by high-grade building envelopes and the continuous renewal of air.

Specific energy consumption is used as the main indicator to quantify the required building quality. In this way, a reliable assessment can be assured. Only the final energy consumed is relevant.

The MINERGIE® Standard is widely accepted. There are many reasons for this, the most important the objective oriented approach: If builders and planners - in other words architects and engineers can achieve the standard, they have complete freedom both in their design and choice of materials and also in their choice of internal and external building structures.

In the meantime, the building sector has developed a wide range of products and services for MINERGIE® buildings. Suppliers include architects and engineers as well as manufacturers of materials, components and systems. The diversity and competition of this market furthers quality and lowers costs.

MINERGIE® is a registered quality label for new and refurbished buildings. This trademark is supported by the Swiss Confederation, the Swiss cantons and the Principality of Liechtenstein along with trade and industry. The trademark is firmly protected against unlicensed use. Within the framework of the MINERGIE® registered trade mark, several products are offered:

- ✓ Looking after the regular MINERGIE®-Standard for buildings is MINERGIE®'s main activity. The standard requires that general energy consumption must not be higher than 75 % of that of average buildings and that fossil-fuel consumption must not be higher than 50 % of the consumption of such buildings.
- ✓ The MINERGIE-P®-Standard defines buildings with a very low energy consumption, it is especially demanding in regard to heating energy demand. This standard corresponds to the internationally-known passive house standard.
- ✓ The MINERGIE-ECO®-Standard adds ecological requirements such as recyclability, indoor air quality, noise protection etc. to the regular MINERGIE®-Requirements.
- ✓ MINERGIE®-Modules are building components and building equipment elements which are certified as being exceptionally well-performing with regard to energy efficiency.
- ✓ MINERGIE® offers a great variety of information material, planning tools, seminars and conferences as well as training courses.

The following focusses on the regular MINERGIE®-Standard for domestic buildings.

Comfort is the central theme – the comfort of the users living or working in the building. This level of comfort is made possible by high-quality building envelopes and the systematic renewal of air.

Specific energy consumption is used as the main indicator to quantify the required building quality. In this way, reliable evaluation can be assured. Only the final energy consumed is relevant.

To maintain feasibility and general use the additional costs for MINERGIE® must not exceed 10 % of the building costs.

In 2007, 8200 buildings with a total of more than 8.3 Million m₂ gross floor area have been certified as MINERGIE®-Buildings.

Apart from general requirements such as a ventilation system and moderate extra costs, a detailed quantitative proof of energy performance (for heating, hot water, ventilation and air conditioning) has to be delivered. This proof is the core of the MINERGIE®-Certification process. The appropriate forms for all projects applying for a certificate are verified and random tests on the building sites are performed.

MINERGIE® is a registered trade mark.

The MINERGIE® label may only be used for buildings that actually meet the MINERGIE®-Standard. Apart from buildings, products and services can also conform to MINERGIE®-Standards. The same applies to building modules such as systems, components and materials.

MINERGIE® is organised as an association and is registered in the Swiss Trade Register. A governing board of eight people is in charge of strategic decisions. There is a head office who is supported in operational decisions by the MINERGIE® Building Agency.

The certification and all related contacts and support activities are executed by MINERGIE® Certification Units located at the administrations of the 26 Swiss cantons and the Principality of Liechtenstein. Hence there is a decentralised system of implementation.

8595 buildings with **MINERGIE**[®] certification, 198 with **MINERGIE-P**[®] certification, 10 with **MINERGIE-ECO**[®] certification, and 6 with **MINERGIE-P-ECO**[®] certification. Heated area: 8.72 million squaremeters in new and renovated buildings.

4.2 *INTERNATIONAL INITIATIVES*

4.2.1 United States of America - LEED Rating Systems

LEED standards (Leadership in Energy and Environmental Design), developed in the US and now adopted in 40 countries around the world, have been elaborated by US Green Building Council (GBC) with the cooperation of universities of United States and Canada.

LEED is a flexible scheme which, despite a basilar commun structure, provides different criteria for many kind of builindgs: new constructions and major renovations - NC; existing buildings - EB; schools - LEED for Schools; small houses - LEED Homes.

The Leed Rating System is based on awarding of credits for every requirement. The level of Rating obtained derives from the addition of credits.

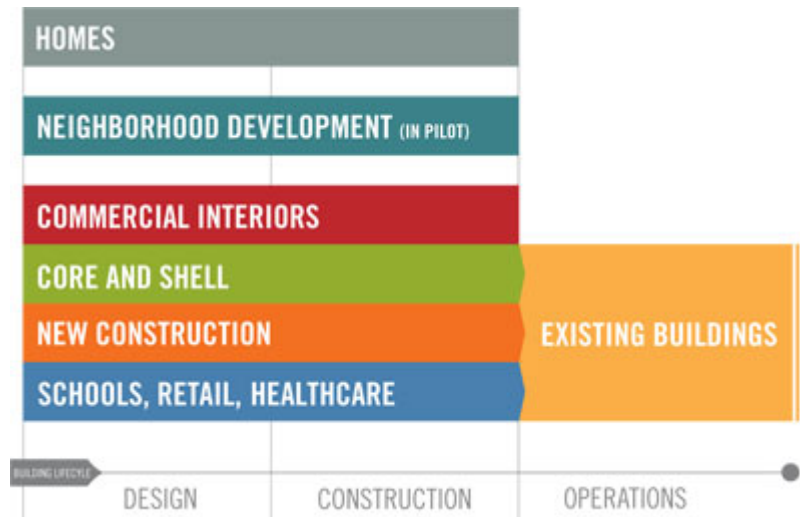
LEED certification provides independent, third-party verification that a building project meets the highest green building and performance measures. All certified projects receive a LEED plaque, which is the nationally recognized symbol demonstrating that a building is environmentally responsible, profitable and a healthy place to live and work.

There are both environmental and financial benefits to earning LEED certification.

LEED-certified buildings:

- Lower operating costs and increased asset value.
- Reduce waste sent to landfills.
- Conserve energy and water.
- Healthier and safer for occupants.
- Reduce harmful greenhouse gas emissions.
- Qualify for tax rebates, zoning allowances and other incentives in hundreds of cities.
- Demonstrate an owner's commitment to environmental stewardship and social responsibility.

The Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ encourages and accelerates global adoption of sustainable green building and development practices through the creation and implementation of universally understood and accepted tools and performance criteria.



LEED is the US accepted benchmark for the design, construction and operation of high performance green buildings. LEED gives building owners and operators the tools they need to have an immediate and measurable impact on their buildings' performance. LEED promotes a whole-building approach to sustainability by recognizing performance in five key areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality.

Architects, real estate professionals, facility managers, engineers, interior designers, landscape architects, construction managers, lenders and government officials all use LEED to help transform the built environment to sustainability. State and local governments across the country are adopting LEED for public-owned and public-funded buildings; there are LEED initiatives in federal agencies, including the Departments of Defense, Agriculture, Energy, and State; and LEED projects are in progress in 41 different countries, including Canada, Brazil, Mexico and India.

LEED Rating Systems are developed through an open, consensus-based process led by LEED committees. Each volunteer committee is composed of a diverse group of practitioners and experts representing a cross-section of the building and construction industry. The key elements of USGBC's consensus process include a balanced and transparent committee structure, technical advisory groups that ensure scientific consistency and rigor, opportunities for stakeholder comment and review, member ballot of new rating systems, and a fair and open appeals process.

LEED Rating Systems

- New Construction. LEED for New Construction and Major Renovations is designed to guide and distinguish high-performance commercial and institutional projects. The LEED for New Construction Rating System is designed to guide and distinguish high-performance commercial and institutional projects, including office buildings, high-rise residential buildings, government buildings, recreational facilities, manufacturing plants and laboratories.
- Existing Buildings. LEED for Existing Buildings: Operations & Maintenance provides a benchmark for building owners and operators to measure operations, improvements and maintenance. LEED for Existing Buildings can be used to certify the following types of buildings:
 - o LEED-NC certified buildings seeking ongoing re-certification
 - o LEED for Existing Buildings certified buildings seeking ongoing re-certification LEED for Existing Buildings
 - o Non-LEED buildings seeking initial certification and ongoing re-certification

- Commercial Interiors. LEED for Commercial Interiors is a benchmark for the tenant improvement market that gives the power to make sustainable choices to tenants and designers.
The LEED-CI Rating System is applicable to tenant improvements of new or existing office space.
- Core & Shell. LEED for Core & Shell aids designers, builders, developers and new building owners in implementing sustainable design for new core and shell construction.
Scope of Construction
 - o LEED for Core & Shell can be used for projects where the developer controls the design and construction of the entire core and shell base building including MEP/FP systems, but have no control over the design and construction of the tenant fit-out. An example of this type of project is a commercial office building, medical office building, retail center, warehouse, or lab facility.
 - o LEED for Core & Shell can also be used for projects that have limited control of the building systems. This is often found in retail development. Projects with limited scope should review the specific credit requirements for guidance.
 - o In projects that are designed and constructed to be partially occupied by the owner/developer, there is clearly the ability of the owner/developer to directly influence the portion of the work that would typically be tenant interior construction. For projects of this type to utilize the LEED for Core & Shell Rating System, the owner/tenant must occupy 50% or less of the building's leasable space. Projects with greater than 50% of the building's tenant space occupied by a tenant/owner should utilize LEED-NC.
- Schools. LEED for Schools recognizes the unique nature of the design and construction of K-12 schools and addresses the specific needs of school spaces.
The LEED for Schools Rating System recognizes the unique nature of the design and construction of K-12 schools. Based on LEED for New Construction, it addresses issues such as classroom acoustics, master planning, mold prevention, and environmental site assessment. By addressing the uniqueness of school spaces and children's health issues, LEED for Schools provides a unique, comprehensive tool for schools that wish to build green, with measurable results. LEED for Schools is the recognized third-party standard for high performance schools that are healthy for students, comfortable for teachers, and cost-effective. The LEED for Schools Rating System is most applicable to new construction and major renovation projects in K-12 educational spaces. Other projects, such as university educational buildings, K-12 athletic facilities, or interpretive centers, may choose to use LEED for Schools if they wish.
- Retail. LEED for Retail recognizes the unique nature of retail design and construction projects and addresses the specific needs of retail spaces. IN PILOT
- Healthcare. LEED for Healthcare promotes sustainable planning, design and construction for high-performance healthcare facilities. - DRAFT
- Homes. LEED for Homes promotes the design and construction of high-performance green homes.
- Neighborhood Development. LEED for Neighborhood Development integrates the principles of smart growth, urbanism and green building into the first national standard for neighborhood design.

4.2.2 Japan - CASBEE (Comprehensive Assessment System for Building Environmental Efficiency)

For the Japan Sustainable Building Consortium (JSBC), CASBEE is intended for implementation of the environmental assessment based on new concepts including BEE (Building Environmental Efficiency).

There has been a growing movement towards sustainable construction since the second half of the 1980s, leading to the development of various methods for evaluating the environmental performance of buildings. Methods developed overseas include BREEAM (Building Research Establishment Environmental Assessment Method) in the UK, LEED™ (Leadership in Energy and Environment Design) in the USA, and GB Tool (Green Building Tool) as an international project. These methods have attracted interest around the world. This kind of assessment, with the publication of the results, is one of the best methods now available to provide an incentive for clients, owners, designers and users to develop and promote highly sustainable construction practices.

CASBEE was developed according to the following policies:

- 1) The system should be structured to award high assessments to superior buildings, thereby enhancing incentives to designers and others.
- 2) The assessment system should be as simple as possible.
- 3) The system should be applicable to buildings in a wide range of applications.
- 4) The system should take into consideration issues and problems peculiar to Japan and Asia.

Framework of CASBEE: CASBEE Family

As shown in the following figure, CASBEE was developed in the suite of architectural design process, starting from the pre-design stage and continuing through design and post design stages.

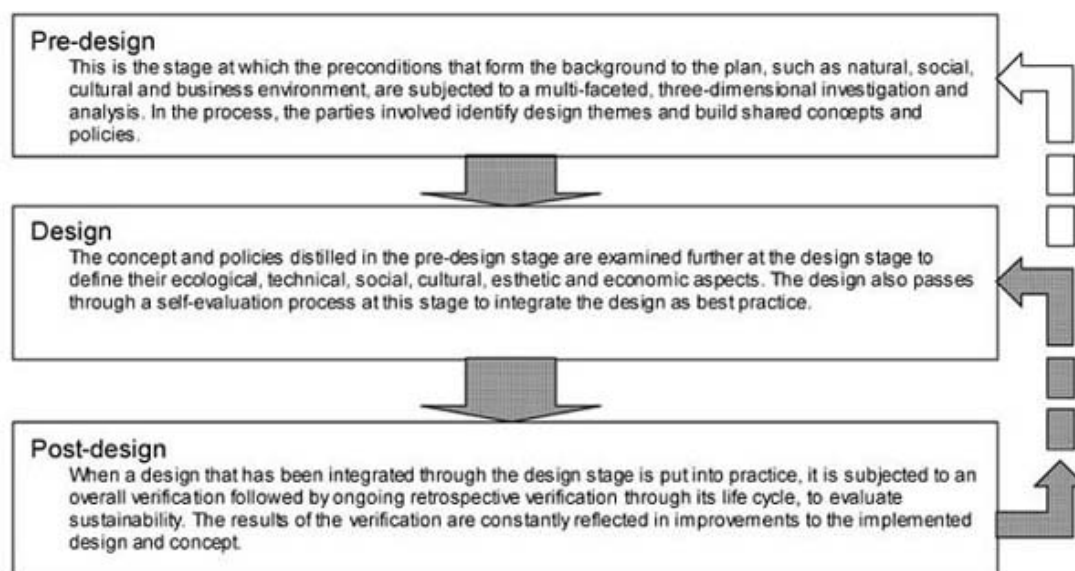


Figure 4.2: The cyclical process of building design

CASBEE is composed of four assessment tools corresponding to the building lifecycle. "CASBEE Family" is the collective name for these four tools and the expanded tools for specific purposes, which are listed below. The CASBEE assessment tools are CASBEE for Pre-design, CASBEE for New Construction, CASBEE for Existing Building and CASBEE for Renovation, to serve at each stage of the design process. Each tool is intended for a separate purpose and target user, and is designed to accommodate a wide range of uses (offices, schools, apartments, etc.) in the evaluated buildings.

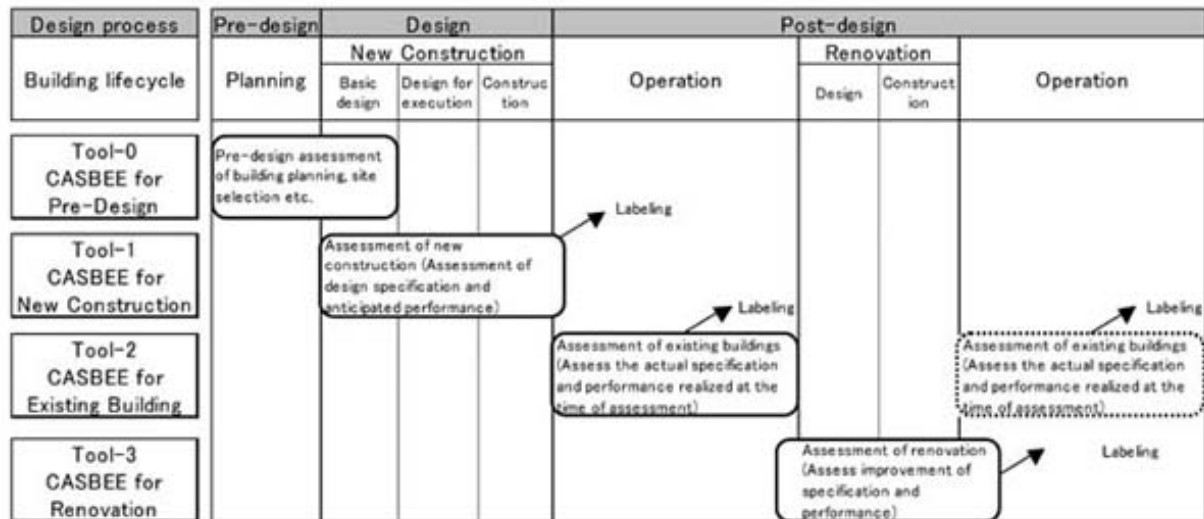


Figure 4.3: Building Lifecycle and Four Assessment Tools

Table 4.2: CASBEE - the four basic tools

Names	Abbreviation	Tool #
CASBEE for Pre-design (<i>underdevelopment</i>)	CASBEE-PD	Tool-0
CASBEE for New Construction	CASBEE-NC	Tool-1
CASBEE for Existing Building	CASBEE-EB	Tool-2
CASBEE for Renovation	CASBEE-RN	Tool-3

CASBEE for Pre-design (*underdevelopment*)

This tool aims to assist the owner, planner and others involved at the planning (pre-design) stage of the project. It has two main roles:

- 1) To assist in grasping issues such as the basic environmental impact of the project and selecting a suitable site.
- 2) To evaluate the environmental performance of the project at the Pre-design stage.

CASBEE for New Construction

This is a self-assessment check system that allows architects and engineers to raise the BEE value of the building under consideration during its design process. It makes assessments based on the design specification and the anticipated performance. It can also serve as a labeling tool when the building is subjected to expert third-party assessment. Remodeling and replacement construction are evaluated under "CASBEE for New Construction."

CASBEE for Existing Building

This assessment tool targets existing building stock, based on operation records for at least one year after completion. It was developed to be applicable to asset assessment as well.

CASBEE for Renovation

There is growing demand for building stock renovation, especially in Japanese market. In the same way as "CASBEE for Existing Building," this tool targets existing buildings. It can be used to generate proposals for building operation monitoring, commissioning and upgrade design with a view to ESCO (Energy Service Company) projects, which will be increasingly important in future, and for building

stock renovation. This tool is designed for ascertaining the degree of improvement (increased BEE), relative to the level that preceded renovation. Labeling is also possible by third-party agencies.

CASBEE for Specific Purposes

The basic CASBEE tool suite is applicable to a diverse range of individual applications.

(1) Application to buildings for short-term use

The tool "CASBEE for Temporary Construction (exhibition facilities)," published in July 2004, was developed as an extension to CASBEE for New Construction for evaluating temporary buildings constructed specifically for short-term use, such as Expo pavilions. Buildings of this type have short-term lifecycles, and therefore consideration must concentrate largely on material use and recycling in the construction and demolition phases. Also, these buildings have simple equipment and interior and exterior finishes. The scoring criteria reflect those features of this type of buildings. So far, the tool has been completed in a version limited to exhibition facilities.

The current version of CASBEE for Temporary Construction (exhibition facilities) targets buildings that have lifetime within 5 years. Scoring criteria are based on those for halls of CASBEE-NC, and some modifications are made as follows;

- 1) The scoring criteria of Q-1 Indoor environment is lowered for background noise, because simple exterior materials with poor performance in sound insulation are often installed in temporally buildings.
- 2) "Durability & Reliability" and "Flexibility & Adaptability" in Q-2 Quality of service are excluded from scoring criteria.
- 3) In LR-2 Resource & Materials, "3R (reuse, reduction and recycling) of building materials" and "Minimization of waste disposal" are evaluated as additional assessment items.
- 4) Weightings are altered to reflect the importance of resource recycle and waste reduction in this assessment system. LR-2 gains heavier weight and lighter weight is allocated for LR-1 Energy and Q-2 Quality of Service.

(2) Simple assessment

Assessment using CASBEE for New Construction may take 3-7 days, including the time required to prepare documents necessary as the basis for scoring. CASBEE for New Construction (brief version) was developed to meet the growing need for a tool to handle objectives such as those below. It makes a simplified, provisional assessment possible in around two hours (excluding time for the preparation of an Energy Saving Plan).

- 1) The need for simplified setting of the Building Environmental Efficiency level (as a tool for consensus forming between owners, designers and builders, etc.).
- 2) The need for setting environmental design targets and assessing attainment (as a proposal management tool etc. under ISO14001).
- 3) The need for preparation of documents for submission to government agencies, etc. (Environmental measures under construction administration, such as CASBEE Nagoya and CASBEE Osaka).

(3) Consideration for regional character

As noted above, CASBEE for New Construction (brief version) can be used by local authorities in construction administration. Local authorities that use this tool can tailor it to local conditions, such as climate and prioritized policies. Changes are generally made by modifying the weighting coefficients. Such assessment can be made mandatory in the same way as an Energy Saving Plan, to be submitted to the authorities together with the building approval application, as a way to improve the environmental efficiency of buildings in the region. Flexible response to regional character is a common feature of all elements of the CASBEE family.

One example is "CASBEE Nagoya." CASBEE Nagoya has its own scoring guidelines that instruct some criteria in relation to local contexts, such as materials from local industry, and that define some excluding criteria. After CASBEE Nagoya began on April 1, 2004, the city received about 30 reports as of the end of July, and most of those buildings were labeled as class "B-" or "B+." Also almost no

confusion was reported to the municipality over the operation of the system (Noda, 2004). It shows that the system effectively works for local application, so far.

Another example is CASBEE Osaka that altered weighting coefficient from the original to reflect the high priority they give to heat island policy. The city of Osaka also started administrative use of CASBEE from October 1, 2004, changed the weights of Q-1 Indoor environment from 0.4 to 0.3 and Q-3 Outdoor environment on site from 0.3 to 0.4.

(4) Detailed assessment of heat island impact

Assessment of the heat island effect is essential in major urban areas, such as Tokyo and Osaka. CASBEE-HI (CASBEE for Heat Island Relaxation) was developed to assess efforts in buildings to alleviate the heat island effect. Its role is to make a more detailed and quantitative assessment of the heat island-related assessment items included in the basic tools.

(5) Extended tool for regional scale assessment

CASBEE considers individual buildings, but it fully recognizes the importance of assessing building groups. Many recent city-center redevelopment projects have included plans taking into account the urban surroundings as one unit. For example, provision of public spaces on the site can be expected to have a positive effect on the surrounding environment, thereby improving environmental quality and performance (Q). Common restrictions imposed on all buildings on a site, even if each one has a different owner, can be regarded as efforts to improve the environmental performance of the urban area as a whole.

CASBEE-UD (CASBEE for Urban Development) was developed to assess the efforts of city-center renewals in urban districts or development of large areas including multiple buildings.

(6) Assessment tool for detached houses

CASBEE's basic tools can assess a large apartment house, but not a small detached house. CASBEE for Home (Detached Houses) has been developing to assess detached houses.

Table 4.3: Expansion of CASBEE for specific purposes

Basic tool	Application	Name	Outline
CASBEE for New Construction	Temporary	CASBEE for Temporary Construction	Currently adapted to exhibition facilities.
	Simple preliminary assessment	CASBEE for New Construction (brief version)	Simplified edition of CASBEE for New Construction.
	For individual areas	-	CASBEE for New Construction (brief version), tailored to regional characteristics
Assessment on the efforts in alleviating the heat island phenomenon		CASBEE-HI	Detailed assessment of the heat island effect using CASBEE
Assessment on the efforts of regional scale development		CASBEE-UD	Mainly assesses outer space excluding buildings in the large development area.
Assessment for a detached house (underdevelopment)		CASBEE-H (DH)	CASBEE for Home (Detached Houses), tailored to detached houses

The assessment method employed by CASBEE

Two Categories of Assessment: Q and L

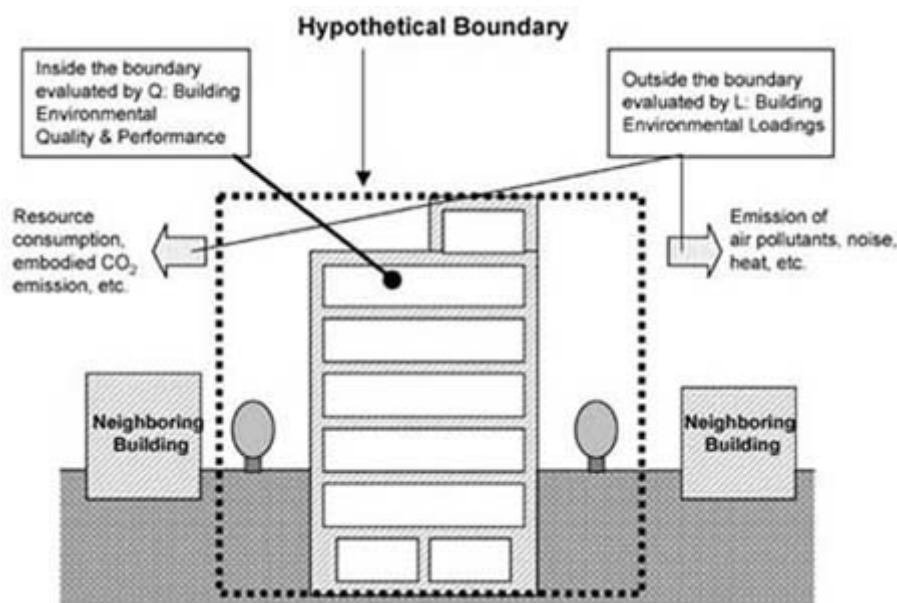
Under CASBEE there are two spaces, internal and external, divided by the hypothetical boundary, which is defined by the site boundary and other elements, with two factors related to the two spaces. Thus we have put forward CASBEE in which the "negative aspects of environmental impact which go beyond the hypothetical enclosed space to the outside (the public property)" and "improving living amenity for the building users" are considered side by side. Under CASBEE, these two factors are defined below as Q and L, the main assessment categories, and evaluated separately.

Q (Quality): Building Environmental Quality & Performance:

Evaluates "improvement in living amenity for the building users, within the hypothetical enclosed space (the private property)".

L (Loadings): Building Environmental Loadings:

Evaluates "negative aspects of environmental impact which go beyond the hypothetical enclosed space to the outside (the public property)".



Four Target Fields of CASBEE and Its Rearrangement

CASBEE covers the following four assessment fields: (1) Energy efficiency (2) Resource efficiency (3) Local environment (4) Indoor environment. These four fields are largely the same as the target fields for the existing assessment tools described above in Japan and abroad, but they do not necessarily represent the same concepts, so it is difficult to deal with them on the same basis.

Therefore the assessment categories contained within these four fields had to be examined and reorganized. As a result, the assessment categories were classified as shown in Figure 5 into BEE numerator Q (Building environmental quality and performance) and BEE denominator L (Reduction of building environmental loadings). Q is further divided into three items for assessment: Q1 Indoor environment, Q2 Quality of services and Q3 Outdoor environment on site. Similarly, L is divided into L1 Energy, L2 Resources & Materials and L3 Off-site Environment.

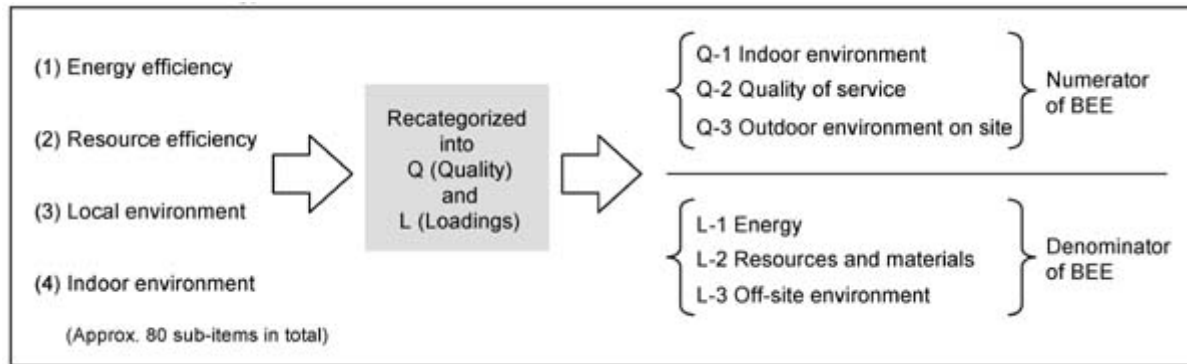


Figure 4.4: Classification and rearrangement of assessment items into Q (Building environmental quality and performance) and L (Building environmental loadings)

Environmental Labeling Using Building Environmental Efficiency (BEE)

As explained above, BEE (Building Environmental Efficiency), using Q and L as the two assessment categories, is the core concept of CASBEE. BEE, as used here, is an indicator calculated from Q (building environmental quality and performance) as the numerator and L (building environmental loadings) as the denominator.

$$\text{Building Environmental Efficiency (BEE)} = \frac{\text{Q (Building environmental quality and performance)}}{\text{L (Building environmental loadings)}}$$

The use of BEE enabled simpler and clearer presentation of building environmental performance assessment results. BEE values are represented on the graph by plotting L on the x axis and Q on the y axis. The BEE value assessment result is expressed as the gradient of the straight line passing through the origin (0,0). The higher the Q value and the lower the L value, the steeper the gradient and the more sustainable the building is. Using this approach, it becomes possible to graphically present the results of building environmental assessments using areas bounded by these gradients (Eco-labeling). The figure shows how the assessment results for buildings can be labeled on a diagram as class C (poor), class B-, class B+, class A, and class S (excellent), in order of increasing BEE value.

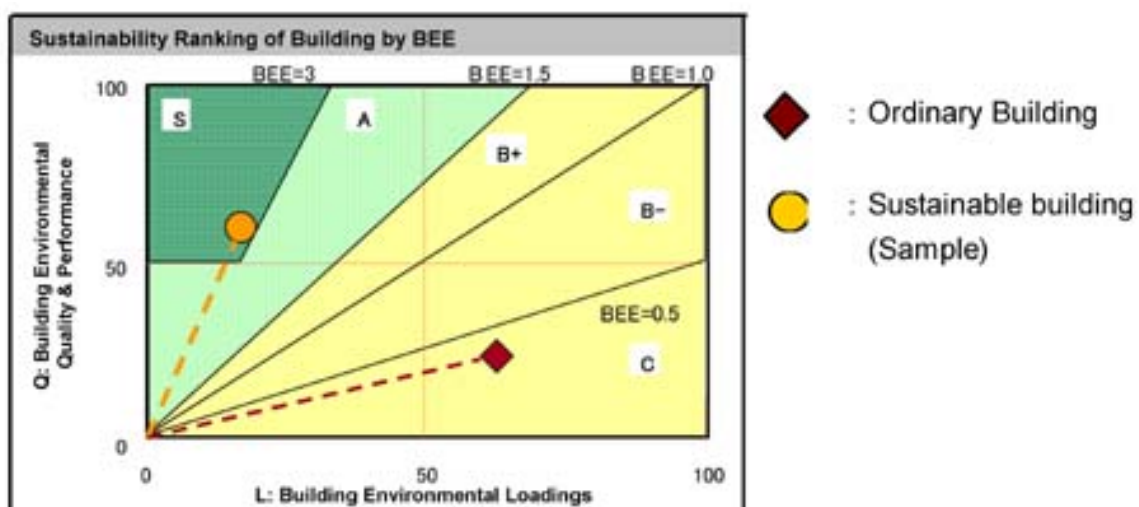


Figure 4.5: Environmental Labeling Based on Building Environmental Efficiency (BEE)

4.3 FURTHER INITIATIVES IN THE FIELD OF CONSTRUCTION SECTOR

[\(Cutaia\)](#)

4.3.1 UNEP - SBCI (Sustainable Buildings and Construction Initiative)

SBCI is a global partnership between UNEP and worldwide leading companies to promote and support sustainable solutions in the building and construction sector.

The objective of the SBCI initiative is to promote a worldwide adoption of sustainable buildings and construction practices; SBCI is implementing a process in 4 steps.

STEP 1 - Provide a common platform for the stakeholders

SBCI provides a common platform to all buildings and construction stakeholders for addressing sustainability issues of global significance, especially climate change.

STEP 2 - Establish baselines

SBCI establishes globally acknowledged baselines based on the life cycle approach, with a first focus on energy efficiency and CO2 emissions.

STEP 3 - Develop tools and strategies

SBCI will develop tools and strategies for achieving a wide acceptance and adoption of sustainable building practices throughout the world.

STEP 4 - Implementation through pilot projects

SBCI promotes to key stakeholders the adoption of the above tools and strategies which will be evaluated through pilot projects

SBCI focus areas

Focus 1 - Qualify buildings and construction activities as eligible activities for support under the flexible mechanisms of the Kyoto protocol.

In particular:

1. Identify barriers to including buildings and construction activities as eligible activities under the flexible mechanisms.
2. Identify requirements for overcoming these barriers
3. Develop tools, methodologies, and projects necessary to achieve the above requirements.

Focus 2 - Develop and promote economic incentives for a life cycle approach (LCA) in design, construction and financing of buildings, so as to create market conditions favourable to buildings that are optimized from a life cycle perspective.

1. Identify existing public sector finance mechanisms that stimulate and increase investment in sustainable buildings, both in the design and operation phases.
2. Evaluate the impact these mechanisms have had on mobilizing investment in sustainable buildings, particularly where these have leveraged private sector investment
3. Explore if and how successful mechanisms can be adapted and replicated in other national and local contexts.

An additional/alternative Focus Area proposed is:

- Identify and promote best practices for design, building, maintenance, renovation and demolition of buildings, with the aim to promote a worldwide baseline for the concept of "sustainable building".

SBCI is planning to establish a working group on **Global Benchmarks for Sustainable Buildings and Construction**.

4.3.2 iiSBE - International Initiative for a Sustainable Built Environment - Green Building Challenge

iiSBE is an international non-profit organization whose overall aim is to actively facilitate and promote the adoption of policies, methods and tools to accelerate the movement towards a global sustainable built environment. iiSBE has an international Board of Directors from almost every continent and has a small Secretariat located in Ottawa, Canada.

Our specific objectives include the following:

- Map current activities and establish a forum for information exchange on SBE initiatives for participating organizations, so that gaps and overlaps may be reduced and common standards established;
- Increase awareness of existing SBE initiatives and issues amongst non-participating organizations and in the international user community;
- Take action on fields not covered by existing organisations and networks.

Activities

- networking; helping specialists and generalists to get to know each others' abilities and needs. This occurs formally through our databases and newsletter, and informally through every-day e-mails;
- managing and providing technical support for the international Green Building Challenge (GBC) process, which involves over 15 countries in the development and testing of a rating tool for buildings. This work has led to the development of a performance rating tool called GBTool, which is unique in its ability to adopt to local needs and conditions. See <http://www.iisbe.org> for details;
- The Sustainable Building Information System (SBIS), a web-based database of international R&D information relating to sustainable building, has been successfully launched, and is attracting users from around the world - see www.sbis.info;
- a web-based database called the Skills Registry, which features a searchable file of the skills and experience of individuals and organizations.

Associate Membership brings the following benefits: Full access to the Sustainable Building Information System (SBIS) <www.sbis.info>. This database provide users with full access to over 1,200 documents relevant to sustainable building, all searchable and downloadable in PDF format.

Green Building Challenge 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.

Green Building Challenge 2005 / SB05 is a continuation of the GBC '98 - 2002 process and a multi-year period of review, modification and testing of the GBC Assessment Framework and Green Building Tool (GBTool) - the operational software for the assessment framework.

The assessment framework and software used to assess the selected projects was developed by a team of international experts under the direction of an International Framework Committee. The process began in 1996 and will continue until at least the SB05 Tokyo conference.

The current GBC'05 version of GBTool in Microsoft Excel format (under the working name of GBTool-Sep29) is available with the integrated manual at the Downloading area (once you are there after registering).

The core assessment framework has been adapted by national teams to the conditions of their own countries and regions. The regionally adapted systems reflect issues such as regional energy and environmental priorities, cost-effectiveness and urban planning issues.

Each national GBC team selects case study buildings to be assessed according to the GBC framework, and to be presented at the SB-series of international conferences. Buildings assessed are selected by national teams to represent at least "Good Practice" and to provide a good learning experience for the respective national industries. National teams gather information about these buildings, including a detailed physical characterization, a description of the process followed in its design, construction and operation and planned building operation procedures. The teams undertake energy simulations using accepted computer programs like DOE-2 or EE4 (in Canada).

The three general goals for the Green Building Challenge process were:

- 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.

These goals reflect the acknowledged success of the GBC process in having significantly increased the understanding of building environmental assessment through international collaboration. In addition to the above general goals, two specific objectives of GBC 2002 and GBC 2005 processes are:

- To develop an internationally accepted generic framework that can be used to compare existing building environmental assessment methods and used by others to produce regionally based industry systems.
- To expand the scope of the GBC Assessment Framework from green building to include environmental sustainability issues and to facilitate international comparisons of the environmental performance of buildings.

Other objectives are:

- To test new methods of assessing building performance
- To showcase "best-practice" examples of green buildings around the world
- To document the successful elements of individual green buildings
- To offer direction to participating countries in the development of regionally-sensitive assessment models
- To promote an international exchange of information, ideas and green building technologies.

The GBC is an evaluation method that can be suited to local conditions in which it is applied (climate, economic and cultural, environmental priorities, etc. ...) maintaining the same terminology and basic structure.

GBC is a tool that allows the evaluation of the environmental impact of construction (residences, offices and schools, new or renovated) throughout the entire life cycle by allocating a score to the building performance to obtain a quality classification. The GBC, started in 1996, is the result of

studies of a worldwide network, currently composed by public and private institutes and research bodies of 24 different countries.

The environmental indicators of sustainability are four:

- ✓ ESI-1: Annual consumption of primary energy
- ✓ ESI-2: Land consumption for the construction
- ✓ ESI-3: Annual consumption of water
- ✓ ESI-4: Annual air-emissions

The process is conducted by the International Framework Committee and is coordinated by the International iISBE (www.iisbe.org).

STRUCTURE

Area performance evaluation

Consumption of resources	Mandatory
Environmental loads	
Quality of indoor environments	

Quality of service	Optional
Economy	
Management	
Transport	

Scores

The building receives a score which can vary from -2 to +5, according to the environmental performance compared to each criteria and sub-criteria

Low Performance	-2
Benchmark - Basic Performance (Regulations, practices constructive)	0
Current best practice constructive	+3
Ideal Performance	+5

4.3.3 GB Tool

GBTool is the software implementation of the Green Building Challenge (GBC) assessment method that has been under development since 1996 by a group of more than a dozen countries. The GBC process was begun with Natural Resources Canada, but responsibility was handed over to the International Initiative for a Sustainable Built Environment (iISBE) in 2002. The generic software is modified by national teams to suit their local conditions, and is then tested on case study buildings. Currently, some 15 countries are involved in preparing assessments that will be exhibited at the global Tokyo SB05 conference in late September 2005.

GBTool 2005 (GBTool-A, GBTool-B) implemented on an Excel spreadsheet is available for downloading for academic or research purposes.

Users of this software should be aware of the following limitations and conditions:

- The system is a framework, not a simulation model. Users are expected to use other software tools to simulate energy performance, estimate embodied energy and emissions, predict thermal comfort and air quality etc.
- An important design feature of the system is that the characteristics of a Design are compared to Benchmark values, and that the features of the Design are then scored and weighted. Results are meaningless unless the given national team has first established the benchmark values, adjusted scoring guides and adjusted the weights, so they are relevant to its region.
- The current version of the system is GBTool 2005.

Features include:

- Covers a wide range of sustainable building issues, not just green building concerns;
- Allows assessments to be carried out at all stages of the life-cycle and provides benchmarks suited to each phase;
- Enables architects to carry out self-assessments of their designs, and enables third parties to provide certification of operational performance;
- Allows third parties to establish weights to reflect the varying importance of issues by occupancy type in each region;
- Allows generic benchmarks to be replaced by local ones, in local languages;
- Handles up to three building types, separately or in a mixed-use project;
- Handles new and existing construction, or a mix of the two;
- Allows comparisons to be made with LEED and Green Globes.

4.3.4 Annex 31

Annex 31 is a project established under the auspices of the International Energy Agency's (IEA) Energy Conservation in Buildings and Community Systems Programme.

Annex 31 examines how energy and life cycle assessment (LCA) tools and methods can be used to reduce the energy-related impact of buildings on interior, local and global environments.

As the need to address environmental concerns such as resource depletion and greenhouse gas emissions become more pressing, the concepts, tools, case studies and practical considerations in Annex 31 present an invaluable information resource.

The report of the Annex 31 project "Energy-Related Environmental Impact of Buildings" is based on the research findings of the fourteen participating countries. The report includes a directory of current tools, a description of tool theory and methods, and research reports on how tools perform. Annex 31 reports may be of interest to users of tools, to groups engaged in tool design, and to anyone establishing policy and guidelines for promoting better decision-making within the building sector.

Interesting seems to be the Directory of Tools, a Survey of LCA Tools, Assessment Frameworks, Rating Systems, Technical Guidelines, Catalogues, Checklists and Certificates.

Improving the environmental performance of buildings and building stocks is best accomplished using tools as decision-making aids. Many countries now have a variety of tools that have been tailored for use by specific users and to fill particular analytical needs. The purpose of this survey is to provide a quick overview of the tools that are currently available or that are soon to be released. Each tool is described in terms of its functions, audience, users, software application and technical support, data requirements, strengths, availability and contact information.

4.3.5 The LEnSe project

The LEnSe project (Methodology Development towards a Label for Environmental, Social and Economic Buildings), is supported by the European Commission within the Sixth Framework Program, started in 2006 and stopped in december 2007.

The results of the LEnSe project have been presented in Brussels the last 4 march 2008 (The LEnSE project results - A basis for a European label? - LEnSE Strategic Workshop - 4 March 2008 - European Commission).

LEnSe project seems to be interesting in relation with the European Ecoabel as reported in the conclusions and future expectations of the projects themselves (from the presentation of K. Putzeys):

Conclusions - Strong points

- The strategic consultation process
 - ✓ National, European and international experts involved
 - ✓ Wide interest from construction industry stakeholders
- The double role of the methodology
 - ✓ assess the building against sustainability
 - ✓ identify areas of future improvement (especially when used at the conception or early design phase of the building).
- The development and testing of "pioneering" assessment methods for previously undeveloped issues (social & economic)

The future (1)

- The LEnSE project results are finalised
 - ✓ Integrate LEnSE approach in existing methods/tools?
 - ✓ Continued (European) research?
 - Reduce time needed for data collection & complexity of data required
 - Take scale and other parameters of individual projects into consideration - more building types - develop corresponding benchmarks
 - Development of remaining sub-issues - assessment methods and benchmarks
 - Weighting factors or alternative approach

The future (2)

- European Standardisation?
 - » CEN TC350 Sustainability of Construction Works
 - ✓ Currently: quantifiable environmental issues
 - ✓ Commitment to standardise social and economic assessment of buildings (pre-activation of work items)
 - ✓ On-going discussion on what to include in social and economic pillar of sustainability
- LEnSE could serve as a starting point for Standardisation.

The future (3)

European labelling scheme?

- » EU Ecolabel exists for products
- » Similar initiative for sustainability label for buildings?
 - ✓ Could start from LEnSE methodology
 - ✓ Could use organisational structure from EU Ecolabel
 - ✓ Could be promoted by EC and national governments

European label has potential for large impact on the construction sector

European label could be used throughout Europe as a policy tool (target setting, financial incentives, ...).

LEnSE is a European research project that responds to the growing need in Europe for assessing a building's sustainability performance. The project draws on the existing knowledge available in Europe on building assessment methodologies.

The main objective of LEnSE is to develop a methodology for the assessment of the sustainability performance of existing, new and renovated buildings, which is broadly accepted by the European stakeholders involved in sustainable construction.

This methodology will allow for future labelling of buildings, in analogy with the Energy Performance Directive. The work should result in increased awareness of the European stakeholders and will allow adequate policy implementation on sustainable construction.

The objectives of the LEnSE project have been translated into 4 work packages:

- ✓ WP1 - The identification of issues and scope definition
- ✓ WP2 - Development of a sustainability assessment methodology
- ✓ WP3 - Consultation and communication with stakeholders
- ✓ WP4 - Project management, meetings and quality assurance.

The benefits of external expertise in the LEnSE project will be

- ✓ To get the involvement of key stakeholders in the development of the assessment methodology
- ✓ To get input from different viewpoints (social / economic..)
- ✓ To create awareness about the LEnSE project
- ✓ To guarantee wide acceptance by stakeholders
- ✓ To ensure that overall sustainability will get priority in national issues

The benefits for the experts' to be involved in LEnSE are:

- ✓ Receiving first-hand information about European harmonisation of sustainability assessment
- ✓ Establishing contacts with other stakeholders on national and international level
- ✓ Being able to co-operate in testing the assessment methodology
- ✓ Creating future co-operation possibilities for implementing the LEnSE methodology in practice

5. LCA and environmental aspects

5.1.1 Foreword

(Neri)

The building is a product having a life cycle with a period that depends on the durability of materials and equipment that are in a construction phase, a use phase and a disposal phase (end of life).

The **construction phase** considers the works of urbanization primary and secondary, the supply of raw materials, production of materials, the implementation on site of materials and technology components necessary to build.

The **use phase** considers the consumption of energy needed for heating for the winter and summer conditioning. These depend on the climate zones in which the buildings are constructed. For this reason it is not possible to compare the environmental impact of two structures located in different climatic zones. One of possible solutions is to consider the total energy consumption as well as defining various types of buildings including several climatic bands (according to principles adopted by legislation for energy certification for buildings).

In the use phase it has to be considering also use energy consumption for heating water, electricity for lighting and the use of appliances, water consumption and consumption of energy (heat or electricity) for cooking food. Most of these consumptions depend on the needs and the manner of use by residents of the addition to the functions of use (residential, office, public use as museums, libraries, etc...), and not the building itself.

Use phase of a building comprises **maintenance**, which often depends on the durability of the materials with which it is built: it is related both with construction materials (painting, remaking plaster, etc...), then with materials and components of plants (replacement boilers, etc...).

The use phase also includes indoor emissions coming from building materials (paints), from windows and doors (paints, ...), air ventilation, combustion gas for cooking food, appliances (e.g. ventilation from computers and photocopiers).

A sustainable end of life of a building consists in a selective demolition with the separation of components of different materials (bricks and cement, metals, wood) for reuse or recycling, or, as last choice, incineration and landfilling.

The boundaries of the building system ranging from production of raw materials and energy, emissions and wastes from the use phase (emission combustion of fuels for electricity and heat, sewage), the EoL phase with the treatment of separate components.

5.2 LCAs OF BUILDINGS

(Fiore, Cutaia)

5.2.1 The building sector and LCA

The building material industry, energy and water use of the households and the more-or-less permanent occupation of land are building, construction and operation services-related factors that constitute a dominant part of the total environmental impact caused by society. The building sector, including housing, constitutes 30-40% of the society's total energy demand and approximately 44% of the total material use. Consequently, the building sector has to be prioritised to be able to reach a sustainable society within a reasonable period of time. This is essential, especially when the long service life of constructions and the pace of research and development within the building sector is considered which make it time consuming to implement the necessary changes to improve the environmental performance of the building sector.

Life cycle assessment (LCA) is applicable on all system levels in the building sector.

Given the complexities of interaction between the built and the natural environment, life cycle assessment (LCA) represents a comprehensive approach to examining the environmental impacts of an entire building. LCA is a process whereby the material and energy flows of a system are quantified and evaluated. Typically, upstream (extraction, production, transportation and construction), use, and downstream (deconstruction and disposal) flows of a product or service system are inventoried first. Subsequently, global and/or regional impacts are calculated based on energy consumption, waste generation and other impact categories (e.g. global warming, ozone depletion, nutrification and acidification).

LCA in the construction industry is less developed today than in other industries, but appears to be developing quickly. For example, someone assess the impacts of different structural materials, and the relative impacts of embodied and recurring energy. More recently some studies have taken a full-life-cycle approach to buildings. Much previous research has focused on determining primary energy consumption for embodied energy of materials, independent of their application. Other research has examined the relationship between embodied energy in construction materials (initial and replacement) and operational energy, or the role of construction materials on global warming.

Given the data intensity of LCAs, it is understandable that only recently has software emerged which attempts to incorporate LCA methods into the design and analysis of buildings. However, because of continuing data limitations, and due to the large range of construction techniques and material choices, none of these tools are currently capable of modeling an entire building, or computing the environmental impacts from all life cycle phases and processes.

Two major approaches of LCA for construction applications can be lined out: a bottom up approach focusing on building material selection, etc. and a top down approach that consider the entire building as a starting point for further improvements. In the first case, if the operation phase shall be included, the environmental impact from the operation phase has to be estimated in relation to a generic context and then distributed down to the building material or the building component level.

LCA can also be implemented to cover an evaluation of an entire sector and has been utilised by the Swedish building sector to describe the impacts and possible improvements in relation the Swedish environmental quality goals.

The use of LCA, in the way described above, identifies a need to describe different aspects of concern to be able to execute accurate assessments of the environmental impacts associated with the physical building, its utilisation and aspects related to adjacent external systems. LCA has, in this matter, been identified as a strong tool that has the opportunity to be a scientifically established method for generation of the necessary decision support.

5.2.2 Tools and methodologies

A number of LCA tools with a clearly described methodology and that currently are in use, have been identified in order to evaluate the practice of today regarding generic LCA methodology for buildings. Here are not included methods that are still under development and methods that are not published. Furthermore, the tools are chosen based on an aspiration towards including global trends regarding feasible LCA methodology approaches for the building sector. These selection criterions resulted in the following tools and methodologies to describe the current practice:

- ATHENA Sustainable Materials Institute, "ATHENA",
- BRE, "Envest",
- IVAM, "Eco-Quantum 3",
- SBI, "BEAT 2000",
- US EPA, "BEES".

The difference in approach between the tools/methodologies listed above is that the majority of the tools are developed based on a bottom up approach, i.e. a combination of building materials and components sums up to a building. This even though they are designed to consider the whole building including energy demand, etc. The only tool that is based on a top down approach is the Envest tool, which is a tool explicitly developed for use in the design phase of a building project.

The starting point of the assessment in Envest is to choose the shape of the building and then gradually work your way down through the construction to the choice of materials in the frame and infill walls etc. The BEES tool differs in usefulness for whole building assessments, while it is designed for decision support in material choice situations. This distinction between the tools is supported by e.g. the classification of tools made by the ATHENA Sustainable Materials Institute, i.e. that ATHENA, Eco-Quantum and Envest are level 2 tool (whole building decision support tools) while BEES is a level 1 tool (Product comparison tools). BEAT 2000 is not mentioned in the by ATHENA introduced assessment tool classification system, but the characteristics and intended use of BEAT 2000 is similar to ATHENA, Eco-Quantum and Envest.

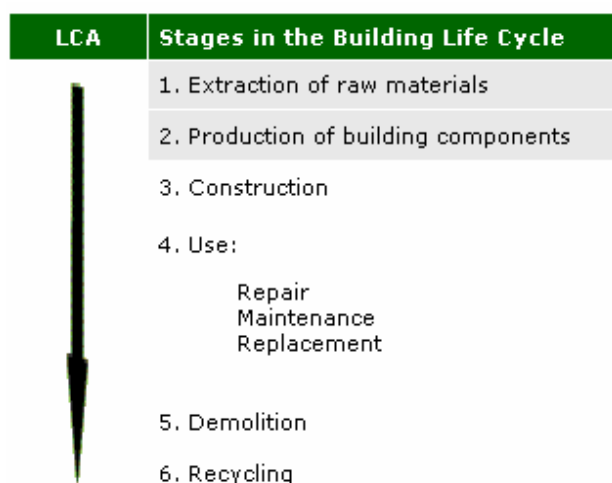


Figure 5.1: The Envest model

5.2.3 Flexible LCA methodology: sequential life time and integrated service system

When the environmental performance of constructions and operations are to be assessed is necessary to have flexible methodology approaches. In fact, for example, the environmental performance of a building is not only dependent on the geographical location based on energy use considerations, but also due to requirements on the design of the foundation and logistic context.

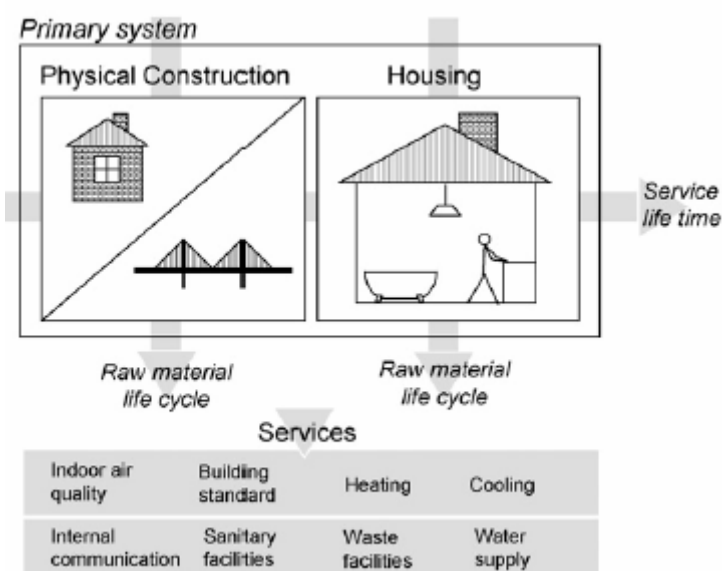
LCA for buildings is often performed as a *linear life cycle* including life-cycle phases such as construction, operation (including maintenance), ending with a demolition and waste treatment phase. This kind of linear thinking is not valid for most buildings in reality and will not be applicable for rebuilding in particular, since this life-cycle phase, i.e. rebuilding, then automatically will not be included.

Therefore, *sequential life-cycle thinking* has to be introduced. The sequential life-cycle of a physical construction can be divided in different activities such as construction, maintenance, rebuilding, extension, operation and “end-of-life scenarios” e.g. including demolition and material recycling, while operation can more or less be compared to a continuous process. The basis behind the sequential life-cycle approach is that the different life-cycle phases should be treated separately in the life-cycle inventory analyses.

Depending on the actual boundary conditions it is then possible to add up the sufficient life-cycle phases corresponding to the goal and scope definition. However, for benchmarking it could always be argued that a normative linear life-cycle always should be presented to illustrate what happens

if a linear life-cycle should be valid. The sequential life-cycle modelling and boundary setting allow the practitioner to add the life-cycle phases that are found convenient and necessary in respect to the goal and scope definition in the particular case study. Consequently concerning rebuilding, etc., the existing construction parts such as the bearing building frame optionally can be regarded as a sunk cost, which is found adequate for e.g. rebuilding.

To make a flexible modelling structure available for construction services a *primary system* is introduced, constituted by two subsystems equal to the *physical construction* and with the construction related housing or in more generally terms *operation*.



The primary system with the functional output defined as services—rather than products. Two life-cycles approach are valid for the physical building and related operation namely the over all service lifetime and the life-cycle for utilised activities indicated as “raw material life-cycle” in the figure.

The primary system is defined by the *services* that are included and considered in each LCA case study and according to LCA terminology *services* will be included in the functional unit. The systems for both the physical construction and operation include related up and down stream activities. Examples of related up and down stream activities in the case of operation systems are heating, ventilation and water supply. When houses, offices, service buildings, etc. are considered, it will be hard to make a sharp distinction between which environmental impacts that originate in the characteristics of the analysed building and which originate in the behaviour of the users of the building. This kind of aspects is not needed to take into account if the functional unit is based on the building service level rather than the physical building itself. The operation is “building related operation”, which means that the environmental performance of an activity must be influenced by the utilisation of the building or dependent on the design of the building. A consequence of this definition of operation is that e.g. the transportation of tenants to and from a building and other facilities are not included in the operation service, since it is not related to the utilisation of the building as such or effected by the design of the construction.

5.2.4 Two different approaches to apply LCA for buildings and operation

A building is usually produced with a defined final utilisation in mind. Since both the building and its utilisation will change over the time, the integrated products must be regarded as a dynamic system with potentially different functional outputs over time. The physical structure of a building, however, can often be regarded as a simple product in relation to the service that the building

satisfies in the society. The problem is to define a functional unit that covers the building as a dynamic system, including all services that the building provides. For example, the service that a construction provides is the function of housing, for which it will always exist a demand. An LCA in this context should cover the performance functional demand for housing that the building shall fulfil, rather than the physical building in itself as a separate entity. This alternative viewpoint makes it logic to distinguish between two approaches to apply LCA for buildings and operation:

- *Alternative Product Evaluation* (APE) corresponds to the original application of LCA described in ISO 14040, which means that the quantified functional outputs of a product system (or service) is described by a functional unit that works as a fix reference unit. Different products that satisfy the defined functional unit are then evaluated regarding their environmental performance.
- *Environmental Functional Demand* (EFD) is based on a quota decided in advance that is equal to a acceptable environmental impact divided by the function output. A number of such, in advance decided, quotas are then set up as goals and as such constitute the starting point for the assessment procedure. Different tecnica solutions that satisfy the quota are then identified, refereed to as inventory profile or environmental profile (if the characterised figures are utilised).

The intended application and benefit of the two approaches is illustrated by the following statements representing the questions that the two approaches can satisfy:

EPE—What is the environmental impact associated with the activity of driving different vehicles 1 km carrying 1 tonne of goods?

EFD—What vehicles can be utilised for carrying 1 tonne of goods 1 km if the acceptable environmental consequence is restricted to a certain environmental impact?

The EPE approach for definition of a functional unit for buildings is congruent with the view on functional unit for buildings presented in the SETAC Report “LCA in building and construction”². This way of introducing LCA for buildings and constructions imply that the functional outputs are given as a fixed values and that they are the starting point of a comparison. In the SETAC report there are a series of examples of “building performance characteristics”, which should be used to be able to assess the true functional equivalence of buildings and constructions over the expected service life of a building or a construction and the choice of characteristics are dependent on the goal of the study. Examples of proposed characteristics, are conformity, location, indoor conditions, service life and deterioration risks, adaptability, safety and comfort.

5.2.5 Interconnections between building sector and society: choice of the analysed system boundaries

The building sector cannot be regarded as an autonomous subsystem without interconnections to the rest of society. The building sector is essential as a foundation of society and interconnects with almost all other sectors and functions of society. This implies that assessments of buildings and other constructions or building sector related activities could not always be treated as a marginal change problem without consequences on the demand for new technologies in adjacent sectors such as the energy sector. Thus, e.g. the energy sector has to be included in a study due to the fact that it is affected by changes in the building sector. The energy sector is defined as a *foreground process*. LCA, however, can handle both *retrospective assessments*, e.g. assessments of existing constructions, and *prospective assessments*, e.g. assessments of alternative constructions in the design phase including systems affected by the design such as the energy sector. In a generic LCA methodology for buildings, system expansion must be regarded as an optional choice to study

² SETAC. LCA in building and construction—A state-of-the-art report of SETAC-EUROPE. Sittard, Holland: Intron, BV, 2001.

marginal effects on externalities e.g. increased electricity supply. A comparison between a retrospective and a prospective assessment gives that a prospective assessment, including marginal technologies, gives additional information in order to put attention on and minimise the potential risk for sub optimisation in the studied primary system. Therefore, when analysing buildings, it has been found convenient to define a primary system that covers the subsystem equal to the physical construction and the utilisation of the construction and facilities related to it, referred to as the subsystem operation in the figure below.

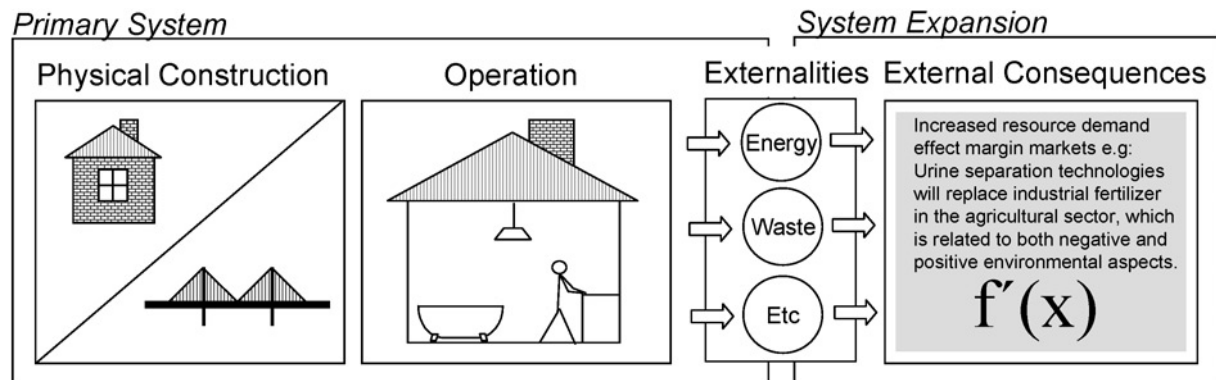


Figure 5.2: The conceptual approach utilised to describe the construction and operation function, divided in a primary system and an optional system expansion.

Therefore, when analysing buildings, it has been found convenient to define a primary system that covers the sub system equal to the physical construction and the utilisation of the construction and facilities related to it, referred to as the subsystem operation. The services all together will then in each case study correspond to the system boundaries valid for the primary system, which corresponds to "foreground system", or "foreground process" as mentioned above, in that sense that the influence of design, tenant behaviour and externalities is very central for the over all studied construction and operation function. Therefore, as an optional choice for a service related to the primary system, it is always possible to work with the concept of prospective assessment in order to evaluate external consequences caused by a changed behaviour in the building sector regarding other systems such as energy supply or wastewater handling.

5.2.6 Topics used to characterise different LCA systems applicable for buildings

In order to characterise different LCA concepts utilised for buildings, a number of different building related topics, that can be considered, have to be introduced. The goal is to find out how far the development and implementation of LCA for buildings has come so far. The topics are based on the perception of which topics that would be adequate to find in an ideal LCA concept for buildings, rather than what is expected to be found. Therefore, these topics also reflect which areas that could be subjects of further research.

Decision supported by	Sub groups	Topics
Scope	Building life-cycle phases and status	Definition of the buildings life-cycle phases Assessment of a new building Assessment of a existing building Assessment of an activity, i.e. rebuilding, extension, demolition.
	Services coverage	Water consumption and use Waste water system Heating and cooling system Ventilation system Building maintenance, i.e. durability aspects Plot operation and maintenance Building related choice versus user-related impact.
	Time dependence (coverage)	Average of today's practice Time dependence affecting LCI Time dependence affecting LCIA
Methodology	Inventory	Allocation procedure for processes Handling of material recycling (i.e. open-loop recycling, boundary setting between products). Sunk costs Scenario modelling Time dependence (i.e. data for future processes) Procedure obtaining specific or generic data Procedure for dealing with data gaps
	Impact assessment	Indoor air quality, IAQ Time dependence Spatial difference Geographical difference Impact categories Conservation of resources Valuation methods

5.2.7 Definition of the building life-cycle

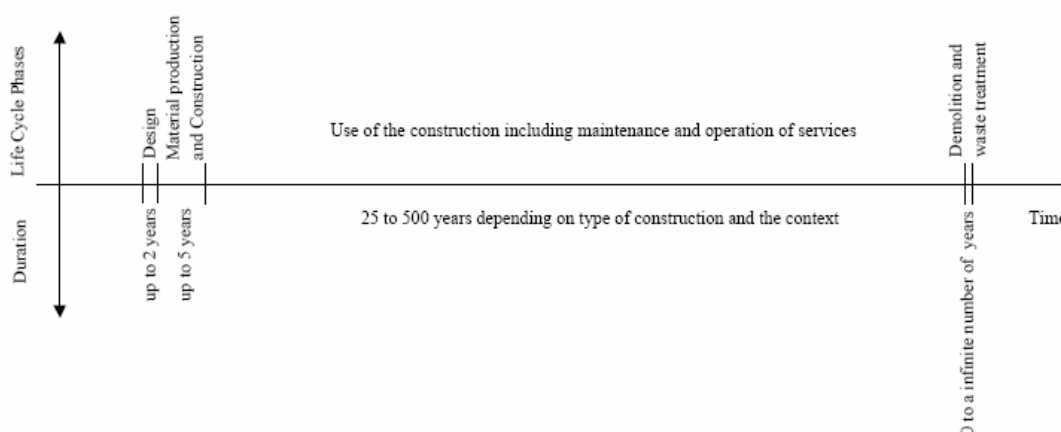
In respect to reality, rebuilding should to be included in the “life-cycle thinking” of a building, in one way or another, if a generic LCA model covering the current situation shall be the goal. The preferred life-cycle approach in the software and methodology practises in the investigated type 2 LCA models designed to perform an LCA are utilised according to a predefined linear life-cycle, typically given on terms of; raw material extraction, manufacturing, on-site construction, operation (including maintenance) and end-of-life/demolition. A generic approach valid for rebuilding is not found in any of the investigated LCA tools/methodologies. It is, however, noticed that the LCA tools/methodologies are designed to be able to always handle any building-related activity. This fact is also valid for rebuilding, why rebuilding as a single activity could be assessed in the established models. The purpose of a life-cycle thinking for a single activity will however not be clear.

A life-cycle covering rebuilding, operation and demolition could fulfil the same purpose as the normative commonly defined “traditional” linear life-cycle thinking for a “new” building. Since the investigated type 2 LCA models are using the physical building as the restricting factor to define the life-cycle, general pre-established life-cycle durations of 50-75 years are used as default. This methodological choice will be adequate if the purpose is to carry out an assessment on the building context level, but when the building service is utilised and the object of the assessment, the life time or duration of the service itself should be utilised to define the starting point and end point of the life-cycle. Hence, the building service can in one way be regarded as continuous, i.e. we will always need a place to live. This implies that the service can be specified in time. For instance,

office buildings in central city areas have a short service life-cycle, frequent rebuilding will take place (e.g. every 3–6 years). To be able to perform an assessment of rebuilding, a set of requirements that the building services should fulfil must be handled in the design phase. An LCA, performed for the building function, will be in line with the arguments put forward for a more generic application of LCA, refereed to as life-cycle management. It must therefore, be the conclusion that the adoption of building service as a context level can be a way to handle rebuilding in a sufficient way, but no such generic applicable LCA methodologies have been found in the literature.

The sequential life-cycle thinking, described above, is the way rebuilding can be handled today, i.e. by just adding another building service life-cycle phase to the already establish list above.

5.2.8 Different life-cycle phases and their duration and place in time:



5.2.9 Inventory-related considerations

There are four different approaches towards dealing with allocation in the case of recycling and in the case of unit processes that have multiple input and output flows, and the allocation problem in general, represented in the considered tools and methodologies. These approaches are schematised in the table below:

Allocation procedure valid for	Material recycling (open loop recycling)	Future material recycling (open loop recycling)	Multi in or output at a unit process.	Allocation of reuse when multiple service live are included.
ATHENA TM	CSA procedure (cut-off)	As present	Mass	Not specified
Envest	Economic value	As present ^a	Economic value	Not specified
Eco-Quantum 3	Economic value based cut-off	As present ^a	Economic value	Not specified
BEAT 2000	Users choice	Users choice	Users choice	Not specified
BEES	Not specified	Not specified	Not specified	Not specified

5.2.10 Lc impact assessment-related considerations

Regarding impact assessment, the following issues valid for buildings have been founded in the considered methods:

- Resource depletion and different impact categories;
- Site specific or site-dependant data including spatial difference;

- Time dependence for characterisation factors, e.g. background conditions such as a concentration of NO_x; VOC a significant substance valid for the characterisation model for photochemical ozone formation;
- Indoor air quality;
- Valuation/weighting method.

The impact categories included regarding different impact categories and resource depletion in the different LCA models investigated, are summarised in the following table.

Characterisation factors in	Resource depletion	Climate change, acidification, photochemical ozone formation, stratospheric ozone depletion	Human and ecological toxicity	Bio diversity
ATHENA 1.2	Yes, via recycling Scenarios	Only climate change included	Water and air toxicity (in development)	Yes, "ecological carrying capacity" ^a
Envest	Classified and Characterised for fossil fuel depletion and minerals used	Mainly CML 92 ^b	CML 92	No
Eco-Quantum 3	Yes, CML 92 ^b	CML 92	CML 92	No
BEAT 2000	UMIP ^c	UMIP	UMIP	No
BEES 2.0	Yes ^d	Yes ^d	Yes, including indoor air quality ^d	No

5.3 LCA OF BUILDING PRODUCTS: MATERIALS, PRODUCTS, COMPONENTS

(Torricelli)

5.3.1 Definition and scope

The LCA of building products-materials aims to clarify the environmental impact derived from various building elements and to allow seeking optimal solutions for the overall impacts of a building design, thus improving the environmental performance of buildings.

The building products are *goods and services used during the life cycle of a building or other construction works*. (ISO 21930:2006)

With the term building product-materials we intend: *an item manufactured or processed for incorporation in a building or other construction works. The manufacturing or processing of the building product can occur at the factory or on the building site*. (ISO 21930:2005)

Life Cycle Assessment (LCA) is a technique for assessing environmental aspects and potential impacts associated with a product by:

- Compiling an inventory of relevant inputs and outputs of a product system
- Evaluating potential environmental impacts of those inputs and outputs
- Interpreting the results of the inventory and impact assessment in relation to the objectives of the study

(EN-ISO 14040-14041-14042-14043-14044).

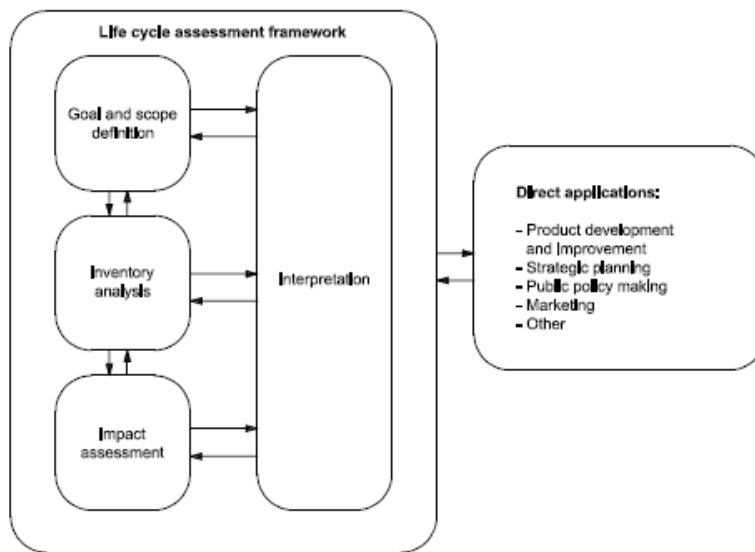


Figure 5.3: Stages of an LCA (ISO14040)

For buildings materials/products, the inventory includes resource acquisition, transport, manufacturing, construction, maintenance, final demolition, removal processes and recycling process, disposal and end of life.

The manufacturing or processing of the building product, the construction process, the maintenance process, the replacement, the demolition process, the recycling process and the disposal and end of life, in a life cycle approach, are assessed as an integrated process.

In accordance with a performance approach, the Building Products LCA (BPLCA) has to evaluate the environmental performances of a product in relation to the environmental requirements of the building in which the product will be used (in accordance with the Directive 89/106/CEE of the Board, of December 21 st 1988]

5.3.2 Conceptual framework

The BPLCA should be consistent, scientifically robust and shall ensure that the environmental impacts are completely accounted for without double counting.

Its prime purpose is to provide measurable and verifiable input for the environmental assessment of buildings. The LCA of a building product is strongly determined by the building design that influences in use performances and service life duration, with the decisions about: set in which the product will be employed, type of building, building techniques, environment and user's conditions.

For component or building system, with specific function (a window, a façade system), the BPLCA integrates different stages of LC, but if the product is building materials or components where multiple functions in a building are possible, and therefore stages of use and disposal are not known, building product LCA is not possible and it is possible only a Life Stage Assessment, i.e a LCA module limited to some stages of the LC. The LCA module will be added to other products LCA module, to the building LCA for a LC integrated environment impact assessment and evaluation.

The methodology LCA is defined by the standards of 14040 group, in the Building application it is interesting to develop the integration of LCA with CAAD System, Quantity surveying, LCC and energy calculation

Criteria of Integration of Life Stage Assessment in a LCA and with LCC (ricerca TAeD-Uni Fi-Laterservice 2007)

5.3.3 Stakeholders

Numerous general stakeholders are interested in the LCA application to building products. Each of the parties regards the building products environment impact data assessment from a different perspective. Stakeholders that belong to the demand side are: State or Government, Municipality and Authority having jurisdiction, institutes engaged in Standardisation, Approval, Certification, and Inspection who establish the needs of data and information about environment impact of products. Others belonging to the demand side are interested in decision making tools and data for specific project: the Client, the Design Team, the contractors; others demand assurance about safety and energy efficiency of the product: the Owner, the Facility Manager, the direct and indirect human End Users. Manufacturers, and others belonging to the supply side, affect the actual environment performance of products and are interested in data to declare the environment performance to the market but also to innovate and improve environment performances of their products.

5.3.4 Environment expectations in regard to a building product

The implementation of a LCA to evaluate the compliance of a building product with the eco-design requirements may be difficult.

The general environment requirement may be expressed as: minimizing the building-related environmental impacts during its life cycle. In terms of the actual performance-based standards and regulation, this could be an Essential Needs.

In 1997, ISO (the International Organization for Standardization) published a guide for the inclusion of environmental aspects in product standards (ISO Guide 64) in order to increase focus on the significance of product standards for the environment and to help avoid requirements which may result in adverse environmental impacts. The guide is intended for those drafting standards and includes a description of the environmental impacts that should be taken into account when product standards are prepared; it addresses techniques for assessing environmental impacts and recommends ways to avoid adverse environmental impacts. This guide was implemented as CEN Guide 4 "Guide for the inclusion of environmental aspects in product standards" (formerly CEN Memorandum No. 4).

Essential requirements are stated explicitly by most Building Laws, delegating the responsibility for implementation by means of regulations or codes to specific Authorities. In the environment domain related to building product, prescriptive terms in the regulations and codes, concern the Environment impact of the manufacturing process and of the waste and recycling process.

With regard to the product, a performance-based approach according to the PDC 89/91 is not at the moment developed in term of LCA. To deduce the product requirements, or statements from the expected performances of a building in its life cycle, the conceptual model elaborates the needs into a hierarchical structure, which ensures that all the detailed requirements stem transparently from clear needs at its root (PeBBU SoTA 2005).

5.3.5 Environment product performance criteria and comparability

The LCA methodology is the basis to implement the performance requirements procedure as stated by the ISO Sub-Committee for Functional/User Requirements and Performance in Building Construction, TC59/SC3, (that has standardised this procedure conceptually [ISO 6240 1980], then elaborated the procedure for establishing requirements [ISO 6241 1984], and finally illustrated it for several topics [ISO 6242 1992]). The reference for this procedure in regard to the environment requirements is given in general terms in the ISO 14024 Type I environmental labelling - Principles and procedures.....And for building product in the ISO DIS 21930 §5 and in the Fig 1 of the same Draft standard where the product chain is illustrated.:

"Any comparisons that may be required should be made with the full understanding that the product can only achieve its purpose when incorporated into the construction works, e.g.: a product may be used in prefabricated construction elements which is then installed in the building or the same product may be installed directly in the building"

The use of criteria in terms of "approved" or "deemed to satisfy" material or building product is not possible due to the lack of knowledge and data at the moment about life cycle environment performances.

For this reason it is important to develop criteria for the "product stage" of a modular LCA following the indication of ISO/21930 on the basis of:

- the selection of identical PCR,
- the demonstration that omitted life cycle stages have no relevant environmental impacts or the environmental data of omitted life cycle stages are identical (same performances in use) and are adequately dealt with and that instructions on where to find this information are available.

Reductions in the number of criteria for product groups are hoped for " by focusing on the overall environmental impact of the final product, e.g. concentrating on some stages in the product life cycle or environmental hot spots (e.g. by way of a "streamlined" or "screening" LCA)". This should be done by promoting and fostering a stronger relationship of the criteria with EU and/or national environmental priorities (see: CEN *Ecolabel final report* .2005).

The demonstration of the possibility to omit life cycle stage because there is no relevant environmental impact at the Building Product level has to be done on the basis of the results of applied research, evaluating the incidence of each process in the LCA at the Building Product level:

e.g. production facilities/equipment manufacturing process, on site construction process, ecc.

The demonstration of identical environment impact at building stage for a product category, has to be done on the basis of the same performance level of the Building element realised by the product for the performances that have influence on the environment impact in the life service: i.e. same U value, same thermal mass, same durability. Usually this is the so called "*additional information*" in the EPD, whose relevance for comparability has to be highlighted.

This is a field of research that has to be developed in the LC point of view.

5.3.6 Requirements for the underlying lca

Product category rules (PCR)

Building products that have similar functions in a building or similar technical specifications and use can be considered in a same Category Product (see ISO 14025, and ISO DIS 21930 and Draft 1 CEN WD 350004 "PCR for construction products"). It is useful that the same category product has same rules which underlie LCA, these rules (PCR) are important for the use of LCA based information in EU Label and EBPd and to add up LCA-based information and enable comparisons to be made between declarations with regard to the environmental performance of products. For this objective a co-operation between countries in this field was promoted between interested bodies acting pro-active and developing practical examples to support the work in CEN as well as in ISO TC 59. (see: IVL "A project outline for International harmonised environmental declarations for building products according to ISO 14025" 2005 and IVL "PCR for building product in an international market 2005")

Due to their performance and technological complexity the building products are referable to building materials, building components and building systems interpreted in the light of evolutionary sector trends: from materials in current use found in different parts of the building (glass, concrete, steel, wood etc.) to specialized and performance materials (blocks for walling, glass panels, plaster panels etc.), to functional components (windows, plant engineering, components etc.) and systems (facade cladding systems, photovoltaic systems etc.). As industrial products they are referable to different industrial sectors also supplying products for other uses than building: the concrete, cement and lime industries, the ceramics, glass and plaster sectors, metallurgic industries, plastic materials industries, wood industries etc.

Product Category Rules identify and report the goal and scope of the LCA, the life cycle stages to be included, the parameters to be covered and the way in which the parameters shall be collated and reported. (ref. Draft 1 CEN WD 350004 "PCR for construction products")

In the EPD System the PCR refer to rules for the underlying LCA and rules to communicate LCA based information and supplementary information. Reference are done in ISO 14025, ISO DIS 21930 and 00350004 CEN/TC 350 WG3 N027 "Sustainability of construction works - Environmental product declarations - Product category rules (Under Development 2010-02 - Draft 1 CEN WD 350004 "PCR for construction products".

The PCR are to be agreed by the stakeholders

In the EPD System all suggested PCR documents are subject to an open consultation procedure before officially being approved. Actually in the EPD system, PCR are defined for these Product Category interesting building products:

- [Electric machinery and apparatus](#)
- [Textiles](#)
- [Wood and wood products](#)
- [Pulp, paper and paper products](#)
- [Furniture](#)
- [Chemicals and chemical products](#)
- [Rubber and plastic products](#)
- [Other non-metallic mineral products](#)
- [Fabricated metal products](#)

"For each Building Product Category the PCR set (see ISO 14025, clause 6.7.1 and ISO DIS 21930):

a) Product category definition and description (e.g. function, technical performance and use, clause 6.2.2).

b) Goal and scope definition for the LCA of the product, according to the ISO 14040 series, including:

- ✓ functional unit (clause 6.2.3);
- ✓ declared unit (clause 6.2.4);
- ✓ system boundary (clause 6.2.5);
- ✓ description of data (clause 6.2.6);
- ✓ criteria for the inclusion of inputs and outputs (clause 6.2.7);
- ✓ data quality requirements including coverage, precision, completeness, representativeness, consistency,
- ✓ reproducibility, sources and uncertainty (clause 6.2.8);
- ✓ units (clause 6.2.9);

c) Inventory analysis according to ISO 14044 including:

- ✓ data collection;
- ✓ calculation procedures; and
- ✓ allocation of material and energy flows and releases (clause 6.2.7);

d) Impact category selection (clause 8.2.2.1) and calculation rules (clause 6.2.7), if applied;

e) Predetermined parameters for reporting of LCA data (inventory data categories and impact category indicators)

In the EPD System PCR, these requirements are reported as follows:

- ✓ Requirements for the underlying LCA...
- ✓ Functional and declared unit
- ✓ System boundaries.
 - Product stage
 - Construction stage
 - Building stage
 - End of life stage
- ✓ Cut-off rules.
- ✓ Allocation rules

- Transportation
- ✓ Data Quality requirements
- ✓ Calculation rules.
- ✓ Characterization factors.
- ✓ Data collection
- ✓ Description of data.
- ✓ Content of substances.

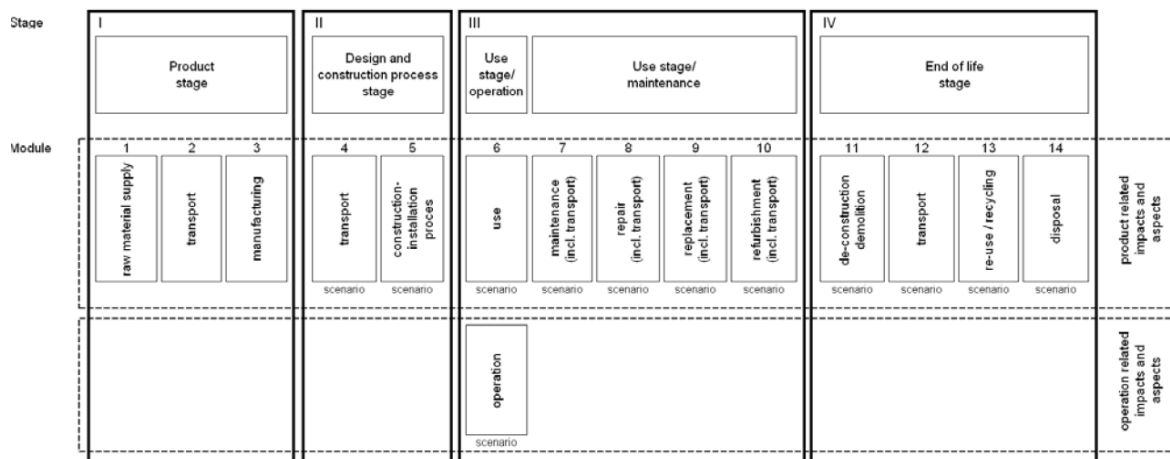
5.3.7 Modularity of building products lca - stages of the life cycle- and system boundaries

LCA for building products is done for stages of the life cycle that can be considered because the process and energy and materials flows are known. The environmental impact of the building product may be assessed for different stages of the life cycle, appropriate and justified, depending on the functional complexity of the building product (e.g. a window) or the specific way in which it is used in the building (e.g. a clay block used for structural wall), defining the design, construction, use, maintenance and end of life scenarios. Most frequently the Building Product LCA concerns the product stage ("cradle to gate") or it is a "cradle to gate with options" LCA, including additional modular information elements, (ISO DIS 21930 fig 2), as maintenance, repair and replacement process, or end of life process.

For each stage the PCR defines the boundaries of the system that is analysed and assessed. Boundaries determine cut off rules: the process that are included in the LCA with their input and output, in dependence of the relative importance of the impacts to be allocated to the main process.

Particular for building materials and products are important the definitions of boundaries at the production stages in terms of:

Raw materials, by-products, secondary materials process, industrial plants production and installation process, land use.



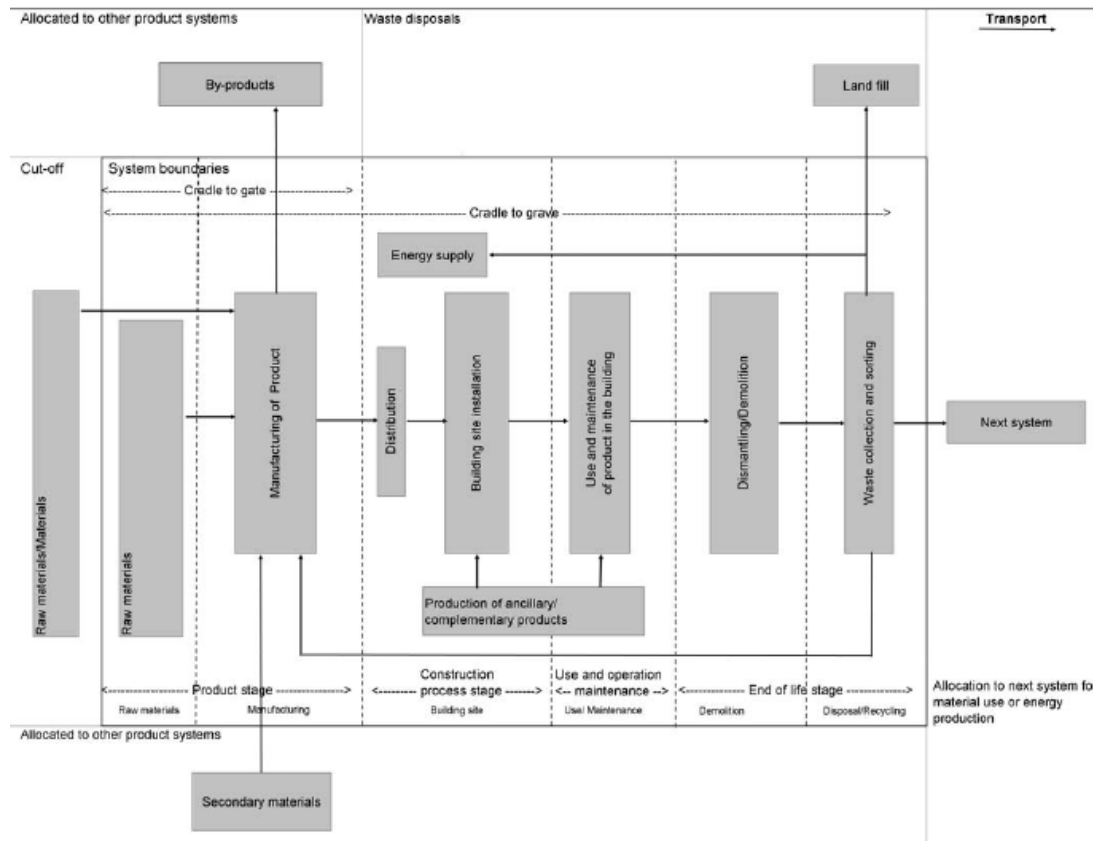


Figure 5.4: Example of system boundaries, information modules and life cycle stages of building products (ISO DIS 21930)

For products used in the construction of specific building elements, such as bricks or wall blocks, and where other materials or products (ancillary/complementary products) used as building elements (e.g. mortar for walls) are known through traditional practice or products sold as a kit of products (e.g. product for roof coverings - tiles and insulation system), the LCA product usually includes the LCA of different materials (bricks and mortar, tiles and insulation) and the flows of materials and energy are quantified in reference to the most common installation used in buildings (quantity, dimensions, etc. in a wall with different thickness).

Impacts from the use stage are related to the service life and to the energy performances of the material in relation to the building consumptions in defined climatic zones (use and operational scenario).

For functional component (e.g. windows), the "use stage" LCA could be done with reference to specific use condition, especially to specific climatic zones or could be done developing criteria of normalization for energy consumption in use, which permits adding this impact to the other impacts of the LC.

The end of life processes and associated environmental impacts allocated to a building product resulting from the dismantling/demolition of a building shall be considered. Difficulties are not only the data availability but especially the reliability of the prediction of end of life scenarios in a time that is often greater than 30 years.

All these are fields of research that have to be developed from the LC point of view.

5.3.8 Functional unit

Material and energy flows and the connected environmental impacts associated with a product are calculated and assessed by reference to a product quantity that is a Functional Unit.

"The functional unit of a building product is expressed on the basis of the relevant technical performance characteristics of the building product when integrated into a building. The primary purpose of the functional unit is to provide a reference to which the material flows (input and output data) of a building product are normalised (in a mathematical sense). That reference is necessary for the comparability of LCA data. The performance characteristics expressed by the functional unit of a building product can be complex and shall be defined and explained in the PCR. The functional unit relates to the reference service life of a building product. Where the estimated service life of a building product is shorter than the design life of the building or part of the building, the number of replacements required to fulfil the required performance and functionality over the service life can be identified. The functional unit provides the reference for adding up material flows and the connected environmental impacts for each of the life cycle stages of the building product." (in accordance with EBPD see ISO DIS 21930:2006 and ISO 14044, clause 4.2.3.2)

In a "Stage building product LC" (incomplete LCA) material and energy flows and the connected environmental impacts associated with a product can also be calculated and assessed by reference to a product quantity without considering the application of building products in a building also with reference to the products typical functions. This quantity is called a declared unit.

"The declared unit is related to a building product without considering the building product's application in a building. It provides a reference by means of which the material flows of the information module of a building material or component are normalised (in a mathematical sense). It provides the reference for combining the material flows attributed to the building product and the relevant environmental impacts, taking into account the selected stages of the building product's incomplete life cycle. The declared unit shall relate to the typical functions of products and their product categories. The declared unit of a building material or component shall include as a minimum:

- ✓ the quantity of the building material or building product;
- ✓ the intended fields of application;
- ✓ which life cycle stages are included (information modules)"

5.3.9 Phase of life cycle assessment - Life Cycle Inventory analysis (LCI)

The first phase of an LCA process is the Inventory analysis (LCI) involving the compilation and quantification of inputs and outputs for a product throughout its life cycle or stage of life cycle. The **life cycle inventory analysis result** (outcome of a life cycle inventory analysis) catalogues the flows crossing the system boundary and provides the starting point for life cycle impact assessment (LCIA)

LCI studies comprise three phases:

- the goal and scope definition,
- inventory analysis,
- interpretation.

Inventory analysis is composed by:

- data collection
- calculation procedures
- allocation of material and energy flows and releases

Inventory analysis is conducted by unit process related to the material or product, the unit process is the smallest element considered in the life cycle inventory analysis for which input and output data are quantified.

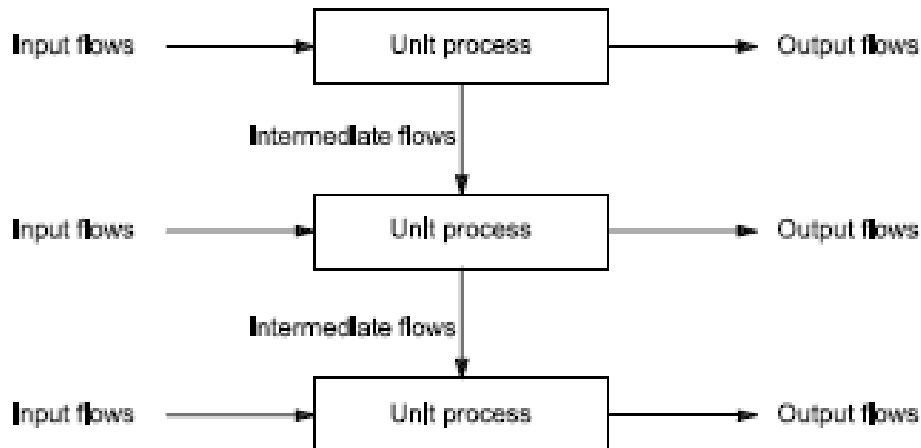


Figure 5.5: Example of a set of unit processes within a product system (ISO 14040)

Critical aspects in the LCI calculation are:

- the so called allocation method adopted. Allocation is “partitioning the input or output flows of a process or a product system between the product system under study and one or more other product systems”.
- the cut off criteria, specification of the amount of material or energy flow or the level of environmental significance associated with unit processes or product system to be excluded from a study (ISO 14044)

The following were taken from Draft 1 CEN WD 350004 “PCR for construction products”:

Allocation

In the data collection and calculation, allocation should be avoided as far as possible. Allocation shall be treated according to ISO 14044 provisions. When choosing allocation rules the following principles are recommended:

- Multi-input: allocation based on physical causal relationships, i.e. relationship between how the pollutant emission from the process is affected by changes in the input flows.
- Multi-output: allocation based on the way in which resource use and pollutant emissions change following quantitative modifications in products, or functions delivered by the system under study.

Open loop recycling: no allocation should be made for materials subject to recycling. Inputs of recycled materials or energy to a product system shall be included in the set of data without adding their environmental impact data caused in “earlier” life cycles, but the burdens caused by collection, transport, and recycling process should be included.

Hence, outputs of products subject to recycling shall be regarded as inputs to the “next” life cycle.

Criteria for the inclusion of inputs and outputs

The inclusion of inputs and outputs is determined by cut-off rules as defined in ISO 14044 to allow the inventory to be simplified. The cut-off rules for inputs and outputs shall be based on environmental relevance which can be expressed by mass, energy or other values.

Cut-off rules shall be defined in a way that has the minimum influence on the result obtained. For material flows, a cut-off rule of 5% by mass (i.e. inclusion of at least 95% of the total mass of inputs), energy or environmental relevancy per impact category shall be a maximum starting point.

When impacts are assessed and reported, the cut off rules shall be based on the environmental impacts related to the respective material flows.

All hazardous and toxic materials and substances shall be declared in the inventory.

Data quality requirements

Depending on the goals, the data quality requirements shall be formulated with regard to accuracy, precision, completeness and representativeness. Data quality requirements shall be treated according to provisions of ISO 14025 and ISO 14044, clause 4.2.3.6

(To satisfy quality requirements it is important to define:)

- the input and output data of the unit processes that are used for the LCA calculations;
- the documentation (measurements, calculations, estimates, sources, correspondence, traceable references to origin, etc) that provides the basis from which the process data for the LCA is formulated;
- referenced literature and databases from which data have been extracted;
- documentation demonstrating that the building product can fulfil the intended use;
- the data used to carry out the sensitivity analyses (see ISO 14044);
- the documentation that substantiates the percentages or figures used for the calculations in the end of life scenario;
- documentation that substantiates the percentages and figures (number of cycles, prices, etc.) used for the calculations (number of cycles, prices, etc.) in the allocation procedure, if it differs from the PCR;
- information showing how averages of different reporting locations have been calculated in order to obtain generic data;
- procedures used to carry out the data collection (questionnaires, instructions, informative material, confidentiality agreements, etc);
- the criteria and substantiation used to determine the system boundaries.

Example of data considered in a LCI for clay building materials:

Research LCA brick block and tiles clay product TAeD Uni Fi- Laterservice:

Product stage (cradle to gate)

Impact of plant and industrial building, associated maintenance and land use, are not included.

Land use of quarry is included

Impact of the activities of the production process are included the quarrying.included.

Input and output are flows referred to the quantity of clay material used to realise a building element defined as functional unit based on the relevant technical performance characteristics of the building product when integrated into a building functional unit : 1 mq of wall, 30 cm thickness, 1 mq of a roof covering.

Waste products, intermediate products and energy loss during the manufacturing process are expressed as output flows.

For raw materials supplying distances and number of trips from supplier to the producer have to be considered.

Transport stage

Transport Data to the construction site are expressed in terms of means of transport and middle distance allocated for functional unit .

Impact referred to the production of packaging are included.

Design Construction stage

Manufacturing data referred to complementary and ancillary materials to realise the building element according to the design decisions. For the aims of the research the building element is a functional unit based on the relevant technical performance characteristics of the building product

when integrated into a building functional unit: 1 mq of wall, 30 cm thickness, 1 mq of a roof covering)

Energy flows of the construction process are not considered because slight on the basis of a BRE research , (0,5% tot en).

Site equipment manufacturing process are not included.

End of life stage

Only percentage in mass of materials brought to dump, to incinerator, to recycling are included.

5.3.10 Life cycle impact assessment LCIA

LCIA assigns LCI results to impact categories (class representing environmental issues of concern to which life cycle inventory analysis results may be assigned); for this a characterization process it is necessary consisting in applying a factor derived from a characterization model to convert an assigned life cycle inventory analysis result to the common unit of the impact category indicator.

For each impact category, a life cycle impact category indicator is selected and the category indicator result (indicator result) is calculated. The collection of indicator results (LCIA results) or the LCIA profile provides information on the environmental issues associated with inputs and outputs of the product system.

There is no scientific basis for reducing LCA results to a single overall score or number, since weighting requires value choices. (UNI EN ISO 14040)

However, often LCIA is expressed, in normalization process, not in terms of Impact Category indicators profile, but in terms of ECO Points for one or more Damage Categories by a process of normalisation by which the impact of the studied system is compared to the medium impact generated by human activities in a Region.

5.3.11 Life cycle interpretation

Life cycle interpretation uses a systematic procedure to identify, qualify, check, evaluate and present the conclusions based on the findings of an LCA, in order to meet the requirements of the application as described in the goal and scope of the study:

- life cycle interpretation uses an interactive procedure both in the interpretation phase and in the other phases of an LCA;
- life cycle interpretation makes provisions for links between LCA and other techniques for environmental management by emphasizing strengths and limits of an LCA in relation to its goal and scope definition.

Interpretation is the phase of LCA in which the findings from the inventory analysis and the impact assessment are considered together or, in the case of LCI studies, the findings of the inventory analysis only. The interpretation phase should deliver results that are consistent with the defined goal and scope and which reach conclusions, explain limitations and provide recommendations.

In particular for Building products where, at the materials and products level, modular LC (cradle to gate with options) are conducted, it is important to remember that:

- The interpretation should reflect the fact that the LCIA results are based on a relative approach, that they indicate potential environmental effects, and that they do not predict actual impacts on category endpoints, the exceeding of thresholds or safety margins or risks.
- The findings of this interpretation may take the form of conclusions and recommendations to decision-makers, consistent with the goal and scope of the study.

Life cycle interpretation is also intended to provide a readily understandable, complete and consistent presentation of the results of an LCA, in accordance with the goal and scope definition of the study. The findings of the life cycle interpretation should reflect the results of the evaluation elements.

It could be useful to separate mandatory elements from non mandatory when doing an interpretation.

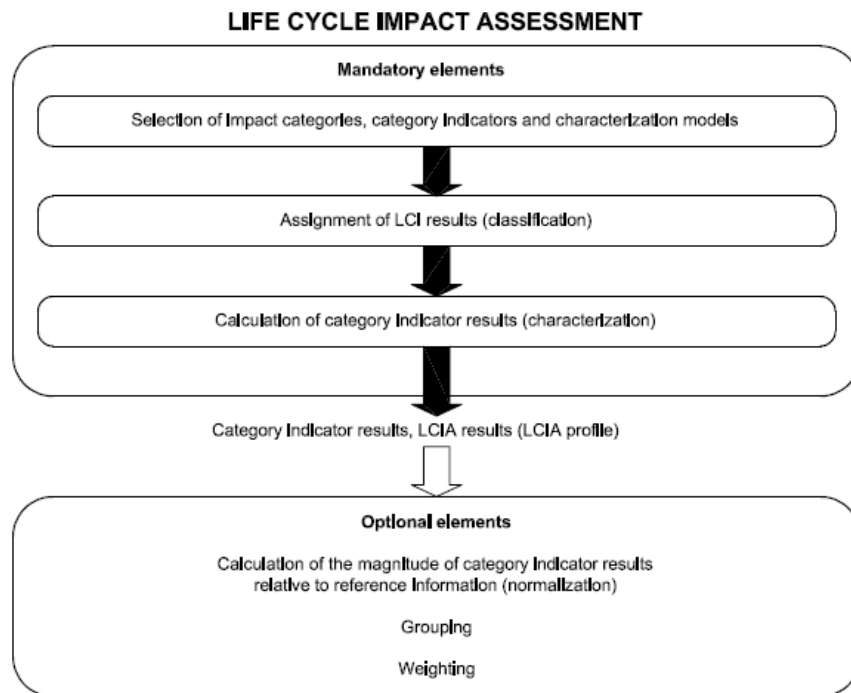


Figure 5.6: Elements of the LCIA phase (UNI EN ISO 14040)

5.4 EPDs OF BUILDING MATERIALS

[Olivetti]

The environmental product declaration is a very recent tool used to communicate environmental information on product based on LCA. Its dissemination and adoption by enterprises is still numerically limited. However, several national EPD programmes are being developed.

In the construction sector one of the major applications of EPD is in the environmental buildings certification.

There is an international non-profit network called GEDNET (The Global Environmental Product Type III Declarations Network). The objective of this network is to present a comprehensive vision of the state-of-art in the field of EPD. The current members of GEDNET are: Japan, Canada, Germany, Norway, Denmark, South Korea, China and Sweden.

A list of PCRs (Product Category Rules) can be found on the home page of the Global Network on Environmental Declarations, GEDNET, www.gednet.org. (EPD DATABASE <http://www.environdec.com/page.asp?id=105&menu=2,15,0>).

5.4.1 Product certifications

Type 1 (UNI EN ISO 14024)

Impose a performance limit (verified by third-party).

They are voluntary, verified by third-party and are assigned to products that comply with certain criteria and environmental performance. These criteria are predetermined for each product category and are defined taking into account the environmental aspects throughout the whole lifecycle of the product, by a forum of stakeholders through a process of open consultation. (Example Ecolabel)

Table 5.1: National ISO-Type I labelling systems in EU-25 and extra-european countries

EU MEMBER STATES WITH NATIONAL ISO-Type I	EU MEMBER STATES WITHOUT NATIONAL ISO-Type I	OTHER STATES WITH NATIONAL ISO-Type I
Austria	Belgium	Australia
Czech Republic	Cyprus	Brazil
France	Estonia	Canada
Germany	Greece	China
Hungary	Ireland	United States of America
Lithuania	Italy	Hong Kong
Nordic countries (Denmark, Finland, Norway, Sweden)	Latria	India
Poland	Luxembourg	Israel
Slovak Republic	Malta	Japan
Spain	Portugal	Korea
The Netherlands	Slovenia	New Zealand
Croatia	United Kingdom	Taiwan
		Thailand

Fonte: Rubik & Frankl (2005)

Type 2 (UNI EN ISO 14021): Self declaration of the manufacturer

This type of label is not certified by a third party and is not based on predefined and recognized criteria, but it refers only to individual aspects of the product.

The manufacturer affirms the characteristics of the product and ensures accuracy.

Type 3 (UNI EN ISO 14025): Validated quantification of the impacts associated with the product life cycle (Environmental Product Declaration - EPD)

It is a not selective type of labelling, because minimum fixed levels are not required to be entered. The EPD is prepared by the producer, tested and validated by third-party bodies and it is communicated to the "market".

So the Environmental Product Declaration is a document that provides objective, comparable and credible information relating to the environmental performances of goods and services. It is applicable to all products or services regardless of their use or positioning in the production chain, classified into well-defined groups.

The EPD is based on the evaluation of the product life cycle (LCA) and is governed by the (voluntary) Regulations Series ISO 14020, in particular, ISO TR 14025:2000 "Labels and environmental declarations; environmental declaration type III" and the series ISO 14040 (concerning LCA).

Through documents called "PCR - Product Category Rules" common requirements for certain categories of products are defined to compare different EPD.

These documents are usually processed in collaboration with stakeholders (industry associations, users, universities, Certification Bodies, etc. ...).

Table 5.2: National Programs EPD reviews and specific sectoral initiatives

Countries	National scheme	Building sector
Europe		
Denmark	Pilot Project EPD (DEPA - Danish Environmental Protection Agency)	BY og BYG
France	Experimental Standard on type III Environmental Declarations (AFNOR - Association Francaise de Normalisation)	FDES
Finland		RTS
Germany		AUB
Italy	EPD Pilot program (ANPA 2000-2001) EU-LIFE INTEND Project - Sistema Pilota Internazionale EPD	
Netherlands		MRPI
Norway	NHO - Type III Project (NHO - Confederation of Norwegian Business and Industry)	
Sveden	EPD Program (SEMC - The Swedish Environmental Management Council)	Byggvarudeklaration
Switzerland		SIA
United Kingdom		BRE Environmental Profiles
EXTRA EUROPE		

Canada	EPDS	
Japan	ECO-LEAF	
South Korea	EPD Program	
USA	CEP	

Source: INTEND 2005

6. Fitness for use

(Laura Cutaia, Gaetano Fasano, Gianfranco Rizzo, Maurizio Cellura, Aldo Blandino, Maria Chiara Torricelli, Alain Lusardi)

6.1 *LIFE PERIOD OF THE BUILDING*

[Fasano]

As far as it is technically possible and economically justifiable, consideration should be given to all aspects of the required energy and resource flows over the total life of the building. These include production, processing, transport, installation and demolition as well as pollutant emissions, in particular those due to the energy consumed by the building materials and by the use of the building.

This question will require greater attention in the future. The installation and demolition phases themselves are only of minor importance in the ecological assessment. As these are based on an ecological balance evaluation "from the cradle to the grave", which assesses the material flows from the construction of the building through its operation and use up to its demolition. The construction planning of the building sets the general conditions for ecological, economic and socio-cultural impacts during the utilisation phase of the building.

The operational and utilisation phase, on the other hand, acquires a special significance. This is particularly true when considering a long-term assessment period (50-100 years).

Hence it is particularly important to monitor the consumption of resources (e.g. energy, water) and operational costs during the utilisation phase.

The conditions for efficient building management have to be established as early as the design phase (comparison of design values with actual values for key indicators).

As a rule, the impacts on the environment arising from the construction, operation, utilisation and demolition of a building correlate with its construction and operational costs.

Nowadays the significant factors here are the costs of:

- Energy (electricity, heating, cooling)
- Cleaning
- Inspection and maintenance
- Value-conserving building maintenance

There are buildings for which the cumulative operational and utilization costs exceed the costs of constructing the building after less than 10 years.

An economic optimization of the total costs (construction costs + building utilization costs), can be expected to lead to a considerable reduction in the environmental impact of the project. The individual factors should be considered separately when making the ecological assessment.

An important element of cleaning costs is the cost of labour. These costs do not include the consumption of electricity and water, since the cleaning companies use the existing infrastructure. The use of cleaning agents takes on a special significance.

Inspection and Maintenance:

The cost of labour outweighs all others, whilst operating resources and electricity are environmentally relevant.

Value-conserving Building Maintenance:

As in the case of the construction of the building, the material flows should be assessed even if the proportion of the costs due to labour and electricity are greater. As compared to a new

construction, reference must be made to the increased use of auxiliary building materials such as adhesives, paint and varnishes (problems of indoor air quality).

Although the scientific investigations and agreements on the comparability of objective ecological balances over the life-cycle of buildings have yet to be completed, the "preliminary ecological assessment" still provides an adequate basis for a design aid for sustainable building.

If the design of a building is based on the above planning principles, then the following general principle provides a first approximation for the construction, utilisation and operation of a building. The better a building is assessed from an ecological standpoint, the lower the total costs of the building will be (construction, operation and utilisation costs). Operation and use are particularly important here.

Besides considering construction costs, future investment decisions made by public sector clients must therefore place increased importance on the costs of operation and utilisation, and these must be included in the assessment of the project.

Favorable operational and utilisation costs can be achieved as a rule by doing without avoidable and expensive building components and building technology. They can also be achieved in individual cases by using such components and technology in a focused manner. For many types of buildings, restricting energy consumption (particularly of electricity) and the costs of cleaning, inspection and maintenance can do away with building components and concepts which would otherwise have driven up the costs of construction.

By following the principle "as little technology as possible, just as much as needed", the construction and operational/utilisation costs can be considerably reduced.

Demolition

The demolition and clearance of a building are governed by the requirements for the most extensive and valuable reuse and recycling of materials and the minimisation of the resulting waste.

The design and tender phases should include a model for the disposal of construction waste. This can be undertaken, for example, by an obligatory interview of the companies on their disposal concepts.

The construction, operation/use and demolition of buildings all lead to damages to the environment and hence to external costs. The assessment and analysis of need must therefore take first place in the planning principles.

Although difficult to quantify, the medium- to long-term effects of using rural and natural areas as well as exploiting raw materials lead to environmental pollution. Similarly, the emission of pollutants from production, processing, transport, utilisation and disposal is transmitted in various ways through the air, water, soil, building structures, plants, animals and humans.

It is possible to estimate and assess environmentally-related pollution in monetary terms for specific sectors (e.g. forest damage reports and structural damage reports from the federal government, insurance company statistics); however, a comprehensive monetary assessment of the consequences for humans and the environment from all the impact factors is currently not feasible.

The environmental effects include storms and floods. Damages to forests and buildings due to pollutants transmitted by air alone causes annual damages in all the Countries of the order of billions of Euro.

The major part of environmental pollution can be traced to the consumption of energy and the nowadays resulting emissions into the atmosphere. Therefore one of the essential objectives of the Ecolabel of buildings must be to reduce the consumption of energy.

6.2 ECOLOGICAL ASSESSMENT

[Fasano]

The ecological assessment of buildings during their long life-cycle is a part of the assessment of their sustainability. This also includes an economic and a socio-cultural assessment. Three protection objectives stand at the forefront of the ecological assessment:

- Protection of human health
- Protection of the ecological system
- Protection of resources

All ecological impacts are based on the flows of energy and material. The assessments are therefore based on the estimation or calculation of the extent of these flows. If precise data on the energy and material flows are lacking, then an attempt can be made to limit their relative extent by suitable measures at the source (avoidance strategies). Each assessment is based on system limits, and these must be known. Without this information the assessment is useless.

A basic distinction has to be made between qualitative (descriptive) and quantitative (calculative) methods for the ecological assessment of buildings and landholdings.

Qualitative assessments are easier to conduct than quantitative procedures. The results however often cannot be compared with another or are not accurate enough, due either to different system limitations or to different reference values.

Quantitative assessments on the other hand are associated with considerably higher costs, due especially to the amount of data needed. This makes the implementation of computer-based tools both necessary and sensible.

In early planning phases (competitions etc.) the required input data are not yet available, so that a qualitative process is stipulated for preliminary assessments. As the planning process becomes more and more concrete, this can be converted into a quantitative assessment constructing and using a building both have an effect on the environment.

High building utilisation costs are not only closely associated with a high level of environmental impact, but usually with high construction costs as well. Therefore considerable care must be given to reducing construction and operational costs when observing the above principles. Thus, besides the generally well-known design requirements for economic construction three areas require increased attention:

- Analysis of the demand in terms of the type and scope of requirements
- Consideration of economic building construction procedures as early as the design stage
- Reduction of operational and utilisation costs, if necessary accepting an increase in construction costs for individual components.

The internal and external impact of a federal building reflects the democratic culture. Both, the relationship with citizens and the creation of historical values can be expressed by the impact of the building and this aspect must therefore be considered in the assessment.

Health risks resulting from the use of hazardous materials must be reliably excluded. The agreed objective is to create the best possible conditions for people residing and working in the interior areas of the building that are also acceptable from an economic point of view.

6.3 HEALTH, COMFORT AND SOCIO-CULTURAL ASPECTS

[\[Fasano\]](#)

Factors that have particular influence on people's well-being and productivity include:

- Building architecture
- Geometry of the building and rooms
- Good design, materials, colour scheme

- Perceived room temperature
- Humidity in the room
- Air quality in the room (IAQ indoor Air Quality)
- External air ventilation/air circulation
- Natural and artificial lighting
- Building acoustics/noise emissions
- Technical installations and furnishing

The physical design parameters, which are defined by the planning of these items, must be determined on the basis of the existing technical specifications (CEN, National regulations, National-guides etc.), whilst taking the requirements of each particular case into account.

The European Regulation on Building Products and building energy efficiency, its implementation at a national level and the international and European standardisation and registration of building products, have all led to building products being treated systematically and as a whole with regard to eight requirements.

These are:

- Durability
- Suitability for use
- Mechanical stability
- Fire prevention
- Hygiene, health, environmental protection
- Safety of use
- Sound protection
- Energy conservation, heat conservation

Social sustainability covers a multitude of dimensions. The preservation of human health and well-being is an essential component. Many illnesses and restrictions on the quality of life are caused by or aggravated by environmental factors. In terms of the building sector, this affects both the people who live in the buildings and those who construct them.

Due to their mostly prominent position and function, public buildings are increasingly a focus of public attention. They are endowed with a model function, which also has a creative component. Forming an important part of our building culture, they reflect how our society sees itself. They are a stable factor with a special responsibility with respect to the relationship between state and citizen. At the same time, if they fulfil their model role, then they are regarded with a special esteem and as a lasting value.

Therefore the interests related to preservation of the building, its upkeep and maintenance as a witness of contemporary history, and cautious conformity to its surroundings are all factors of sustainable building that also have to be included in the design together with the general economic and ecological aspects.

A further component is the introduction of mechanisms to encourage the users of a building to adopt more economical and environment-friendly behavior by implementing appropriate measures. The ability to visualize (user feedback) one's own consumption (heating energy, electricity, water, etc.) is a suitable means of reducing their use.

The ecological principles are anchored in the project tender. The opportunity to submit ancillary offers and special suggestions is intended to encourage alternatives, with the general aim of finding better ways of fulfilling the requirements.

The reuse of building materials and components (e.g. broken concrete, stairs, windows and structural members resulting from the conversion of a building, the demolition of another structure or from a reusable materials exchange) as well as the utilisation of recycled building materials must be clearly set out as appropriate items in the specifications. In this context, the long-term economic impacts over the entire life-cycle of the project should also be taken into consideration.

When examining the ancillary offers, attention is given to ensure that the ecological criteria are complied with as specified in the project tender documents.

Environment-friendly construction site facilities and operations are to be identified separately in the tender documents. They must be monitored during the construction phase.

6.4 PROJECT TENDER AND CONSTRUCTION

[Fasano]

Constant checks on performance and consumption, educating and informing the users and operators on all the effects of sustainability and frequent operational and utilisation analyses will help reduce costs during the utilisation phase. This requires an adequate number of monitoring facilities.

Regular inspections will have to be conducted to establish the required level of building maintenance, and smaller construction measures will have to be prepared. They can be used as an opportunity to analyse the operation and the use of the building as defined by the planning, operational and utilisation requirements referred to earlier. This should be done in close agreement with the client and the user. Measures for improving the operation and utilisation of the building should be mutually defined and agreed to.

The implementation of the requirements for sustainable building must be guaranteed over the entire life-cycle of a building project.

It should be ensured that the jury for the competition process includes at least one technical assessor, who is also competent in the areas of operation/energy/ecology.

Demonstrable experiences in the ecological and economic sectors are important characteristics of a suitable project management team.

Monitoring during the utilisation phase is to be seen as part of a required comparison process (benchmarking).

The continuity of expert support throughout the life cycle should be guaranteed by suitable organisational measures.

By means of modern, computer-based management of inventory and consumption data, the buildings and landholdings can be compared with each other. The aim here is to improve quality, which as a rule implies lower costs.

6.5 BUILDING MAINTENANCE

[Fasano]

The area and space requirements established by the client should be critically reviewed in terms of their real need and appropriateness, and in particular for any likely over-provision. The assessment of needs should also include the proposed standard of fittings and equipment. This also applies to the relevant guidelines and publications. Attention is drawn to the health and safety protection regulations when working with computer displays.

Before a decision can be made on a new building project, it must be conclusively demonstrated that the spatial requirement cannot be covered by existing buildings - even after allowing for optimising the building occupancy. This step should include consideration of the possibilities offered by change of use, building conversion and building renovation.

The demand for space should be minimised. The building design should be as amenable as possible for subsequent uses.

6.6 THERMAL COMFORT

6.6.1 Verification Procedures

[Fasano]

Verification procedures are necessary, specially, for the assessment of comfort during winter and summer periods.

The verification that the incident sunlight values are below threshold values must be established according to National regulations and National climatic conditions.

Note: If the maximum value of incident sunlight permitted by National regulations must be observed, then it may be assumed that the threshold room temperatures during summer periods will be exceeded for a maximum of 10% of the use-time.

Where the level of incident sunlight is exceeded, a thermal room simulation is to be carried out using an approved procedure.

NOTE

Immissions in the outside air are regulated and restricted by numerous laws and regulations. Conversely hardly any legal regulations exist for indoor air quality. Exceptions are working areas in which air pollution may be caused by technical production processes. These are restricted by provisions of industrial law.

A large number of pollutants from different sources may be present in interior rooms. These may be partly carried in by the outside air (especially those arising from vehicle exhausts); or they may come from sources in the interior rooms.

6.7 THE CHARTER OF EUROPEAN CITIES AND TOWNS TOWARDS SUSTAINABILITY (AALBORG 27TH MAY 1994)

[Blandino]

A Charter was drawn up, based on a network consensus, thus formalizing the commitment of all partners towards the implementation of a durable development policy for tourism.

The signatories of this Charter declare that they adhere to the principles of the Charter of European Cities and Towns Towards Sustainability (Aalborg 27th May 1994), with, for example, the adoption of the procedure of Local Agenda 21, as well as that of the Charter of Sustainable Tourism (Lanzarote 28th April 1995).

The commitments of this Charter constitute the minimum objectives which are to be undertaken; they will be adapted to fit national and regional legal frameworks.

1. Town planning and urbanism

1. Have at one's disposal a planning document (communal or supracommunal) which defines the purpose and the usage of each space and which ensures the preservation

and the enhancement of the physical and morphological character of historic towns and its (their) surrounding area(s).

2. Ensure that the general public is informed of and aware of issues concerning the effects of town planning and urbanism on the quality of life.

2. Economy

1. Promote the diversification of economic activities or services which are not in direct relation to but which are compatible with tourism and which respect local resources, in view of a policy of integrated sustainable development.
2. Promote economic activities which are related to the environment, culture, local traditions and know-how.
3. Encourage the development of the concept of added value to a tourism related economy.
4. Encourage tourism activities all the year round.

3. Housing and accommodation

1. Encourage permanent housing in order to create the right balance throughout the year.
2. Encourage an even distribution of principal and second homes in all of the communal area especially by improving the quality of life for the residents.

4. Culture

1. Help the preservation, the re-introduction and the development of local traditions and know-how, in order to maintain the social and cultural identity of the population.
2. Promote and support the organisation of cultural events all the year round.

5. The built heritage

1. Ensure the protection and the enhancement of archaeological sites and other buildings of heritage interest which are not already protected by other authorities (national or regional).
2. Work to save archaeological sites and buildings of heritage interest which are in danger.
3. Draw up an inventory of the built heritage and its conservation requirements which are coherent with future interventions.
4. Ensure its protection from badly integrated development alongside isolated buildings of heritage interest.
5. Provide the general public with an architectural and technical consultant who is competent in heritage matters.
6. Help to inform and make the public (local population and visitors) more aware of the built heritage in the town by installing informative signposting.

6. Environment

1. Ensure the protection (communal or supracommunal) of the ecosystems and all other sites of ecological interest, particularly by setting up appropriate networks and by creating "ecological corridors".
2. Ensure the sustainable management of sensitive tourist sites, particularly by means of suitable regulations.

3. Set up a policy for the prevention of environmental risks (on a communal and supracommunal level).
4. Guarantee the environmental quality of communal buildings which are to be renovated or built, by means of the choice of building materials, the regulation of energy costs, the reduction of water costs and the prevention of natural risks
5. Help to inform the public (local population and visitors) and make them more aware of the environment of the commune by means of informative signposting.

7. Living environment and landscapes

1. Ensure the protection and the revitalisation of the landscapes of historic towns and the rural and natural scenery which are characteristic of the area.
2. Promote, as far as is possible, the management of the local landscape through its agricultural, pastoral, forestry and fishing activities.
3. Establish regulations for billboard posting and signposting.
4. Provide the general public with a technical consultant who is competent in the subject of landscapes.
5. Help to inform the public (local population and visitors) and make them more aware of local landscapes by means of informative signposting.

8. Traffic, transport and mobility

1. Regulate the access of motorised vehicles within historic villages and other sensitive areas.
2. Improve access and parking close to residential accommodation in historic villages.
3. Improve the population's mobility as well as the mobility of physically disabled people and tourists by means of public transport.
4. Improve access to all amenities and tourist sites for physically disabled people.

9. Village and town associations

1. Promote the attachment of the town to any association which shares the same objectives as those which are presented in this Charter.
2. Actively participate in the exchange of experiences and initiatives and the Village *Terraneo* network project.

7. Towards a product group definition

According to the Regulation EC 1980/2000 the product group shall:

- represent a significant volume of sales and trade in the internal market;
- involve, at one or more stages of the product's life, a significant environmental impact on a global or regional scale and/or of a general nature;
- present a significant potential for effecting environmental improvements through consumer choice (...);
- be a significant part of its sales volume shall be sold for final consumption or use.

Taking into account:

- the standards and definitions available and used;
- results coming from the marketing analysis carried out so far;
- a preliminary environmental analysis carried out considering the LCA approach;
- existing certification schemes as requested by article 10 of the EC Regulation 1980/2000 and ongoing initiatives

We propose the following definition:

The product group buildings shall comprise “buildings considered in their entirety, as well as small houses, new, existing or renovated, public or private, used for different purposes”.

From the definition possible exclusions could be:

- Part of the building such as dwellings. The reason underlying the exclusion is related to the possible confusion amongst consumers that might cause awarding the European Eco-label at both level, i.e. the entire building or just part of it, being dwellings part of the building.
- Leisure complexes and laboratories. The reason is related to special conditions and exigences that these kinds of buildings could have, such as special acoustic insulation for disco club, or special conditions for laboratories (radiations etc.).

Possible criteria structure

According to the different level of potential environmental improvement that occurs in new buildings compared to existing ones, we suggest to divide the criteria in three main sections:

- criteria for existing buildings
- criteria for new buildings
- criteria for renovated buildings

Some environmental areas to address the criteria:

- Reduction of environmental impacts in the construction phase (both internal such as insulation and external such as integration with landscape, etc.)
- Reduction of environmental impacts in the mantainance phase (water, energy, waste, noise, comfort, etc.)
- Reduction of environmental impacts in the end use phase (?). The consideration of end use phase such as demolition could be avoided in consideration of the long term lifetime and the low energy demand compared to the other phases.

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9. Annexes

9.1 TECHNICAL NORMS

Products covered	TCs INVOLVED	FINALIZED/HARMONIZED PRODUCT STANDARDS	OUTSTANDING STANDARDS
Precast concrete products	CEN/TC 229 'Precast concrete products CEN/TC 177 'Prefabricated reinforced components of autoclaved aerated concrete or lightweight aggregate concrete with open structure'	<p>Elements for fences (EN 12839);</p> <p>Prefabricated reinforced components of lightweight aggregate concrete (EN 1520);</p> <p>Special roof elements (EN 13693);</p> <p>Hollow core slabs (EN 1168);</p> <p>Precast concrete garages (EN 13978-1);</p> <p>Floor plates for floor systems (EN 13747);</p> <p>Linear structural elements (EN 13225);</p> <p>Ribbed floor elements (EN 13224);</p> <p>Foundation piles (EN 12794);</p> <p>Masts and poles (EN 12843);</p> <p>Precast concrete products - Box culverts (EN 14844);</p> <p>Precast concrete products - Foundation elements (EN14991);</p> <p>Precast concrete products - Wall elements (EN 14992)</p> <p>Precast concrete products - Bridge elements (EN 15050);</p> <p>Precast concrete products - Stairs (EN 14843);</p> <p>Floor slats for livestock (EN 12737);</p> <p>Beam-and-block floor systems - Part 1: Beams (EN 15037-1);</p>	<p>Prefabricated reinforced components of autoclaved aerated concrete (prEN 12602);</p> <p>Beam-and-block floor systems - Part 2: Concrete blocks (prEN 15037-2);</p> <p>Beam-and-block floor systems - Part 3: Clay blocks (prEN 15037- 3);</p> <p>Beam-and-block floor systems - Part 4: Polystyrene blocks (prEN 15037-4);</p> <p>Beam-and-block floor systems - Part 5: Lightweight blocks (prEN15037-5);</p> <p>Retaining wall elements (prEN 15258);</p> <p>Normal weight and lightweight concrete shuttering blocks - Product properties and performance (prEN 15435);</p> <p>Wood-chip concrete shuttering blocks - Product properties and performance (prEN 15498)</p>
Doors, windows	CEN/TC 33 "Doors, windows, shutters and building hardware'	<p>Building hardware (EN 179);</p> <p>Panic exit devices (EN 1125);</p> <p>Controlled door closing devices (EN 1154);</p> <p>Electrically powered hold-open devices (EN 1155);</p> <p>Door coordinator devices (EN 1158);</p>	<p>Multipoint locks and their locking plates (prEN 15685);</p> <p>Single swing spring hinge closing devices (WI 00033327);</p> <p>Electrically controlled panic exit systems for use on escape routes (prEN</p>

		<p>Industrial, commercial and garage doors and gates (EN 13241-1);</p> <p>External blinds (EN 13561); shutters (EN 13659);</p> <p>Single-axis hinges (EN 1935);</p> <p>Locks and latches (EN 12209)</p> <p>Windows and doors - Product standard, performance characteristics - Part 1: Windows and external pedestrian doorsets without resistance to fire and/or smoke leakage characteristics (EN 14351-1)</p>	<p>13633);</p> <p>Electrically controlled emergency exit systems for use on escape (prEN 13637);</p> <p>Lever handles and knob furniture (prEN 1906);</p> <p>Internal pedestrian doors - Part 2: Internal pedestrian doorsets without resistance to fire characteristics (prEN 14351-2);</p> <p>Windows and doors - Part 3: Windows and pedestrian doorsets with resistance to fire and/or smoke leakage characteristics (prEN 14351-3);</p> <p>Industrial, commercial and garage doors and gates - Product Standard - Part 2: Products with fire resistance or smoke control characteristics (prEN 13241-2);</p> <p>Building hardware - Locks and latches - Electromechanically operated locks and striking plates - Requirements and test methods (prEN 14846)</p>
Membranes	CEN/TC 254 'Flexible sheets for waterproofing'	<p>Reinforced bitumen sheets for roof waterproofing (EN 13707);</p> <p>Flexible sheets for waterproofing- Plastic and rubber vapour control layers (EN 13984);</p> <p>Bitumen water vapour control layers (EN 13970);</p> <p>Bitumen damp proof sheets including bitumen basement tanking sheets (EN 13969);</p> <p>Plastic and rubber damp proof sheets including plastic and rubber basement tanking sheets (EN 13967);</p> <p>Underlays for walls (EN 13859-2);</p> <p>Underlays for discontinuous roofing (EN 13859-1);</p> <p>Plastic and rubber sheets for roof waterproofing (EN 13956)</p> <p>Flexible sheets for waterproofing</p>	Completed

		<p>- Plastic and rubber damp proof courses - Definitions and characteristics (EN 14909)</p> <p>Flexible sheets for waterproofing</p> <p>- Bitumen damp proof courses - Definitions and characteristics (EN 14967)</p>	
Thermal insulation products	CEN/TC 88 'Thermal insulating materials and products'	<p>Factory made mineral wool (EN 13162);</p> <p>Factory made products of expanded polystyrene (EPS) (EN 13163);</p> <p>Factory made products of extruded polystyrene foam (XPS) (EN 13164);</p> <p>Factory made rigid polyurethane foam (PUR) products (EN 13165);</p> <p>Factory made products of phenolic foam (PF) (EN 13166);</p> <p>Factory made cellular glass (CG) products (EN 13167);</p> <p>Factory made wood wool (WW) products (EN 13168);</p> <p>Factory made products of expanded perlite (EPB) (EN 13169);</p> <p>Factory made products of expanded cork (ICB) (EN 13170);</p> <p>Factory made wood fibre (WF) products (EN 13171);</p> <p>In-situ formed expanded clay lightweight aggregate products (LWA) (EN 14063-1);</p> <p>In-situ thermal insulation formed from expanded perlite (EP) products (EN 14316-1);</p> <p>In-situ thermal insulation formed from exfoliated vermiculite (EV) products (EN 14317-1);</p> <p>Factory made products of expanded polystyrene (EPS) (EN 14933);</p> <p>Factory made products of extruded polystyrene foam (XPS) (EN 14934);</p>	<p>Specification for the loose-fill products before installation (prEN 14064-1);</p> <p>Factory made mineral wool (MW) products (prEN 14303);</p> <p>Factory made flexible elastomeric foam (FEF) products (prEN 14304);</p> <p>Factory made cellular glass (CG) products (prEN 14305);</p> <p>Factory made calcium silicate (CS) products (prEN 14306);</p> <p>Factory made extruded polystyrene foam (XPS) products (prEN 14307);</p> <p>Factory made rigid polyurethane foam (PUR) and polyisocyanurate foam (PIR) products (prEN 14308);</p> <p>Factory made products of expanded polystyrene (EPS) (prEN 14309);</p> <p>Factory made polyethylene foam (PEF) products (prEN 14313);</p> <p>Specification for the rigid foam spray system before installation (prEN 14315-1);</p> <p>Specification for the rigid foam dispensed system before installation (prEN 14318-1);</p> <p>Specification for the rigid foam dispensed system before installation (prEN 14319-1);</p> <p>Specification for the rigid foam spray system before installation (prEN 14320-1);</p> <p>Specification for the foam system before</p>

			<p>installation (prEN 15100-1);</p> <p>Specification for the products before installation (prEN 15101-1);</p> <p>Expanded clay lightweight aggregate products (prEN 15732);</p>
Structural bearings	CEN/TC 167 'Structural bearings'	<p>Spherical and cylindrical PTFE bearings (EN 1337-7);</p> <p>Roller bearings (EN 1337-4);</p> <p>Rocker bearings (EN 1337-6);</p> <p>Elastomeric bearings (EN 1337-3);</p> <p>Pot bearings (EN 1337-5);</p> <p>Structural bearings - Part 8: Guide Bearings and Restraint Bearings (EN 1337-8)</p>	Complete
Chimneys	<p>CEN/TC 62 'Independent gas-fired space heaters'</p> <p>CEN/TC 180 'Domestic and non-domestic gas-fired air heaters and non-domestic gas-fired overhead radiant heaters' CEN/TC 166 'Chimneys, flues and specific</p>	<p>Chimneys components-Concrete outer wall elements (EN 12446);</p> <p>Clay/ceramic flue terminals (EN 13502);</p> <p>Clay/ceramic flue liners (EN 1457);</p> <p>Metal chimneys (EN 1856-1; EN 1856-2);</p> <p>Concrete flue liners (EN 1857);</p> <p>Concrete flue blocks (EN 1858);</p> <p>System chimneys with clay/ceramic flue liners (EN 13063-1; EN 13063-2);</p> <p>Clay/ceramic outer walls for system chimneys (EN 13069);</p> <p>Free-standing chimneys-Material for brick liners (EN 13084-5);</p> <p>System chimneys with plastic flue liners (EN 14471)</p> <p>Free-standing chimneys - Cylindrical steel fabrications for use in single wall steel chimneys and steel liners (EN 13084-7:2005).</p> <p>Chimneys - Clay/ceramic flue blocks for single wall chimneys - Requirements and test methods (EN 1806:2006)</p> <p>Vertical air/flue terminals for C6-type appliances (EN 14989-1);</p> <p>Requirements and test methods</p>	<p>Non-domestic gas-fired forced convection air heaters for space heating (prEN 1020 rev);</p> <p>Domestic gas-fired forced convection air heaters for space heating (prEN 1319 rev);</p> <p>Flue and air supply ducts for individual room sealed appliances (prEN 14989-2);</p> <p>Single burner gas-fired overhead radiant-tube heaters - Part 1:</p> <p>Safety (prEN 416-1);</p> <p>Non-domestic direct gas-fired forced convection air heaters</p> <p>(prEN 525);</p> <p>Non-domestic gas-fired forced convection air heaters (prEN 621);</p> <p>Multi-burner gas-fired overhead radiant tube heater - Part 1: System D, safety (prEN 777-1);</p> <p>System E, safety (prEN 777-2);</p> <p>System F, safety (prEN 777-3);</p> <p>System H, safety (prEN</p>

		for air flue system chimneys (EN 13063-3);	777-4); Domestic gas-fired forced convection air heaters (prEN 778);
Gypsum products	CEN/TC 241 'Gypsum and gypsum based products'	<p>Gypsum blocks (EN 12859);</p> <p>Gypsum based adhesives for gypsum blocks (EN 12860);</p> <p>Metal framing components for gypsum plasterboard systems (EN 14195);</p> <p>Preformed plasterboard cornices (EN 14209);</p> <p>Gypsum based adhesives for thermal/acoustic insulation composite panels and plasterboards (EN 14496);</p> <p>Gypsum plasterboard thermal/acoustic insulation composite panels (EN 13950)</p> <p>Gypsum plasterboards (EN 520);</p> <p>Jointing materials for gypsum plasterboards (EN13963);</p> <p>Gypsum plasterboard products for reprocessing (EN 14190);</p> <p>Gypsum binders and gypsum plasters (EN 13279-1);</p> <p>Metal lath and beads- Internal plastering (EN 13658- 1)-External plastering (EN 13658-2)</p> <p>Fibrous gypsum plaster casts - Definitions, requirements and test methods (EN 13815)</p> <p>Gypsum elements for suspended ceilings - Definitions, requirements and test methods (EN 14246);</p> <p>Prefabricated gypsum plasterboard panels with a cellular paperboard core (EN 13915);</p> <p>Metal beads and feature profiles for use with gypsum plasterboards (EN 14353);</p> <p>Mechanical fasteners for gypsum plasterboard systems - (EN 14566);</p>	<p>Gypsum boards with mat reinforcement (prEN 15283-1)</p> <p>Gypsum boards with fibrous reinforcement - Part 2: Gypsum fibre boards (prEN 15283-2)</p>
Geotextiles	CEN/TC 189 'Geotextiles and geotextile-related products'	Geo-textiles and geo-textile-related products for use in the construction of roads and other trafficked areas (excluding railways and asphalt inclusion (EN 13249);	<p>Requirements for use in pavements and asphalt overlays (prEN 15381);</p> <p>Geosynthetic barriers - Characteristics required for use in transportation</p>

		<p>For use in the construction of railways (EN 13250);</p> <p>For use in earthworks, foundations and retaining structures (EN 13251);</p> <p>For use in drainage systems (EN 13252);</p> <p>For use in the construction of reservoirs and dams (EN 13254);</p> <p>For use in the construction of canals (EN 13255);</p> <p>For use in the construction of tunnels and underground structures (EN 13256);</p> <p>For use in solid waste disposals (EN 13257);</p> <p>For use in erosion control works (EN 13253);</p> <p>Characteristics required for use in liquid waste containment projects (EN 13265);</p> <p>Geo-synthetic barriers (EN 13361; EN 13362; EN 13491; EN 13492; EN 13493)</p>	<p>infrastructure (prEN 15382);</p>
Curtain walling	CEN/TC 33 ‘‘Doors, windows, shutters and building hardware’	Curtain walling (EN 13830)**	Completed
Fixex fire-fighting equipment	<p>CEN/TC 72 ‘Automatic fire detection systems’</p> <p>CEN/TC 191 ‘Fixed firefighting systems’</p> <p>CEN/TC 192 ‘Fire service equipment’</p>	<p>Fixed fire-fighting systems-components for gas extinguishing systems (EN 12094-1; EN 12094-2; EN 12094-3; EN 12094-4; EN 12094-5; EN 12094-6; EN 12094-7; EN 12094-9; EN 12094-10; EN 12094-11; EN 12094-12; EN 12094-13);</p> <p>Smoke and heat control systems (EN 12101-1; EN 12101-2; EN 12101-3; EN 12101-6; EN 12101-10);</p> <p>Powder systems (EN 12416-1; EN 12416-2);</p> <p>Hose systems (EN 671-1; EN 671-2);</p> <p>Components for sprinklers (EN 12259-1; EN 12259-2; EN 12259-3; EN 12259-4; EN 12259-5);</p> <p>Automatic sprinkler systems; foam systems (EN 13565-1);</p> <p>Fire alarm devices (EN 54-3);</p> <p>Powder supply equipment (EN 54-4);</p>	<p>Components for gas extinguishing (prEN 12094-20)</p> <p>Smoke control ducts (prEN 12101-7);</p> <p>Specification for smoke control dampers (prEN 12101-8);</p> <p>Control panels (prEN 12101-9)</p> <p>Components for sprinkler and water spray systems - Part 12: Pumps (prEN 12259-12)</p> <p>Pressure switches(prEN12259-8)</p> <p>Deluge valve assemblies (prEN 12259-9)</p> <p>Point detectors using a combination of detected fire phenomena (prEN 54-15)</p> <p>Voice alarm control and indicating equipment</p>

		<p>Heat detectors (EN 54-5);</p> <p>Smoke detectors (EN 54-7; EN 54-12);</p> <p>Flame detectors-Point detectors (EN 54-10);</p> <p>Fire detection and fire alarm systems-Manual call points (EN 54-11);</p> <p>Fire detection and fire alarm systems -Short-circuit isolators (EN 54-17);</p> <p>Fire detection and fire alarm systems-Input/output devices (EN 54-18);</p> <p>Underground fire hydrants (EN 14339);</p> <p>Pillar fire hydrants (EN 14384);</p> <p>Smoke alarm devices (EN 14604);</p> <p>Fire detection and fire alarm systems - Part 20: Aspirating smoke detectors (EN 54-20);</p> <p>Fire detection and fire alarm systems - Part 21: Alarm transmission and fault warning routing equipment (EN 54-21);</p> <p>Fixed firefighting systems - Components for gas extinguishing systems - Part 8: Requirements and test methods for connectors (EN 12094-8);</p> <p>Fire detection and fire alarm systems - Part 2: Control and indicating equipment (EN 54-2);</p>	<p>(prEN 54-16);</p> <p>Line type heat detectors (prEN 54-22);</p> <p>Visual alarms (prEN 54-23);</p> <p>Loud speakers (prEN 54-24);</p> <p>Components using radio links and system requirements (prEN 54-25);</p>
Sanitary appliances	CEN/TC 163 'Sanitary appliances'	<p>Kitchen sinks (EN 13310);</p> <p>WC pans and WC suites with integral trap (EN 997);</p> <p>Shower enclosures (EN 14428);</p> <p>Whirlpool baths (EN 12764);</p> <p>Bidets (EN 14528);</p> <p>Communal washing troughs (EN 14296)</p> <p>Wall-hung urinals - Functional requirements and test methods (EN 13407)</p> <p>Wash basins - Functional requirements and test methods (EN 14688)</p>	<p>WC pans and urinals flushing cisterns (prEN 14055);</p> <p>Shower tray for domestic purposes (prEN 14527);</p> <p>Baths for domestic purposes (prEN 14516);</p>
Circulation fixtures	<p>CEN/TC 50 'Lighting columns and spigots'</p> <p>CEN/TC 226 'Road</p>	<p>Anti-glare systems for roads (EN 12676-1);</p> <p>Drop on materials for road</p>	<p>Road marking materials - Physical properties (prEN 1871);</p>

	equipment'	<p>markings (EN 1423);</p> <p>Lighting columns in steel (EN 40-5:2002), aluminium (EN 40-6:2002), fibre reinforced polymer (EN 40-7:2002); reinforced and pre-stressed concrete (EN 40-4:2005)</p> <p>Retro-reflecting road studs (EN 1463-1);</p> <p>Variable message traffic signs (EN 12966-1);</p> <p>Traffic control equipment - Warning and safety light devices (EN 12352)</p> <p>Traffic control equipment - Signal heads (EN 12368)</p> <p>Road traffic noise reducing devices (EN 14388)</p> <p>Road restraint systems - Part 5: Product requirements and evaluation of conformity for vehicle restraint systems (EN 1317-5);</p> <p>Fixed, vertical road traffic signs - Part 1: Fixed signs (EN12899-1);</p> <p>Trans-illuminated traffic bollards (TTB) (EN 12899-2);</p> <p>Delineator posts and retro-reflectors (EN 12899-3);</p>	<p>Preformed road markings (prEN 1790);</p> <p>Road restraint systems - Part 6 : Pedestrian road restraint system (prEN 1317-6)</p>
Structural timber products And ancillaries	CEN/TC 124 'Timber structures'	<p>Prefabricated structural members assembled with punched metal plate fasteners (EN 14250);</p> <p>Structural laminated veneer lumber (EN 14374);</p> <p>Glued laminated timber (EN 14080)</p> <p>Strength graded structural timber with rectangular cross section (EN 14081-1)</p>	<p>Wood poles for overhead lines - Requirements (prEN 14229);</p> <p>Structural timber with round cross-section (prEN 14544);</p> <p>Prefabricated wall, floor and roof elements (prEN 14732);</p> <p>Finger jointed structural timber (prEN 15497);</p> <p>Dowel-type fasteners (prEN 14592);</p> <p>Connectors (prEN 14545);</p>
Wood-based panels	CEN/TC 112 'Wood-based panels'	Wood-based panels for use in construction (EN 13986**)	Completed
Cement	CEN/TC 51 'Cement and building limes'	<p>Common cements (EN 197-1);</p> <p>Building lime (EN 459-1);</p> <p>Very low heat special cements (EN 14216);</p> <p>Low early strength blast furnace</p>	<p>Hydraulic road binders - Composition, specifications and conformity criteria of normal hardening hydraulic road binders (prEN 13282-2);</p>

		cements (EN 197-4); Masonry cement (EN 413-1); Calcium aluminate cement (EN 14647)	Hydraulic binder for non-structural applications: definition, specifications and conformity criteria (prEN 15368);
Reinforcing steel	ECISS/TC 19 'Concrete reinforcing steel- Qualities, ,dimensions and tolerances'	Steel strip sheaths for prestressing tendons (EN 523);	Corrosion resistant reinforcing steels (WI EC019025); Prestressing steels - Part 1: General requirements (prEN 10138-1); Zinc and zinc alloy coated prestressing steel wires and strands (prEN 10337); Galvanized reinforcing steel (prEN 10348); Steel for the reinforcement of concrete - Weldable reinforcing steel - General (prEN 10080);
Masonry	CEN/TC 125 'Masonry'	Clay units (EN 771-1); Calcium silicate units (EN 771-2); Aggregate concrete(EN 771-3); Autoclave aerated concrete (EN 771-4); Manufactured stone masonry units (EN 771-5) Natural stone masonry units (EN 771-6) Ties, tension straps, hangers and brackets (EN 845- 1); Lintels (EN 845-2); Bed joint reinforcement (EN 845-3); Rendering and plastering mortar (EN 998-1); Masonry mortar (EN 998-2);	Specifications for Mortar for Masonry - Part 3: Products for external rendering and internal plastering based on organic binders (prEN 998-3)
Waste water engineering	CEN/TC 155 'Plastic piping systems and ducting systems' CEN/TC 165 'Waste water engineering'	Wastewater lifting plants for buildings and sites (EN 12050-1; EN 12050-2; EN 12050-3; EN 12050-4); Anti-flooding devices for buildings (EN 13564-1); Drainage channels for vehicular and pedestrian areas (EN 1433); Concrete manholes and inspection chambers (EN 1917); Fibre cement manholes and	Gully tops and manhole tops for vehicular and pedestrian areas (prEN 124); Prefabricated treatment units for septic tank effluent (prEN 12566- 6); Prefabricated tertiary treatment units (prEN 12566-7); Manholes and inspection

		<p>inspection chambers (EN 588-2);</p> <p>Small wastewater treatment systems (EN 12566-1; EN 12566-3);</p> <p>Fixed ladders for manholes (EN 14396);</p> <p>Grease separators (EN 1825-1);</p> <p>Vitrified clay pipes and fittings (EN 295-10);</p> <p>Separator systems for light liquids (EN 858-1);</p> <p>Air admittance valves for drainage systems (EN 12380);</p> <p>Steps for underground man entry chambers (EN 13101);</p> <p>Septic tanks assembled in situ from prefabricated kits (EN 12566-4);</p>	<p>chambers (prEN 14636-2);</p> <p>Vitrified clay pipes and fittings and pipe joints for drains and sewers (prEN 295-1 rev);</p> <p>Requirements for special fittings, adaptors and compatible accessories (prEN 295-4);</p> <p>Requirements for perforated vitrified clay pipes and fittings (prEN 295-5);</p> <p>Requirements for vitrified clay manholes (prEN 295-6);</p> <p>Requirements for vitrified clay pipes and joints for pipe jacking (prEN 295-7);</p> <p>Plastics piping systems for renovation of underground water supply networks - Part 3: Lining with close fit-pipes (prEN 14409- 3);</p> <p>Plastics piping systems for drainage and sewerage - Glassreinforced thermosetting plastics (GRP) based on polyester resin (UP) - Manholes and inspection chambers (prEN 15383);</p> <p>Plastics piping systems for renovation of underground nonpressure drainage and sewerage networks - Part 2: Lining with continuous pipes (prEN 13566- 2);</p> <p>Plastics piping systems for renovation of underground nonpressure drainage and sewerage networks - Part 3: Lining with close-fit pipes (prEN 13566-3);</p> <p>Plastics piping systems for renovation of underground nonpressure drainage and sewerage networks - Part 7: Lining with spirally-wound pipes (prEN 13566-7);</p> <p>Plastics piping systems -</p>
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Floorings	<p>CEN/TC 67 'Ceramic tiles'</p> <p>CEN/TC 129 'Glass in buildings'</p> <p>CEN/TC 134 'Resilient and textiles floor coverings'</p> <p>CEN/TC 175 'Round and sawn timber'</p> <p>CEN/TC 178 'Paving units and curbs'</p> <p>CEN/TC 217 'Surfaces for sports areas'</p> <p>CEN/TC 229 'Precast concrete products'</p> <p>CEN/TC 246 'Natural stones'</p>	<p>Concrete paving blocks (EN 1338);</p> <p>Flags (EN 1339);</p> <p>Kerb units (EN 1340);</p> <p>Slabs of natural stone (EN 1341);</p> <p>Kerbs of natural stone (EN 1343);</p> <p>Setts of natural stone for external paving (EN 1342);</p> <p>Clay pavers (EN 1344);</p> <p>Screed material (EN 13813);</p> <p>Natural stone modular tiles (EN 12057);</p> <p>Natural stone slabs for floors and stairs (EN 12058);</p> <p>Terrazzo tiles for internal and external use (EN 13748-1; EN 13748-2) ;</p> <p>Binders for magnesite screeds (EN 14016-1);</p> <p>Resilient textile and laminate floor coverings (EN 14041);</p> <p>Ceramic tiles (EN 14411);</p> <p>Wood flooring (EN 14342);</p> <p>Surfaces for sports areas - Indoor surfaces for multi- sports use - Specification (EN 14904);</p> <p>Glass blocks and glass pavers (EN 1051-2);</p>	<p>Agglomerated stone - Modular tiles for flooring (internal and external) (prEN 15285)</p> <p>Slabs and cut to size products for floor and stairs (WI 00246073)</p>
Structural metallic Products	<p>CEN/TC 121 'Welding'</p> <p>CEN/TC 132 'Alluminium and alluminium alloys'</p> <p>CEN/TC 133 'Copper and copper alloys'</p> <p>CEN/TC 135 'Execution of steel structures and</p>	<p>Hot rolled products of structural steels (EN 10025-1);</p> <p>Welding consumables - Filler metals for fluxes for fusion welding (EN 13479);</p> <p>High strength structural bolting assemblies for preloading (EN</p>	<p>Stainless steels - sheet/plate and strip of corrosion resisting steels for construction purposes (prEN 10088-4);</p> <p>Stainless steels - bars, rods,</p> <p>wire, sections and bright</p>

	<p>alluminium structures'</p> <p>CEN/TC 185 'Threaded and non-threaded mechanical fasteners and accessories'</p> <p>ECISS/TC 10 'Structural steels - Qualities'</p> <p>ECISS/TC 13 'Flat products for cold working qualities, dimensions, tolerances and specific tests'</p> <p>ECISS/TC 19 'Concrete reinforcing steel - Qualities, dimensions and tolerances'</p> <p>ECISS/TC 23 'Steels for heat treatment, alloy steels and free-cutting steels-qualities'</p> <p>ECISS/TC 29 'Steel tubes and fittings for steel tubes'</p> <p>ECISS/TC 31 'Steel castings'</p>	<p>14399-1)</p> <p>Aluminium and aluminium alloys - Structural products for construction works (EN 15088)</p> <p>Cold formed welded structural hollow sections of nonalloy and fine grain steels - Part 1: Technical delivery conditions (EN 10219-1)</p> <p>Hot finished structural hollow sections of non-alloy and fine grain steels - Part 1: Technical delivery conditions (EN 10210-1)</p> <p>Non-preloaded structural bolting assemblies - Part 1:</p> <p>General requirements (EN 15048-1);</p> <p>Steel castings for structural uses (EN 10340);</p> <p>High-strength structural bolting assemblies for preloading (EN 14399-7);</p> <p>System HV - Hexagon fit bolt and nut assemblies (EN 14399-8);</p>	<p>products of corrosion resisting (prEN 10088-5);</p> <p>Hot-rolled steel sheet piling (prEN 10248-1);</p> <p>Cold formed steel sheet piling (prEN 10249-1);</p> <p>Steels for quenching and tempering (prEN 10343);</p> <p>Steel and aluminium structural components (prEN 1090-1);</p>
Wall and ceiling finishes	<p>CEN/TC 67 'Ceramic tiles'</p> <p>CEN/TC 99 'Wallcoverings'</p> <p>CEN/TC 128 'Roof covering products for discontinuous laying and products for wall cladding'</p> <p>CEN/TC 175 'Round and sawn timber'</p> <p>CEN/TC 246 'Natural stones'</p> <p>CEN/TC 249 'Plastics'</p> <p>CEN/TC 277 'Suspended ceilings'</p> <p>BT/TF/119 'Stretched ceilings'</p>	<p>Suspended ceilings (EN 13964);</p> <p>Natural stone slabs for cladding (EN 1469);</p> <p>High-pressure decorative laminates (EN 438-7);</p> <p>Stretched ceilings (EN 14716);</p> <p>Slate and stone products (EN 12326-1);</p> <p>Fully supported metal sheet and strip for roofing, external cladding and internal lining - Product specification and requirements (EN 14783);</p> <p>Solid wood panelling and cladding - Characteristics, evaluation of conformity and marking (EN 14915);</p> <p>Decorative wall-coverings - Roll and panel form (EN 15102);</p>	<p>Plastics - Profiles for internal and external wall and ceiling finishes (prEN 13245-2);</p> <p>Agglomerated stone - Slabs and tiles for wall finishes (internal and external) (prEN 15286);</p>
Roof coverings	<p>CEN/TC 128 'Roof covering products for discontinuous laying and products for wall cladding'</p>	<p>Fibre-cement flat sheets (EN 12467);</p> <p>Fibre-cement slates and fittings (EN 492);</p> <p>Permanently fixed roof ladders (EN 12951);</p> <p>Fibre-cement profiled sheets and</p>	<p>Light transmitting single skin profiled plastics sheeting for internal and external roofing, wall cladding and ceiling finishes - Part 1: General requirements and test methods (prEN 1013-1);</p>

		<p>fittings (EN 494);</p> <p>Clay roofing tiles and fittings (EN 1304);</p> <p>Concrete roofing tiles and fittings (EN 490);</p> <p>Individual roof lights of plastics (EN 1873)</p> <p>Bitumen shingles with mineral and/or synthetic (EN 544)</p> <p>Prefabricated accessories for roofing-walkways, treads and steps (EN 516)</p> <p>Prefabricated accessories for roofing- Roof safety hooks (EN 517)</p> <p>Self-supporting metal sheet for roofing, external cladding and internal lining (EN 14782)</p> <p>Rigid underlays for discontinuous roofing - Definitions and characteristics (EN 14964):</p> <p>Self-supporting double skin metal faced insulating panels - Factory made products - Specifications (EN 14509)</p> <p>Corrugated bitumen sheets - Product specification and test methods (EN 534)</p> <p>Roof coverings - Continuous rooflights of plastics with or without upstands - Classification, requirements and test methods (EN 14963)</p>	
Road construction Products	<p>CEN/TC 127 'Road materials'</p> <p>CEN/TC 336 'Bituminous binders'</p>	<p>Joint fillers and sealants (EN 14188-1;EN 14188-2; EN 14188-3);</p> <p>Bitumen and bituminous binders (EN 13808*);</p> <p>Dowels for use in concrete pavements (EN 13877-3)</p> <p>Bituminous mixtures- Asphalt concrete (EN 13108-1)</p> <p>Bituminous mixtures-Asphalt concrete for very thin layers (EN 13108-2)</p> <p>Bituminous mixtures-Soft asphalt (EN 13108-3)</p> <p>Bituminous mixtures-Hot rolled asphalt (EN 13108-4)</p> <p>Bituminous mixtures- Stone mastic asphalt (EN 13108-5)</p> <p>Bituminous mixtures-Mastic</p>	<p>Slurry surfacing - Specifications (prEN 12273);</p> <p>Bitumen and bituminous binders - Specifications for paving grade bitumens (prEN 12591);</p> <p>Flexible sheets for waterproofing - Reinforced bitumen sheets for waterproofing of concrete bridge decks and other concrete surfaces trafficable by vehicles (prEN 14695);</p> <p>Bitumen and bituminous binders - Framework for specifying cutback binders (prEN 15322);</p>

		asphalt (EN 13108-6) Bituminous mixtures-Porous asphalt (EN 13108-7) Bitumen and bituminous binders - Framework specification for polymer modified bitumens (EN 14023) Bitumen and bituminous binders - Specifications for hard paving grade bitumens (EN 13924): Awaiting the finalization of package for citation in OJEU. Surface dressing - Requirements (EN 12271)	
Aggregates	CEN/TC 154 'Aggregates'	Aggregates for concrete (EN 12620); Bituminous mixtures (EN 13043); Mortar (EN 13139); Lightweight aggregates (EN 13055-1; EN 13055-2), Unbound and hydraulically bound materials (EN 13242); For railway ballast (EN 13450); Armourstone (EN 13383-1);	Completed
Adhesives	CEN/TC 67 'Ceramic tiles' CEN/TC 193 "Adhesives"	Adhesives for tiles (EN 12004); General purpose adhesives for structural assembly - Requirements and test methods (EN 15274); Structural adhesives. Characterisation of anaerobic adhesives for co-axial metallic assembly in building and civil engineering structures (EN 15275);	
Concrete mortar and grout	CEN/TC 104 'Concrete' CEN/TC 298 'Pigments and extenders'	Admixtures for concrete, mortar and grout (EN 934-2); Admixtures for grout for prestressing tendons (EN 934-4); Admixtures for masonry mortar (EN 934-3); Surface protection systems for concrete (EN 1504-2); Structural bonding (EN 1504-4); Concrete injection (EN 1504-5); Fly ash for concrete (EN 450-1); Pigments for the colouring of building materials based on cement and/or lime (EN 12878);	

		<p>Silica fume for concrete (EN 13263-1);</p> <p>Protection and repair of concrete structures -</p> <p>Structural and non-structural repair (EN 1504-3);</p> <p>Admixtures for sprayed concrete (EN 934-5);</p> <p>Products and systems for the protection and repair of concrete structures - Part 6: Anchoring of reinforcing steel bar (EN 1504-6);</p> <p>Products and systems for the protection and repair of concrete structures - Part 7: Reinforcement corrosion protection (EN 1504-7);</p> <p>Fibres for concrete - Part 1: Steel fibres - Definitions, specifications and conformity (EN 14889-1);</p> <p>Fibres for concrete - Part 2: Polymer fibres -</p> <p>Definitions, specifications and conformity (EN 14889- 2);</p> <p>Ground granulated blast furnace slag for use in concrete, mortar and grout - Part 1: Definitions, specifications and conformity criteria (EN 15167-1);</p> <p>Fly ash for concrete - Part 1: Definition, specifications and conformity criteria (EN 450-1);</p> <p>Admixtures for concrete, mortar and grout - Part 5:</p> <p>Admixtures for sprayed concrete (EN 934-5);</p>	
Space heating appliances	<p>CEN/TC 46 'Oil stoves'</p> <p>CEN/C 130 'Space heating appliances without integral heat sources'</p> <p>CEN/TC 295 'Residential solid fuel burning appliances'</p>	<p>Ceiling mounted radiant panels (EN 14037-1);</p> <p>Residential independent boilers fired by solid fuel (EN 12809);</p> <p>Residential cookers fired by solid fuel (EN 12815);</p> <p>Inset appliances including open fires fired by solid fuels (EN 13229);</p> <p>Room heaters fired by solid fuel (EN 13240);</p> <p>Radiators and convectors (EN 442-1);</p> <p>Slow heat release appliances</p>	<p>Sauna stoves fired by solid fuel - Requirements and test methods (WI 00295016)</p>

		<p>fired by solid fuel - Requirements and test methods (EN 15250);</p> <p>Flued oil stoves with vaporizing burners (EN 1:1998/prA1:2007);</p>	
<p>Pipes, tanks not in contact With drinking water</p>	<p>CEN/TC 69 'Industrial valves'</p> <p>CEN/TC 92 'Water meters'</p> <p>CEN/TC 155 'Plastic piping systems and ducting systems'</p> <p>CEN/TC 164 'Water supply'</p> <p>CEN/TC 193 "Adhesives"</p> <p>CEN/TC 203 'Cast iron pipes, fittings and their joints'</p> <p>CEN/TC 208 'Elastomeric seals for joints in pipework and pipelines'</p> <p>CEN/TC 221 'Shop fabricated metallic tanks and equipment for storage and for service stations'</p> <p>CEN/TC 235 'Gas pressure regulators and associated safety shut-off devices for use in gas transmission and distribution'</p> <p>CEN/TC 236 'Non-industrial manually operated shut-off valves for gas and particular combinations valves and other products'</p> <p>CEN/TC 266 'Thermoplastic static tanks'</p>	<p>Concrete pipes and fittings, un-reinforced, steel fibre and reinforced (EN 1916);</p> <p>Elastomeric seals (EN 681-1;EN 681-2; EN 681-3; EN 681-4; EN 682);</p> <p>Overfill prevention devices for static tanks for liquid petroleum fuels (EN 13616);</p> <p>Thermoplastic static tanks for above ground storage of domestic heating oils, kerosene and diesel fuels (EN 13341);</p> <p>Workshop fabricated steel tanks (EN 12285-2);</p> <p>Galvanized steel pipes and fittings with pigot and socket (EN 1123-1);</p> <p>Welded stainless steel pipes with spigot and socket (EN 1124-1);</p> <p>Non-alloy steel tubes and fittings (EN 10224);</p> <p>Joints for the connection of steel tubes and fittings (EN 10311);</p> <p>Welded stainless steel tubes (EN 10312);</p> <p>Leak detection systems (EN 13160);</p> <p>Copper and copper alloys - Seamless, round copper tubes for water and gas in sanitary and heating applications (EN 1057);</p> <p>Non-Alloy steel tubes suitable for welding and threading (EN 10255);</p> <p>Stainless steel pliable corrugated tubing systems in buildings for gas with an operating pressure up to 0,5 bar (prEN 15266);</p> <p>Corrugated safety metal hose assemblies for the connection domestic appliance using gaseous fuels (prEN 14800);</p> <p>Cast iron pipes and fittings, their joints and accessories for the evacuation of water from buildings - Requirements, test methods and quality assurance</p>	<p>Plastics piping systems for non pressure drainage and sewerage</p> <p>- Polyester resin concrete (PRC)</p> <p>- Part 1: Pipes and fittings with flexible joints (prEN 14636-1);</p> <p>Plastics piping systems for renovation of underground water supply networks - Part 3: Lining with close fit-pipes (prEN 14409- 3);</p> <p>Ductile iron pipes, fittings accessories and their joints for gas pipelines - Requirements and test methods (prEN 969 rev);</p> <p>Safety gas connection valves for metal hose assemblies used for the connection of domestic appliances using gaseous fuel (prEN 15069);</p>

		(EN 877); Adhesives for non-pressure thermoplastic piping systems - Specifications (EN 14680); Adhesives for thermoplastic piping systems for fluids under pressure - Specifications (EN 14814); Plastics piping systems - Soil and waste discharge systems within the building structure (EN 15012); Buried and above ground systems for water and other fluids under pressure - Performance characteristics for pipes, fittings and their joints (EN 15014); Systems for hot and cold water not intended for human consumption (prEN 15015); Ductile iron pipes, fittings, accessories and their joints for sewerage applications (EN 598);	
Amendment to m/104, m/111, M/109 Floor screeds	CEN/TC 241 "Gypsum products" CEN/TC 340 'Anti-seismic devices'	Binders, composite binders and factory made mixtures for floor screeds based on calcium sulphate (EN 13454-1)	Completed
Glass	CEN/TC 129 'Glass in buildings'	Coated glass (EN 1096-4); Thermally toughened soda lime silicate safety glass (EN 12150-2); Chemically strengthened soda lime silicate glass (EN 12337-2); Thermally toughened borosilicate safety glass (EN 13024-2); Basic alkaline earth silicate glass (EN 14178-2); Borosilicate glass (EN 1748-1-2); Glass ceramics (EN 1748-2-2); Heat strengthened soda lime silicate glass (EN 1863- 2); Basic soda lime silicate glass (EN 572-9); Laminated glass and laminated safety glass (EN 14449); Insulating glass units (EN 1279-5); Heat soaked thermally toughened soda lime silicate safety glass (EN 14179-2);	Mirrors from silver-coated float glass for internal use - Part 2: Evaluation of conformity/Product standard (prEN 1036-2); Thermally toughened soda lime silicate channel shaped safety glass - Part 2: Evaluation of conformity (prEN 15683-2); Glass in building - Basic alumino silicate glass products - Part 2: Evaluation of conformity/Product standard (prEN 15681-2); Glass in building - Heat soaked thermally toughened alkaline earth silicate safety glass - Part 2: Evaluation of conformity/Product standard (prEN 15682-2); Glass in Building - Thermally toughened soda lime silicate channel

		Thermally toughened alkaline earth silicate safety glass (EN 14321-2);	shaped safety glass - Part 2: Evaluation of conformity/Product standard (prEN 15683-2)
Construction products in Contact with drinking water	CEN/TC 69 'Industrial valves' CEN/TC 92 'Water meters' CEN/TC 155 'Plastic piping systems and ducting systems' CEN/TC 164 'Water supply' CEN/TC 193 "Adhesives" CEN/TC 203 'Cast iron pipes, fittings and their joints' CEN/TC 235 'Gas pressure regulators and associated safety shut-off devices for use in gas transmission and distribution' CEN/TC 236 'Non-industrial manually operated shut-off valves for gas and particular combinations valves and other products' CEN/TC 266 'Thermoplastic static tanks'		NOTE: CEN is awaiting detailed information from EC.
Amendment to m/103	CEN/TC 88 "Thermal insulating materials and products"		
Amendments to m/100, m/106, M/109, m/110, m/125			
Addendum to m/103	CEN/TC 88 "Thermal insulating materials and products"		
Amendment to m/110	CEN/TC 163 'Sanitary appliances'		
Amendment to m/129	CEN/TC 312 "Thermal solar systems and components"		
Amendment to m/107	CEN/TC 189 'Geotextiles and geotextile-related products"		

Amendment to m/124	CEN/TC 227 'Road materials'		
Reaction to fire test methods	127 'Fire safety in buildings'		
Resistance to fire	127 'Fire safety in buildings'		
Amendment to M/88	127 'Fire safety in buildings'		
Amendment to M/88	127 'Fire safety in buildings'		
Amendment to M/117	127 'Fire safety in buildings'		
Amendment to aoc fire	127 'Fire safety in buildings'		
Amendment to M/88	127 'Fire safety in buildings'		
Development of horizontal Standardized assessment methods For harmonized approaches relating to Dangerous substances under the CPD	351 'Construction products -Assessment of release of dangerous substances		
Amendment to M/129 to cover Thermal solar Systems			Thermal solar systems and components - Solar collectors - Part 1: General Requirements (prEN 12975-1)