Development of European Ecolabel and Green Public Procurement Criteria for Office Buildings
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Executive summary

The aim of this task 2 was to describe the market for office buildings as well as to provide information of expected demand for ecolabelled office buildings. In this sense, this task will provide crucial information for next tasks, because it provides information on structural characteristics of the office buildings market, recent trends and expected demand for ecolabelled buildings.

With this objective in mind, firstly, the EU-27 construction sector is analyzed in order to quantify the relative importance of the office building sector. Secondly, some indicators are provided in order to characterize office building market and recent trends (stock, take-up, etc.). General economic indicators as well as structural construction indicators are then presented in order to emphasize the importance of the economic and construction sector evolution for the office market. Thus, in order to do a more accurate forecast of the office market, information on general economic indicators has to be forecasted. To complete the analysis, some evidence to know whether demand for ecolabelled office buildings is likely to be higher or lower than demand for non-ecolabelled office buildings is provided. Finally, the analysis concludes providing Green Public Procurement (GPP) information and key environmental aspects that will inform the selection of the best environmental performance building.

Unfortunately, to the best of the authors´, there is no official data on office buildings stock in EU-27. Only for few countries some estimates have been found from different sources. Moreover, data on the office sector are often outdated and assembled from sector estimates, as a result of which their statistical validity can be doubted. Furthermore, the comparability of data between countries may be low because different definitions may have been used in the different countries. To sum up, office building data are not official and rarely harmonized between countries.

In terms of main results, first of all, office buildings are part of the non-residential buildings which represent 1% of the total building sector. Most of them are concentrated in the moderate climatic zones, are large office buildings and were mainly erected before 1975. Secondly, office rents and vacancy ratios are basically obtained from changes in national Gross Domestic Product (GDP), inflation and unemployment rates. In this sense, as economic growth in the EU-27 is expected to be accelerated over the 2010-2015 period from the forecasted

1.7% (2011) to a 2.4% GDP annual growth , this will result in an increased office employment in the EU-27 by an annual growth of 1.2%.

Demand for ecolabelled office buildings is likely to be higher than demand for non-ecolabelled office buildings since a significant positive relationship between occupancy rate and the ecolabel is found. Ecolabel premium in vacancy rates ranges from 2% to 18%.

Finally, public activity is a crucial element to be considered. The percentage of office buildings from the government and municipalities for some EU-27 countries e.g: The Netherlands (3%), Germany (20%), France (30%), Austria (17%) and Finland (11%). However, as a result of the financial crisis, public deficit and deficit indicators have increased dramatically. Only when economic recovery occurs and the crisis of confidence is over, the amount of money spent in environmental policy will equal the one observed in the years before the financial crisis.

1. Introduction

This task aims to describe the market for office buildings as well as to provide information on the expected demand for ecolabelled office buildings. In this sense, this task will provide crucial information for the remaining tasks of the project, because it will highlight structural characteristics of the office buildings market, recent trends and expected demand for ecolabelled buildings.

With this objective in mind, firstly, the EU-27 construction sector is analyzed in order to quantify the relative importance of the office building sector. Secondly, some indicators are provided in order to characterize the office building market and recent trends (stock, take-up, etc.). In particular, stock data will allow us to classify office buildings by climatic zone and age according to the categorization developed in Task 1. Then, general economic indicators as well as structural construction indicators are presented to emphasize the importance of the economic and construction sector evolution for the office market. Thus, in order to undertake an accurate forecast of the office market, it is needed to forecast information on general economic indicators. To complete the analysis, some evidence is provided to determine whether the demand for ecolabelled office buildings is likely to be higher or lower than the demand for non-ecolabelled office buildings. Finally, the analysis concludes providing Green Public Procurement (GPP) information and key environmental aspects that will help in the selection of the Best Environmental Performance building

In terms of GPP information, one could argue that often public authorities try to fight economic downturns through public investments, such us public construction procurement. However, the possibilities to do so depend on budget constraints. In this sense, a final section which examines government activity is needed. In this final section, the following information is provided. Firstly, data on size of the EU-27 government expenditure as well as the importance of environmental and construction expenditure in EU-27 government budget is provided to finish with the consequences of financial crisis to governments budgets.

Methodologically, official data from, basically, Eurostat, has been used together with data information from various Real Estate Companies in order to characterize and forecast the evolution of the office building market as well as to provide information on the public sector. In addition, information from some reports is used to provide and classify stock data. Finally, information from peer-review academic Journals is also used in order to forecast the demand for ecolabelled office buildings in comparison to non-ecolabelled office buildings.

2. Generic Data

2.1 Buildings in general

This section provides generic data in order to establish the basic elements of the construction sector that will be studied in the following sections of this report. It has to be noted that the main data source used is [Eurostat, 2010], although data from various Real Estate Companies [BNP Paribas Real Estate, 2007-2010; Dtz Research, 2009-2010; Jones Lang Lasalle, 2010; King Sturge, 2010; Knight Frank, 2010; Pike Research, 2011], among other reports [EURIMA, 2010a and 2010b; OTB Research Institute for Housing, Urban and Mobility Study, 2008] are also used for specific sections (mainly Tables 3 and 5). Some deviations exist between different data sources. In particular, Table 1 lists population of the EU-27.

The main focus was to start with information on data related to "building in general". Two are the main reasons for this approach. On the one hand, it allows approaching office buildings gradually from general buildings. That is especially relevant considering that office buildings are a very small part of the total building stock. In addition, behavior of the office building market is to some extent related to behavior of the total building market, since both markets

depend on the evolution of the economy. Secondly, the lack of data related to office buildings leaves no other option but to work with approximations.

With the availability of country specific data (basically from population and housing census[1]), information on the number of buildings[2] by type expressed in a measure of density (i.e. buildings per 1,000 inhabitants) can be extracted for almost all EU-27 countries (see Table 2). This density can be interpreted in terms of the relative importance of building total stock in relation to population. In this sense, the highest building density is observed in Greece (500.97 buildings/ 1000 inhabitants), Finland (484.92) and Austria (481.65). A higher building density can be caused by a higher density in residential buildings, by a higher density in non-residential buildings, or both. In the case of Finland and Austria this fact is caused, in part, by the high density of non-residential buildings in these countries, which is higher than 10 (per 1,000 inhabitants). Thus, Cyprus (31.32), Austria (13.20), Finland (12.90) and Belgium (12.18) are the countries with the highest non-residential buildings for every 1,000 inhabitants.

Office buildings are, however, only a part of the amount of non-residential buildings. In fact, as commented in Task 1, non-residential buildings can be: shopping centres, shopping malls, department stores, detached shops and boutiques, indoor markets, warehouses, exhibition halls, office buildings, bank buildings, air, rail or road transport terminals, parking garages and petrol and service stations.

This report will focus on **office buildings as defined in Task 1** "**A building which contains administrative, financial, technical and bureaucratic activities as core representative activities. The office area must make up a vast majority of the total building´s gross area dedicated to purpose providing a service to other companies or to individuals. Therefore, it could have associated other type of spaces, like meeting rooms, training classes, staff facilities, technical rooms, etc.**"

Table 1: Population in EU-27 (in millions of persons) [Eurostat 2010].

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
UE-27	471.60	473.38	474.33	476.29	478.40	480.69	482.70	484.71	487.00	427.36
Belgium	10.24	10.26	10.31	10.36	10.40	10.45	10.51	10.58	10.67	
Bulgaria	8.19	8.15	7.89	7.85	7.80	7.76	7.72	7.68	7.64	7.61
Czech Republic	10.28	10.27	10.21	10.20	10.21	10.22	10.25	10.29	10.38	10.47
Germany	82.16	82.26	82.44	82.54	82.53	82.50	82.44	82.31	82.22	82.00
Estonia	1.37	1.37	1.36	1.36	1.35	1.35	1.34	1.34	1.34	1.34
Ireland	3.78	3.83	3.90	3.96	4.03	4.11	4.21	4.31	4.40	4.45

[1] The majority of Census Data on EU-27 are from 2001.

[2] For almost all countries, buildings are the sum of residential and non-residential buildings. The exceptions are: Belgium, Estonia, Ireland, Lithuania, Luxembourg and Cyprus. In these countries census information includes the category "other type of buildings".

Greece	10.90	10.93	10.97	11.01	11.04	11.08	11.13	11.17	11.21	11.26
Spain	40.05	40.48	40.96	41.66	42.35	43.04	43.76	44.47	45.28	45.83
France	60.55	60.98	61.42	61.86	62.29	62.77	63.23	63.65	64.01	64.37
Italy	56.93	56.97	56.99	57.32	57.89	58.46	58.75	59.13	59.62	60.05
Latvia	2.38	2.36	2.35	2.33	2.32	2.31	2.29	2.28	2.27	2.26
Lithuania	3.51	3.49	3.48	3.46	3.45	3.43	3.40	3.38	3.37	3.35
Luxembourg	0.43	0.44	0.44	0.45	0.45	0.46	0.47	0.48	0.48	0.49
Hungary	10.22	10.20	10.17	10.14	10.12	10.10	10.08	10.07	10.05	10.03
Netherlands	15.86	15.99	16.11	16.19	16.26	16.31	16.33	16.36	16.41	16.49
Austria	8.00	8.02	8.06	8.10	8.14	8.20	8.25	8.28	8.32	8.36
Poland	38.26	38.64	38.24	38.22	38.19	38.17	38.16	38.13	38.12	38.14
Portugal	10.20	10.26	10.33	10.41	10.47	10.53	10.57	10.60	10.62	10.63
Romania	21.91	21.88	21.83	21.77	21.71	21.66	21.61	21.57	21.53	21.50
Slovenia	1.99	1.99	1.99	2.00	2.00	2.00	2.00	2.01	2.01	2.03
Slovakia	5.40	5.38	5.38	5.38	5.38	5.38	5.39	5.39	5.40	5.41
Finland	5.17	5.18	5.19	5.21	5.22	5.24	5.26	5.28	5.30	5.33
Cyprus	0.69	0.70	0.71	0.72	0.73	0.75	0.77	0.78	0.79	0.80
Denmark	5.33	5.35	5.37	5.38	5.40	5.41	5.43	5.45	5.48	5.51
United Kingdom	58.79	59.00	59.22	59.44	59.70	60.04	60.41	60.78	61.18	
Sweden	8.86	8.88	8.91	8.94	8.98	9.01	9.05	9.11	9.18	9.26
Malta	0.38	0.39	0.39	0.40	0.40	0.40	0.41	0.41	0.41	0.41

Table 2: Number of buildings by type [Eurostat (2010)].

Countries	Buildings	Residential Buildings	Non-residential	Buildings*	Residential*	Non-residential*
	(total amount)			(*amount per 1,000 inhabitants)		
Belgium	4,083,991	3,459,146	124,961	397.92	337.04	12.18
Bulgaria	3,680,126	3,677,618	2,508	451.58	451.27	0.31
Czech Republic	3,827,678	3,792,861	34,817	372.83	369.44	3.39
Germany	38,690,000	38,260,000	430,000	470.34	465.11	5.23
Estonia	617,399	607,629	2,508	451.66	444.51	1.83
Ireland	1,279,617	1,242,273	10,726	333.84	324.10	2.80
Greece	5,476,162	5,442,151	34,011	500.97	497.85	3.11
Spain	14,184,026	14,125,848	58,178	350.42	348.99	1.44
France	28,699,868	28,699,868	-	470.65	470.65	-
Italy	27,320,022	27,284,340	35,682	479.57	478.94	0.63
Latvia	795,700	795,700	-	336.55	336.55	0.00
Lithuania	1,292,336	1,265,339	3,895	370.62	362.87	1.12
Luxembourg	171,953	167,755	4,068	391.69	382.13	9.27
Hungary	4,064,653	4,042,829	21,824	398.48	396.34	2.14
Netherlands	6,456,036	6,456,036	-	403.83	403.83	-
Austria	3,863,262	3,757,409	105,853	481.65	468.45	13.20
Poland	12,523,583	12,475,349	48,234	324.07	322.83	1.25
Portugal	3,551,229	3,537,834	13,395	346.24	344.93	1.31
Romania	7,170,069	7,139,700	30,369	327.75	326.36	1.39
Slovenia	777,772	768,950	8,822	390.82	386.39	4.43
Slovakia	1,896,554	1,867,116	29,438	352.60	347.13	5.47

Finland	2,512,442	2,445,586	66,856	484.92	472.02	12.90
Cyprus	292,934	270,444	21,844	419.95	387.71	31.32

Note: There is no available data from Denmark, UK, Sweden and Malta.

As shown in Figure 1, the vast majority of buildings in the EU are residential.

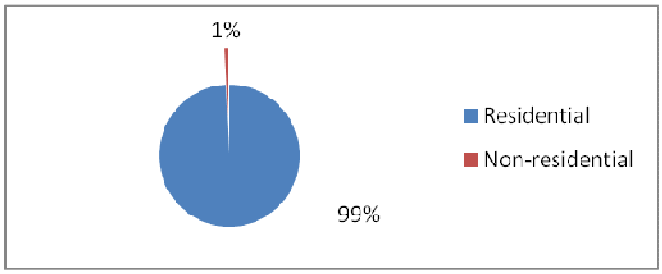

Figure 1: Percentage of Residential and Non-residential buildings [Eurostat (2010)]

Note: Excluding data from France, Latvia and Netherlands for whom data about non-residential buildings is not provided.

Table 3 presents census data on non-residential buildings by age. This is a first approximation to the classifications of office buildings that will be made in section 2.2., due to the fact that it is difficult to find data that distinguish among non-residential buildings and office buildings. Table 3 can be interpreted as a more disaggregated classification of non-residential buildings by age than Table 5 (and in terms of number of units).

Table 3: Non-residential existing buildings by age [Eurostat (2010)].

Non-residential	1996 and after	1991 to 1995	1981 to 1990	1971 to 1980	1961 to 1970	1946 to 1960	1919 to 1945	Before 1919	Unknown
Belgium	201,004	197,015	286,778	485,735	439,829	484,432	525,282	477,089	986,827
Bulgaria	124,364	139,980	730,395	829,245	685,026	671,996	406,302	89,501	3,317
Czech Republic	143,864	169,905	627,486	861,718	614,696	392,526	561,934	418,004	37,545
Germany	-	-	-	-	-	-	-	-	-
Estonia	11,562	16,553	118,396	128,764	117,823	59,106	77,963	48,849	38,383
Ireland	197,134	94,199	170,403	216,497	114,010	146,206	114,304	167,033	59,831
Greece	390,085	389,414	1,043,444	1,339,979	1,068,880	667,429	398,454	167,482	10,995
Spain	1,199,974	1,005,959	1,922,476	3,405,009	2,683,301	1,724,139	923,097	1,261,893	58,178
France	-	-	-	-	-	-	-	-	-
Italy	-	2,162,381	3,326,312	5,145,232	5,710,016	4,336,314	2,707,183	3,896,902	35,682
Cyprus	-	-	-	-	-	-	-	-	-
Latvia	4,600	23,339	164,695	175,029	146,621	79,972	111,036	89,642	766
Lithuania	26,967	60,286	302,996	321,676	242,172	138,764	142,835	50,111	6,529
Luxembourg	13,267	16,189	19,974	25,685	20,274	26,121	25,494	20,402	4,547
Hungary	120,045	118,706	764,395	902,796	592,306	473,834	514,269	578,302	-
Netherlands	382,005	425,999	1,020,001	1,187,985	1,068,021	980,029	877,002	514,994	-
Austria	-	559,867	486,402	-	1,243,436	475,654	333,156	764,747	-
Poland	864,418	507,882	2,511,762	2,208,270	-	3,340,295	1,700,943	1,294,006	96,007
Portugal	405,583	364,678	772,187	702,916	495,142	361,304	268,887	180,532	-
Romania	230,489	244,117	1,170,743	1,780,957	1,457,264	1,209,123	708,048	365,646	3,682
Slovenia	32,874	28,277	127,514	185,380	132,657	88,334	62,132	120,460	144
Slovakia	49,571	71,018	358,363	438,362	344,082	256,772	113,144	58,993	206,249
Finland	135,183	174,269	512,965	598,926	392,226	390,903	236,464	44,236	27,270
Liechtenstein	1,657	1,497	2,422	2,927	2,278	1,266	1,007	1,209	-

As follows, the information provided in Table 3 on non residential existing buildings is regrouped into the climatic zones presented in task 1 (See Task 1, table7).

Table 4: Non-residential existing buildings by age and climatic zone [Eurostat (2010)].

	< 16 years	16 to 20	21 to 30	31 to 40	41 to 50	51 to 65	66 to 92	> 92 years	Total
A1	178,312	274,447	1,099,052	1,224,395	898,842	668,745	568,298	232,838	5,144,929
%	3.47	5.33	21.36	23.80	17.47	13.00	11.05	4.53	**100 (5%)**
B1	2,359,035	2,573,154	8,274,216	9,122,630	6,711,601	8,545,322	5,942,010	4,869,177	48,397,145
%	4.87	5.32	17.10	18.85	13.87	17.66	12.28	10.06	**100 (47%)**
C2	390,085	389,414	1,043,444	1,339,979	1,068,880	667,429	398,454	167,482	5,465,167
%	7.14	7.13	19.09	24.52	19.56	12.21	7.29	3.06	**100 (55%)**
C1	1,605,557	3,533,018	6,020,975	9,253,157	8,888,459	6,421,757	3,899,167	5,339,327	44,961,417
%	3.57	7.86	13.39	20.58	19.77	14.28	8.67	11.88	**100 (43%)**
Total	**4,532,989**	**6,770,033**	**16,437,687**	**20,940,161**	**17,567,782**	**16,303,253**	**10,807,929**	**10,608,824**	**103,968,658**

[1]Data from Liechtenstein have not been used as no climatic zone was associated to this country. [2]Non residential building information for the period of time considered as "unknown" has not been included in the addition either.

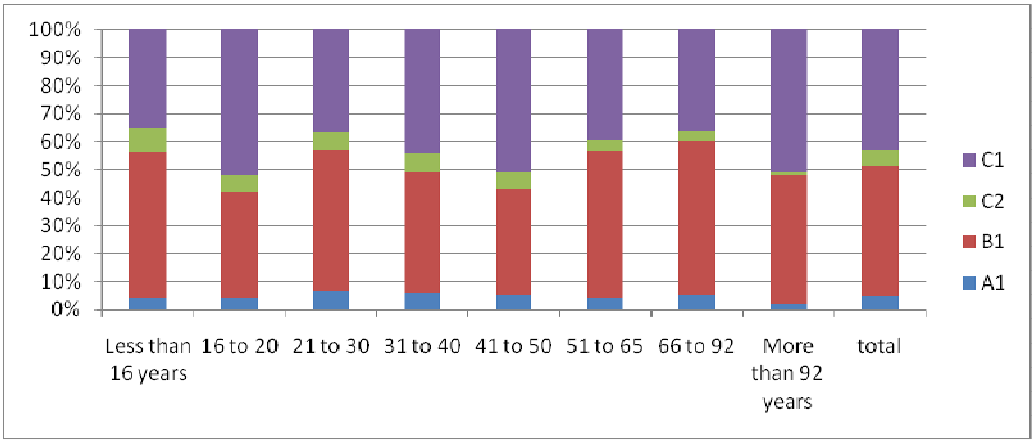

Figure 2: Non-residential existing buildings by age and climatic zone. [Eurostat (2010)].

From Table 4, it can be concluded that the existing non residential buildings are mainly located in climatic zone B1 (47%) and C1 (43%), while only around the remaining 10% are located in A1 (5%) and C2 (5%) respectively (see Figure 3).

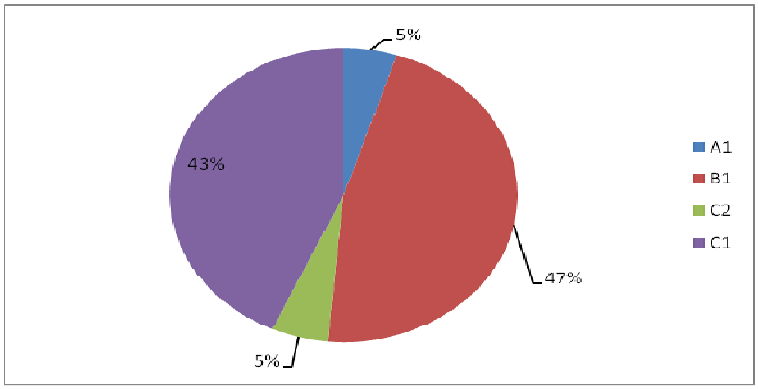

Figure 3: Distribution of non-residential buildings in the climatic zones. [Eurostat (2010)].

From Table 4, it can be concluded that the existing non residential buildings are mainly located in climatic zone B1 (47%) and C1 (43%), while only around the remaining 10% are located in A1 (5%) and C2 (5%) respectively (see Figure 3).

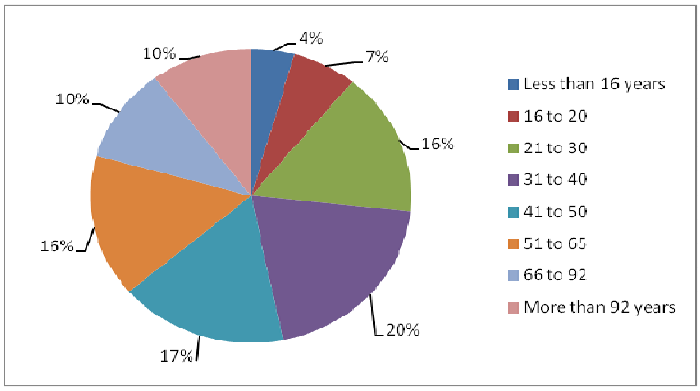

Figure 4: Distribution of non-residential buildings by age (in years).

Table 4 shows that currently there are around 104,000,000[3] existing non-residential buildings, 36% of which are over 50 years old (see Figure 3). Assuming that all buildings over 50 years old will be renovated (see Section 4.2), the 37% of the non residential building stock (those with an age between 31 and 50 years) are likely to be renovated in the following 20 years. Finally, assuming a total life span for buildings of 100 years (see Section 4.2 in this report), it is therefore expected that a 10% of the total (those older than 92 years) will be knocked down in the following 10 years.

2.2 Office buildings

Unfortunately, **there is no official data on office buildings stock in EU-27**. In fact, there is no country-data of this market for the EU-27. Only for few countries some estimates have been found from different sources. Moreover, data on the office sector are often outdated and assembled from sector estimates, as a result of which their statistical validity can be doubted. Furthermore, the comparability of data between countries may be low because different definitions may have been used in different countries. Unfortunately, the methodology and definitions used in many studies are not always clear. For instance, the definitions of "useful area" differ in each country (sometimes in terms of "useful floor area" and sometimes in terms of "heated area"). To sum up, office building data is not official and is rarely harmonised between countries. [Broin, 2007] summarizes and describes availability and how official and harmonised data are defined.

[3] It is worth to remind that no data from Germany and France are included on this figure, so the final number will be higher.

Table 5 reports the office building stock for the countries for which this information is available. Basically, information comes from [EURIMA, 2005b][4] report and [OTB Research Institute for Housing, Urban and Mobility Study, 2008] report. In this case, data are for different years (from 2003 to 2006) and are expressed in floor area for all countries except for Austria, Finland and the Netherlands expressed in terms of number of buildings. It is observed that Poland is the country with highest floor area dedicated to office buildings (Netherlands the country with the highest number of offices), while Latvia is the country with the highest office building stock per person.

Table 5: Office building stock [OTB Research Institute for Housing, Urban and Mobility Study, 2008][1], [OTB Research Institute for Housing, Urban and Mobility Study, 2008 and Odyssee, 2007][2], [EURIMA, 2010][3]

Countries	Stock (millions of m^2/Number of buildings)	Stock per 1,000 inhabitants
Austria[1]	32,235	3,875.1
Finland[1]	10,695	2,017.7
France[1]	182	2.8
Germany[2]	202	2.5
Netherlands[1]	60,000	3,657.3
Sweden[1]	34	3.7
UK[2]	106	1.7
Estonia[3]	13.9	10.4
Latvia[3]	27.3	12.0
Lithuania[3]	31.7	9.4
Poland[3]	286.3	7.5
Czech Republik[3]	105.2	10.1
Slovakia[3]	51.3	9.5
Hungary[3]	91.3	9.1
Slovenia[3]	18.3	9.1

The scope of this Task is to try to extrapolate the available information on office building stock into each of the office building categories defined in report "Product definition and scope". In doing so, Table 6 below is included providing an office stock categorization by building age, size and climatic zone. It is worth noting that the climatic classification presented in Table 6 (cold, moderate and warm) is somewhat different to that presented in report "Product definition and scope", which differentiates the climate zones by Heating and Cooling Degree Days (HDD and CDD respectively). Acknowledging the fact that efforts should be made to harmonise the climatic classification in both tasks, a decision was made to keep Table 6 in as it provides relevant information on the distribution of office building stock in these climatic zones that can not be segregated. In fact, this categorisation is the only one for which some office stock data is available.

[4] According to results of the stock per 1,000 persons, EURIMA data are, probably, data on non-residential buildings rather than office buildings. In the EURIMA report there is a contradiction between information on pages 66 (where it says literally “office buildings”) and 67 (where it says literally “non-residential buildings”)

Table 6 shows data from [EURIMA, 2005a] and [EURIMA, 2005b] and distinguishes three climatic zones according to HDD assumed by [STOA, 1998]: cold (4,500 Kd/a to 3,001 Kd/a), moderate (3,000 Kd/a to 1,801 Kd/a), and warm (up to 1,800 Kd/a)[5]. Countries included by the authors in each zone are:

- Cold: Finland, Sweden, Poland, Estonia, Latvia and Lithuania.
- Moderate: Austria, Belgium, Denmark, France, Germany, Ireland, Luxembourg, Netherlands, UK, Czech Republic, Slovakia, Hungary and Slovenia.
- Warm: Greece, Italy, Portugal and Spain.

For every location, the stock can be classified by age (buildings erected before 1975, buildings erected between 1976 and 1990 and buildings erected from 1990 to 2001) and building size (small office building of less than 1,000m^2 and large office buildings bigger than 1,000 m^2). Data covers up to 23 of the EU-27 countries (all EU-27 countries with the exception of: Romania, Bulgaria, Cyprus and Malta).

As observed, most office buildings are concentrated in moderate climatic zone (4,382.2 million of m^2), are large office buildings (4,278.7 million of m^2) and were erected before 1975 (6,277.2 million of m^2). Comparing climatic zones, in moderate climatic zones the difference between small and large size office buildings is maximum while in warm climatic zones is minimum. Moreover, in moderate climatic zones, the percentage of buildings erected before 1975 is almost 64%, while in warm climatic zone this percentage is only 46%.

[5] Classification was originally made for EU-15. In order to incorporate 8 new EU countries, Central-Eastern European countries can be considered within the moderate climatic zone and Estonia, Latvia and Lithuania within the cold climatic zone.

Table 6: Stock of office buildings by age, size and location (million of m^2) for 23 European countries. [EURIMA, 2010a and EURIMA, 2010b]

		Non-Residential < 1000 m^2	Non-Residential >1000 m^2	Total
Cold climatic Zone	< 1975	150.4	208.2	**358.6**
	1975-1990	63.5	84.3	**147.8**
	1991-2002	37.9	52.8	**90.7**
	Total	251.8	345.3	**597.1**
Moderate climatic Zone	< 1975	857.8	1944.8	**2802.6**
	1975-1990	249.5	554.1	**803.6**
	1991-2002	232.5	543.5	**776**
	Total	1339.8	3042.4	**4382.2**
Warm climatic Zone	< 1975	319	416	**735**
	1975-1990	199	259	**458**
	1991-2002	166	216	**382**
	Total	684	891	**1575**
Total	Total	**2275.6**	**4278.7**	**6554.3**

As stated before, the climatic classification presented in this section and Table 6 is somewhat different to the one presented in Task 1, where six main Climate Zones are identified according to HDD: A (above 4.001 HDD), B (between 2.500-4.000 HDD) and C (below 2.500 HDD) and CDD: 1 (CDD below 345) and 2 (CDD above 345). Acknowledging the fact that efforts should be made to harmonise the climatic classification in both tasks, a decision was made to keep Table 6 in as it provides relevant information on the distribution of office building stock in these climatic zones that can not be segregated. **Results derived from Table 4, however, are similar to results from Table 6 concluding that offices (or non residential buildings) are mostly concentrated in the moderate climatic regions.**

In **order to establish the market office status quo**, indicators such as take-up, availability or rents are needed. Unfortunately, to the best of teh authors´ knowledge, there is no available official data on the office buildings stock in EU-27. In fact, there is no country-data (at country level) for this market for the EU-27. Due to the fact that office buildings are concentrated in some cities or business centres[6] [Dtz Research, 2009; King Sturge, 2010; Knight Frank, 2010], the availability of data on office buildings is limited to these locations. Collecting information from various Real Estate Companies [BNP Paribas Real Estate, 2007-2010; Dtz Research, 2009-2010; Jones Lang Lasalle, 2010; King Sturge, 2010; Knight Frank, 2010; Pike Research, 2011], Table 7 can be constructed with **information from up to 17 cities across EU-27 countries**.

[6] For example, is considered that 25% of square meters dedicated to offices in Netherlands are in Amsterdam or 66% of square meters dedicated to offices in Poland are concentrated in Warsaw.

Table 7 shows the consequences of the economic situation in 2009, where there was employment destruction in all these cities. Moreover, economic conditions are not yet back to normal and employment destruction will still continue in the next months and even longer in some countries [Baily and Okun, 1965]. Occupier markets across Europe continued to deteriorate in 2009, with take-up falling significantly below the levels registered during 2008. On an annual basis, the most substantial falls were registered in Stockholm (-212.23%), Dublin (-57.33%), Bucharest (-56.14%), Luxembourg (-53.12%), Athens (-52%), Moscow (-68%) and Warsaw (-51.89%). By contrast, there were some signs of recovery in the Central London market (0.71%). Indeed, the most significant increases in demand are expected in the larger global centres, notably Central London and Paris. These markets went into the downturn the earliest and hardest as the financial crisis hit. But as the recovery in world demand has gathered pace, led by emerging Asia, they have also experienced the quickest turnaround. That is, these are the markets that first entered the crisis and also the first to recover from it. Elsewhere, the upturn is more gradual. In general, leasing activity across Europe continues to be driven by cost reduction and space rationalisation, with demand mainly concentrated in smaller premises (around 1,000m^2). Therefore, European net absorption rates in 2010 should not be positive (at present, information is collected for some quarters of 2010, but not for the whole year).

In this sense, availability continued to rise across the region with the average availability ratio reaching 11.8%, up from 2008 data. The considerable increase in availability was due to a combination of weak occupier demand and a surge in supply of new space (as well as in second-hand available space as tenants released surplus space back onto the market). On an annual basis, the most substantial availability ratios were registered in Dublin (22.9%), Budapest (20.6%), Amsterdam (19.8%) and Bucharest (17.5%). This fact was particularly worrying in Budapest and Bucharest, where the increase in the stock of offices´ square metres rose up to 28.5% and 13.4% respectively.

As a result of rising availability and weak demand, widespread rental declines across Europe were not surprising. In fact, this was the most positive news for occupiers, since the climate was presenting tenants with good opportunities to secure rent reductions, more flexible lease terms and other incentives as landlords look to avoid being left with vacant space on their hands[7] [King Sturge, 2010; Knight Frank, 2010]. At the end of 2009, rents finally stabilised after

[7] Companies are also taking advantage of a contracting market to secure office space in good quality buildings. As a consequence, relocations were the main driving force of demand and transaction activity in 2009.

dropping by 18% over two years, reaching what looked like the bottom line. Indeed, demand for prime offices rises since supply for these quality buildings remains limited. By contrast, significant corrections in prime rents were registered in those markets where rents have been slower to respond to changing market conditions. For example, rents drop in cities such as Madrid where tenants still are in an advantaged position in negotiations. Moreover, rents should continue to dip in most peripheral areas of European cities where vacancy rates remain high and important developments took place in the last three years [King Sturge, 2010; Knight Frank, 2010].

To sum up, as a consequence of the economic situation in 2009, where there was employment destruction in all these cities, office market indicators from cities from up to 17 of the EU-27 countries show rising availability (higher than 10%), weak demand and widespread rental declines (18%) across Europe since 2008.

Table 7: 2009 Key office market indicators for major centres of UE-27 countries [BNP Paribas Real Estate, 2007-2010; Dtz Research, 2009-2010; Lasalle, 2010; Sturge, 2010; Frank, 2010; Pike Research, 2011].

	Take-up 2009[1]	Take-up[2] Growth	Stock[1]	Stock[2] Growth	Available space[1]	Availability[3]	Rents[4]	Rents Growth[2]
Paris (CBD)	1,483.0	-24.21	7,018.9	0	372.0	5.3	63	15.4
London (CBD)	997.0	0.71	88,000.0	3.2	6,952.0	7.9	56	23.0
Luxembourg	119.3	-53.12	3,200.0	2.8	222.4	7.0	40	0
Bratislava	87.0	-38.30	1,014.0	-	-	10.7	-	-
Athens	60.0	-52.00	-	-	-	12.1	-	-
Dublin	95.8	-57.33	3,245.9	0.6	743.3	22.9	29	-7.2
Stockholm	-156.0	-212.23	11,300.0	0.6	1,389.9	12.3	41	15.8
Madrid	298.0	-38.43	11,463.0	1.4	928.5	10.0	24	-10.7
Amsterdam	190.0	-38.51	6,504.1	-2.1	1,287.8	19.8	31	10.3
Warsaw	221.2	-51.89	3,400.0	5.5	244.8	7.2	24	0
Bucharest	131.5	-56.09	1,680.0	13.4	294.0	17.5	19	-9.5
Prague	246.3	-5.39	2,698.0	0.3	356.1	13.2	21	0
Brussels	407.8	-30.35	12,990.0	1.5	1,597.8	12.3	23	5.8
Budapest	260.0	-21.28	3,083.0	28.5	635.1	20.6	14	0
Vienna	295.0	-26.25	-	-	-	5.0	-	-
Berlin	429.5	-8.23	17,725.0	0.6	1,524.4	8.6	22	2.3
Milan	176.0	-35.06	12,000.0	2	870.0	8.8	41	2.1

Notes: [2] Growth (%), [3] % of stock, [4] €/ m^2/month (%).

Glossary definition: Take-up growth represents the new total floor space (In 1000 m^2) known to have been let or pre-let, sold or pre-sold to tenants or owner-occupiers during the survey period. Available space: is total floor space (In 1000 m^2) remained unused (unsold unlet) during the survey period. Stock is total office building floor space (In 1000 m^2) in this city

3. Construction sector: Indicators, Evolution and Forecast

3.1 General economic Indicators

Table 8 shows the main economic indicators for the EU-27: GDP (Gross Domestic Product), inflation rate, GFCF (General Fixed Economic Formation) and unemployment rate. The connection of these indicators with the construction and, especially, with the office building market is as follows. The behaviour of the office market is a consequence of overall economic performance. In an expanding economy (demand and investment growth, GDP growth, inflationary pressures, unemployment rate decline), this economic performance will lead to more demand for office buildings and, therefore, diminishing space availability and increasing rents. In an economy in crisis (decline in demand and investment, decrease of GDP, deflationary trend, increasing unemployment rate), this performance will result in decreased demand for office buildings and, therefore, excess of space availability and decreasing rents.

In terms of GDP, last decade was one of economic stagnation. Thus, cumulative economic growth only reached 5.9% from 2000 to 2010. On the one hand, this is due to the fact that the higher obtained cumulative growth GDP rates were from countries with low participation in European GDP (basically Eastern European countries). On the other hand, most Western European countries with high participation in European GDP, obtained low (or even negative) cumulative growth GDP rates. That is the case for Germany, Italy, Denmark and Ireland. Analysing 2010 growth GDP rates, the scenario is of clear economic recovery from the bust experienced in 2009. This economic recovery cannot be extended to all European countries. Countries from the south of Europe (Portugal, Italy, Greece and Spain), Ireland and some Eastern European countries (Bulgaria, Romania, Latvia, Lithuania, Hungary and Slovenia) have been in economic recession or stagnation in 2010.

However, GFCF (investment component of the GDP) is still decreasing for the EU-27 (-0.6%). In fact, only Germany, Italy, Luxembourg, Malta, Poland, Slovakia, Finland, Sweden and the United Kingdom have clearly increased their GFCF in 2010 with respect to 2009. GFCF can be understood as a sign of economic recovery consolidation. In this sense, most of these countries have experienced significant economic growth in 2010 (Germany, Luxembourg, Malta, Poland, Slovakia, Finland, and Sweden).

Inflation rate in 2010 is around 2% (2.1%), fulfilling the aim of price control from the European Central Bank (ECB). Moreover, in 2010, the deflation risk has significantly decreased for almost all European countries. Only Ireland, Latvia and, probably, the Netherlands and Slovakia are in risk of deflation. The EU-27 as a whole has definitely removed deflation risk. Actions of ECB (which includes maintaining interest rates at 1% and periodic injections of liquidity) have significantly contributed to achieve this aim. Finally, and as a consequence of the intense recession period experienced in 2008 and 2009, unemployment rate of the EU-27 has reached 9.6%. This rate of unemployment is concentrated in the following countries: Spain (20.1%), Latvia (17.1%), Slovakia (14.5%), Estonia (13.8%), Lithuania (13.7%), Ireland (13.5%), Greece (12.9%) and Portugal (10.9%). In all cases, these are countries whose economic models are based in highly intensive labour force activities such as construction or tourism.

To sum up, and in order to connect with the office building market, economic indicators show an scenario of clear economic recovery from the bust experienced in 2009 (since GDP growth is positive and higher in 2010 with respect to 2009), which can be interpreted as a sign of short term recovery of office building demand. However, the investment component, which is the most related one to the still decreasing office building market, can be interpreted as an absence of economic recovery consolidation. That is, recovery is unstable at this moment. The absence of a clear inflationary pattern (although it seems EU-27 have avoided deflation risk) and a higher and difficult to reduce unemployment rate, reinforce this point. Obviously, a higher dispersion is found when countries are analysed individually. Thus, Germany, Luxembourg, Malta, Poland, Slovakia, Finland, Sweden and the United Kingdom show a stable economic recovery (that is a higher probability of demand for office buildings), while Portugal, Italy, Greece, Spain, Ireland, Bulgaria, Romania, Latvia, Lithuania, Hungary and Slovenia show a scenario of recession or stagnation (that is a lower probability of demand for office buildings).

Table 8: General Economic indicators. [Eurostat (2010)]

Countries	%GDP[1] 2008	%GDP[1] 2009	%GDP[1] 2010	Cumulative[2] 2000-2010	%GFCF[3, 1] 2010	Inflation rate 2010	Unemployment rate 2010
EU-27	**0.5**	**-4.2**	**1.8**	**105.9**	**-0.6**	**2.1**	**9.6**
Belgium	1.0	-2.8	2.0	118.0	-1.1	2.3	8.4
Bulgaria	6.2	-4.9	-0.1	238.9	-9.8	3.0	9.9
Czech Republic	2.5	-4.1	2.4	126.9	-1.8	1.2	7.4
Denmark	-1.1	-5.2	2.3	101.9	-3.8	2.2	7.5
Germany	1.0	-4.7	3.6	94.5	5.5	1.2	6.8
Estonia	-5.1	-13.9	2.4	146.1	-6.6	2.7	13.8[4]
Ireland	-3.5	-7.6	-0.2	87.6	-21.1	-1.7[4]	13.5
Greece	1.3	-2.3	-4.2	115.1	-17.4	4.7	12.9
Spain	0.9	-3.7	-0.2	115.7	-7.9	1.8	20.1
France	0.2	-2.6	1.6	114.7	-1.7	1.7	9.7

Italy	-1.3	-5.0	1.1	95.8	2.4	1.6	7.8[4]
Cyprus	3.6	-1.7	0.5	160.3	-12.9	2.6	6.8
Latvia	-4.2	-18.0	-0.4	146.8	-24.8	-1.2	17.1[4]
Lithuania	2.9	-14.7	0.4	153.0	-8.5	1.2	13.7[4]
Luxembourg	1.4	-3.7	3.2	128.5	8.7	2.8	4.7
Hungary	0.8	-6.7	1.1	127.2	-1.9	4.7	11.2
Malta	2.7	-1.9	3.1	68.9	9.6	2.0	6.7
Netherlands	1.9	-3.9	1.7	100.0	-4.3	0.9	4.5
Austria	2.2	-3.9	2.0	100.7	-2.6	1.7	4.6
Poland	5.1	1.7	3.5	140.2	0.1	2.7	9.7
Portugal	0.0	-2.5	1.3	79.2	-4.1	1.4	10.9
Romania	7.3	-7.1	-1.9	224.9	-9.9	6.1	6.9[4]
Slovenia	3.7	-8.1	1.1	126.8	-4.4	2.1	7.2
Slovakia	5.8	-4.8	4.1	130.7	1.7	0.7	14.5
Finland	0.9	-8.2	2.9	106.3	0.4	1.7	8.4
Sweden	-0.6	-5.3	4.8	116.1	5.9	1.9	8.4
United Kingdom	-0.1	-4.9	1.4	106.7	2.8	2.2[4]	7.6[4]

Notes: [1]Growth percentage from previous year; [2]100 refers to the year 2000; [3]Gross Fixed Capital Formation (GFCF); [4]Data from 2009 (2010 is still unavailable)

3.2 Structural construction indicators

Once the general economic indicators and their influence in the office building market have been commented, the analysis continues with the discussion about structural indicators of the construction sector. As it has been stated previously, the office building sector is a part of the non-residential building sector, which is also a part of the building sector. Although less important quantitatively, the non-residential building sector (and also the office building sector) shares certain trends and characteristics with the overall building sector. In addition, knowing the future trends for the overall building/construction sector could provide some clues in order to establish future trends for the office building sector (sharing its relationship in both cases with the evolution of the overall economy, for example).

Historically, the European construction sector has experienced cyclical patterns to its development. These may be linked to consumer confidence, the availability of credit (often in the form of mortgages), political events (such as the construction boom in Germany following reunification), or general economic cycles. As stated before, construction sector is intensive in labour force and is a pro-cyclical sector, that is, peaks and troughs in construction activity tend to be more amplified than those for the whole economy. This can perhaps be linked to a result

of large projects being postponed and/or cancelled during periods when economic output slows or contracts [Muellbauer and Murphy , 1997; Ortalo-Magné and Rady, 1999].

In recent years, the European construction industry has been highly concentrated in Spain, Ireland, Poland and Cyprus. As an example, almost 50% of the economic growth experienced in Spain from 1998 to 2008 was related to the construction sector. Besides, around one quarter of all persons employed in the Polish non-financial business economy were employed within construction activities in 2007 [Rodriguez, 2008; Dtz Research, 2009; Sturge, 2010; Frank, 2010].

Table 9 provides detailed information on structural indicators from the construction sector within EU-27. In particular information related to the number of enterprises, turnover (in millions of €), Gross Value-Added (GVA) as percentage of total value-added of the economy, employees, apparent productivity (value-added in €1,000 per person), and investment rate (percentage of investment divided by value added) are given. In almost all cases, these indicators provide information on the importance of this sector. That is, the higher the indicator value is, the higher the importance of this construction sector on the overall economy is. In this sense, there are some indicators that can be considered to be related to the economic development, as follows:

- GVA is especially important because it provides a relative measure of value (which does not depend on the size of the country).

- Apparent productivity can be interpreted as a measure of efficiency: the higher the value, the higher the production per person in the building sector.

- Investment rate can be interpreted in terms of renovation or modernisation of the sector. The higher the investment rate is, the higher is the percentage of GVA dedicated to investment. This fact indicates that the production would be increased in the future.

There were an estimated 3,090,144 construction enterprises at EU-27 which generated an estimated turnover of €1,665,092 and employed 147,880 persons[8]. The GVA can be used as an indicator of the relative weight of the construction sector: in 2009 6.3% of the total GVA of the whole EU-27 economy came from the construction sector, meaning that it is a very important sector for the UE. The quantitative importance of this sector is especially significant in Bulgaria

[8] The construction sector is divided in five subsectors (site preparation, general construction, building installation, building completion and renting of construction equipment). The general construction sector (which involves building complete constructions and civil engineering) is the one which accounts for the greatest value-added (58%) and persons employed (55%).

(8.6%), Ireland (8.5%), Spain (10.8%), Cyprus (9.0%), Romania (10.9%) and Slovakia (8.8%). At this point, it is useful to remind that 2009 was the second year of the financial crisis and therefore these percentages were higher in previous years (however, percentages in 2009 reflect better long-term trends for this sector in the UE). In 2007, the relative contribution made by the construction sector to the GVA of the non-financial business economies of the EU-27 was around 9.5%, being notably higher in Cyprus (19.4%), Poland (18.1%) and Spain (17.6%). Apparent productivity within the EU-27 construction sector was, in average, €38,000. That is, each person employed within the EU-27 construction sector generated an average €38,000 of value added in 2007. This value is lower than in other sectors what indicates the labour-intensive characteristic of this sector. This fact is seen from the lower percentage of investment with respect to GVA, 12%, which is, around 25% for an average sector of the EU economy. In fact, the bigger values observed in Romania and Bulgaria for the investment indicator only shows that it is a non-developed sector. All these values characterise the building sector in Europe as an important but not very productive sector (with the exception of some East European countries in which this sector is underdeveloped). The office building sector shares these characteristics. However, some innovations such as the development of an ecolabel can be seen as an advantage to modernise, renovate or even increase the efficiency of the sector.

Table 9: Structural indicators of the construction sector. Source: [Eurostat (2010)]

Countries	Number Enterprises	Turnover	GVA	Persons employed	Apparent Productivity (1,000€)	Investment (%)
EU-27	**3,090,144**	**1,665,092**	**6.3**	**147,880**	**38.0**	**12.0**
Belgium	66,619	43369.3	5.4	271,782	45.3	25.3
Bulgaria	18,193	6716.7	8.6	221,176	7.9	92.2
Czech Republic	153,156	16187.3	7.4	401,661	15.1	13.5
Denmark	35,611	30655.8	5.0	206,829	53.6	10.2
Germany	220,663	139221.6	4.3	1,521,751	38.1	6.9
Estonia	6,431	4322.2	7.0	58,933	19.0	15.3
Ireland	1,344	-	8.5	70,971	112.1	10.4
Greece	108,830	15467.1	4.5	304,589	20.4	15.4
Spain	456,358	295272.0	10.8	2,880,513	35.1	9.1
France	435,326	213764.3	6.4	1,724,266	43.9	8.2
Italy	615,862	146991.2	6.3	1,964,195	36.0	16.0
Cyprus	5,987	2684.1	9.0	36,799	37.4	7.3
Latvia	5,974	5542.4	6.6	85,922	16.7	27.8
Lithuania	19,545	5382.4	6.3	139,197	13.0	19.2
Luxembourg	2,266	4156.6	5.8	37,628	45.0	3.4
Hungary	69,939	11912.3	4.8	242,794	10.8	16.8
Malta	-	-	3.4	-	-	-

Netherlands	85,910	82021.2	6.0	486,171	53.2	7.2
Austria	26,965	32681.3	7.3	261,861	52.1	6.1
Poland	205,440	40832.9	7.5	796,882	16.0	15.9
Portugal	122,487	33043.4	6.1	514,514	18.4	19.9
Romania	46,925	18073.0	10.9	513,355	10.2	139.1
Slovenia	17,176	-	7.9	79,853	22.1	25.3
Slovakia	4,981	5054.5	8.8	74,470	15.6	29.7
Finland	40,456	22324.6	7.0	146,692	54.5	11.0
Sweden	73,388	12166.5	5.4	298,460	49.7	-
United Kingdom	240,401	283412.2	5.9	1,430,515	75.5	8.7

Note: All data are from 2007 with the exception of Gross Value-Added values, which are for 2009.

It is expected, that statistics from 2008-2009 will show a significant reduction on the impact of the economic downturn on these variables what will correspond to a reduction of the indicator values shown in Table 9. Recent finance crisis and economic downturn have had some serious implications for the EU-27 construction sector. As commented, employment ratios fell sharply in many EU-27 countries, particularly in Spain and the Baltic countries [BNP Paribas, 2010; Dtz Research, 2009; King 2010; Knight, 2010].

In this sense, once the importance of the recent downturn and its implications for the construction sector is determined, some indicators in order to establish the short term evolution of the construction sector are required. Table 10 shows detailed information on short-term indicators for the construction sector within EU-27. This information is provided in order to assess the current status quo of the sector. All information is from 2010. As previously reported, major employment decreases are observed in: Latvia (37.68%), Spain (23.03%), Lithuania (21.45%), Estonia (16.02%) and Romania (15.45%). The downsizing of the workforce is reflected in a declining output [Baily and Okun, 1965], as the EU-27 Construction Production Index fell by 14.2% in 2009 and 8.91% in 2010. Major decreases in this index are observed in: Lithuania (48.49%), Ireland (36.42%), Bulgaria (34.76%) and Estonia (28.48%). As demand falls, gross wages present negative growth rates for the EU-27 (-6.64%), especially in Lithuania (-46.97%), Latvia (-45.15%), Estonia (-26.99%) and Spain (-25.78%) However, considering year 2005 as baseline (i.e. 100%), construction costs in EU-27 in 2010 are 13.34% higher than those from 2005 (in real terms it can be assumed that costs have remained constant) with the highest increases observed in Latvia (66.20%), Portugal (46.33%) and Latvia (42.20%). All this information points out a sector with lower and decreasing demand (and, therefore wages).

In this sense, a continuous adjustment to the construction sector is expected for years 2011 and 2012 with an eventual recovery in year 2013 [BNP Paribas, 2010; Dtz Research, 2009; King

Sturge, 2010; Knight Frank, 2010]. This is the usual prediction included in the last Real Estate and International Institutions Reports. The reason is that 2011 and 2012 are forecasted as the years for the overall economic recovery. However, as already commented, the construction sector is a procyclic sector with some lag with respect to overall economy [Muellbauer and Murphy, 1997; Ortalo-Magné and Rady, 1999], and therefore the recovery of the construction sector is expected to happen later on. In terms of the office building sector this fact implies that the construction of new office buildings is also expected to grow from 2013 onwards, what means that the lag of the construction section in relation to the overall activity, would be lower for the office building sector. As a consequence of this evolution, it is expected that a reduction of available space will start in 2011-2012 [Giussani et al, 1993; De Wit and Van Dijk, 2003; Kennedy, Lee and McAllister, 2007].

Table 10: Short-term indicators of the construction sector. [Eurostat (2010)]

Countries	Construction production Index[1]	Employment[1] (%)	Gross wages[1] (%)	Construction cost (2005→100%)
EU-27	**-8.91**	**-7.85**	**-6.64**	**113.34**
Belgium	-6.63	-0.12	-0.03	109.86
Bulgaria	-34.76	-10.36	11.14	142.20
Czech Republic	-0.46	-1.41	1.09	112.70
Denmark	-17.78	-13.61	-13.05	114.10
Germany	0.05	1.25	1.38	109.50
Estonia	-28.38	-16.02	-26.99	115.30
Ireland	-36.42	-	-	91.20
Greece	-20.43	-1.28	0.55	114.90
Spain	-11.27	-23.03	-25.78	119.60
France	-5.86	-2.22	-1.36	117.00
Italy	-11.49	-	-3.49	-
Cyprus	-11.10	-4.87	-1.67	119.69
Latvia	-34.92	-37.68	-45.15	166.20
Lithuania	-48.49	-21.45	-46.97	114.84
Luxembourg	0.97	-1.62	4.14	111.02
Hungary	-4.35	-8.08	-3.95	127.10
Malta	-6.71	-7.99	-2.56	111.40
Netherlands	-5.93	-1.94	1.13	116.27
Austria	-1.65	2.96	5.10	115.57
Poland	4.50	3.88	7.78	111.84
Portugal	-6.63	-7.69	-8.28	146.33
Romania	-15.21	-15.45	-10.44	116.50
Slovenia	-20.92	-1.35	1.18	117.00
Slovakia	-11.13	1.95	1.60	112.57
Finland	-13.15	-5.72	-4.37	120.00
Sweden	-3.46	1.03	0.04	103.30
United Kingdom	-11.62	-6.75	-2.41	-

Notes: [1]Growth percentage from previous year

3.3 Short-term office building indicators

Focusing on the evolution of the office buildings, Table 11 presents detailed information on the office building permits. A building permit is an authorisation to start working on a building project and it can be considered as the final stage prior to starting the construction work. The objective of building permits indices is to assess the development of construction activity[9], that means, it is a short-term activity indicator. In fact, building permits information is a so-called "advanced indicator", as it allows the prediction of future construction activity. Thus, a higher level of current building permits can be interpreted as a higher level of construction activity.

Office buildings are a subsector of the construction sector which is particularly sensible to economic evolution [Giussani et al, 1993; De Wit and Van Dijk, 2003; Kennedy et al, 2007)]. The depth of the downturn since 2007, where office buildings permits rose by 11.6% [Eurostat, 2010b], may be due to a combination of:

- such a previous oversupply of construction;
- a reduction of consumer and business confidence delaying investment plans;
- a constraint of finance from credit lenders during the crisis to finance building work;
- and cuts-off in public spending (public sector applied an expansionary-countercyclical policy in 2008 and the beginning of 2009, however the increasing public deficit led to the European countries to come back to restrictive fiscal policy, see section 5 of this task for details).

As a consequence, an important decrease in the number of permits in the office building sector in 2009 was observed (32.41%). This decreasing pattern was particularly significant in: Lithuania (74.38%), Slovakia (50.81%), Spain (46.22%) and Bulgaria (40.89%).

Unlike the index for residential buildings, from 2000 to 2009 the index for non-residential buildings was less regular [Eurostat, 2010], office building permits show frequent changes between positive and negative rates of change. Although the rates of change for non-residential buildings were generally smaller, the office buildings sub-index was relatively

[9] The type of building permit used in office buildings relates to the authorised useful floor area which covers all types of buildings. The number of permits only covers residential units.

volatile as annual rates of change were often in excess of +/-10% (with respect to residential or non-residential index for which annual rates vary rarely are out of the +/-5% range). In terms of the office building index, all EU-27 countries presented a decrease in the building permits index in 2009 with respect to that in 2008. Decreases are particularly significant in Bulgaria, Spain, Lithuania, Slovakia and Sweden. Reflecting its volatile behaviour, the office building area index recorded a positive rate of change in the third quarter of 2010 [Eurostat, 2010] what can be interpreted as a first sign of recovery, even though it must be confirmed with future data.

Almost all markets in Europe moved forward on the cycle in 2009 and are expected to see a slowdown in building permits falls as they experience improved take-up and a more stable vacancy. In many markets, however, the improvement in take-up is not yet sustainable (sometimes pick-up reflects the completion of a number of large deals which have been under negotiation for some time rather than the start of a meaningful recovery). Thus, the basic scenario for 2009 has remained at declining accelerating office building permits. To sum up, for many cities, recovery is not a consolidated scenario, and the improvement in take-up can be interpreted as temporal (only as a result of the completion of deals which are previous to 2009). In this sense, the real scenario is still declining accelerating office building permits.

Table 11: Office building permits in 1,000 m^2 of usable area. [Eurostat (2010)]. Annual percentage of change and Index

Office building permits	% change versus previous year				Index. 2005 →100%		
	2000	2005	2008	2009	2000	2008	2009
EU-27	13.00	-6.55	-0.32	-32.41	143.44	139.92	94.57
Belgium	8.50	15.10	3.85	-19.60	119.80	60.93	48.99
Bulgaria	-	15.94	44.60	-40.49	54.64	227.65	135.48
Czech Republic	-	6.47	-2.94	-39.15	72.18	118.10	71.86
Denmark	-	-	-	-	-	-	-
Germany	11.97	-10.43	17.74	-10.75	217.84	136.44	121.77
Estonia	-13.55	-15.43	-58.83	-16.41	23.84	175.73	146.89
Ireland	-	-21.01	12.77	-26.78	92.69	169.37	124.02
Greece	-	68.96	-22.90	-31.12	-	64.29	44.29
Spain	39.98	1.27	-6.42	-46.22	88.84	247.90	133.31
France	37.02	14.59	4.23	-20.73	103.35	129.13	102.36
Italy	-	-	-	-	-	-	-
Cyprus	-	51.62	70.41	-18.90	91.72	97.63	79.18
Latvia	208.72	74.00	6.10	-19.37	33.05	213.02	171.75
Lithuania	91.11	-36.55	-31.32	-74.38	75.06	311.13	79.71
Luxembourg	-	-65.16	77.89	-20.26	1374.04	1092.77	871.38
Hungary	-32.62	286.99	65.39	9.29	66.85	104.66	114.39
Malta	-	-	-	-	-	-	-
Netherlands	5.98	-9.11	12.08	-21.53	282.46	141.03	110.66
Austria	-	-	-34.11	-32.47	-	73.36	49.54
Poland	-	16.24	137.57	-18.04	86.41	210.23	172.30
Portugal	15.66	-77.19	71.47	-5.57	892.67	116.36	109.88
Romania	-	138.04	0.90	10.04	36.67	139.68	153.71
Slovenia	-26.24	-4.75	-3.99	-8.52	254.56	178.82	163.59

Slovakia	-	27.02	7.66	-50.81	-	174.93	86.05
Finland	102.36	14.50	-39.48	-43.09	290.14	122.05	69.45
Sweden	-15.35	142.74	63.60	-36.70	233.29	213.92	135.41
United Kingdom	-0.01	-6.94	-5.98	-26.88	122.40	88.37	64.62

In terms of replacement rate, the building heterogeneity and the importance of location in determining property values, make estimates of depreciation rates particularly arbitrary. [Salway, 1986], for example, estimates depreciation from rental value based methodology, for British offices and reports, averaging around 3% per year. In contrast, [Baum, 1991] suggested a much lower value, giving a rate of 1% per year for city offices. [Ball, 2003] reported 5%, 4% and 3.33% values using, as a methodology to calculate depreciation, the rate of withdrawal of UK commercial buildings analysis. As we can see, these estimates are higher with respect to previous depreciation estimates. Keeping these estimations in mind, years for full renovation of the stock building are: 15 years (5%), 18 years (4%), 22 years (3.33%), 24 years (3%) and 70 years (1%). According to take-up values of Table 7 and understanding them not only in terms of replacement rate but also as refurbishments and new offices in market, a value of 3% can be assumed.

3.4 Forecast

On the one hand, taking into account the former indicators, it is expected that the scenario for building permits during 2010-2011 will change from *decline accelerating* to *decline slowing* and, in some countries, a *growth accelerating* scenario will start (see Table 11). Economic recovery will gradually lead to improved occupier demand and thus rental and permits stability. However, demand continues to lag economy and many markets are expected to see further falls in employment before recovery takes hold. Positive signs will emerge in 2010-2012, but overall prospects remain patchy at present [King, 2010; Knigh, 2010].

On the other hand, previous studies have sought to explain office rents and vacancy ratios[10] by changes in national GDP (a variable that accounts for major variability in office rents and vacancy ratios), inflation and unemployment rates. Available data on these economic indicators suggest a substantial agreement on direction, quantity and timing of the office market change. Gathering information on these indicators, a similar scenario for office

[10] Similar results are obtained when the variable of interest are take-up or yield product.

buildings can be predicted [Giussani, Hsia and Tsolacos, 1993; De Wit and Van Dijk, 2003; Kennedy, Lee and McAllister, 2007].

Thus, in order to do a more accurate forecast of the office market, we need forecast information on general economic indicators. Table 12 forecasts information on GDP[11] up to 2015 and on Growth Fixed Capital Formation (GFCF) up to 2012. It is important to keep in mind that office activity is concentrated in urban areas. In this sense, and due to the fact that economic growth in almost all of Europe's city centres exceeds the EU regional averages, this prediction can be understood as relatively pessimistic. As it can be observed, economic growth in the EU-27 will accelerate over the 2010-2015 period. Thus, from the forecasted 1.7% growth in GDP for EU-27 economies in 2011, a 2.4% GDP annual growth, on average, will be reached during 2012-2015. One of the first components of GDP to recover when the economy begins to grow is usually the investment. In this regard, it can be seen that the annual percentage of GFCF (that is, investment) is forecast to increase rapidly form -0.6% (2010) to 4.2% (2012).

Table 12: GDP forecast 2011-2015. GFCF forecast 2012. [Eurostat (2010)]

Countries	% GDP 2011	% GDP 2012	% GFCF 2012	% GDP 2012-2015
EU-27	1.7	2.0	4.2	2.4
Belgium	1.8	2.0	2.9	2.3
Bulgaria	2.6	3.8	5.4	6.4
Czech Republic	2.3	3.1	3.7	4.4
Denmark	1.9	1.8	2.8	2.5
Germany	2.2	2.0	5.1	2.1
Estonia	4.4	3.5	6.4	5.2
Ireland	0.9	1.9	0.0	3.8
Greece	-3.0	1.1	-2.6	1.1
Spain	0.7	1.7	2.7	1.7
France	1.6	1.8	3.5	2.1
Italy	1.1	1.4	3.1	1.6
Cyprus	1.5	2.2	-1.5	3.3
Latvia	3.3	4.0	15.0	6.3
Lithuania	2.8	3.2	8.5	6.4
Luxembourg	2.8	3.2	7.3	3.1
Hungary	2.8	3.2	5.5	4.5
Malta	2.0	2.2	3.3	3.0
Netherlands	1.5	1.7	4.2	3.0
Austria	1.7	2.1	2.9	2.1
Poland	3.9	4.2	9.2	4.9
Portugal	-1.0	0.8	-0.4	1.5
Romania	1.5	3.8	7.3	5.7
Slovenia	1.9	2.6	4.1	2.9
Slovakia	3.0	3.9	6.4	4.6
Finland	2.9	2.3	3.0	3.5

[11] Due to the higher correlation among GDP and unemployment rates (Okun's law), similar results will be obtained using unemployment rates. But, as stated before, GDP is the variable which accounts for the major variability of office demand.

Sweden	3.3	2.3	4.7	2.4
United Kingdom	2.2	2.5	6.5	3.2

Notes: [1] Growth percentage of change from previous year. [2] Average growth percentage of change from previous year from 2012 to 2015.

A similar office job growth can be forecasted (See Table 13) [King Sturge, 2010]. Thus, previous evidence about economic growth will result in increased office employment by an annual 1.2% in the EU-27[12], indicating healthy fundamentals for occupier demand. Office job growth will be higher in all forecasted cities than the EU-27 average value. In particular, the major office job growth is forecasted in Bucharest (6.5%). Budapest, Warsaw, Sofia and Prague will also present a significant growth. In East Europe, structural change means that the rapid GDP growth has not always been translated into office jobs and consequently these cities still have a higher office job growth potential: the highest office centre growth in the next decade is expected to take place in Bucharest, albeit from a very low base. This expansion is mainly driven by the strong growth in the underdeveloped business services sector.

Some traditional big business economic centres will also experience a significant office job growth. In this way, London is the second fastest growing city and by far the largest creator of office jobs. But Frankfurt, Paris, Amsterdam, Munich and Milan are also set to expand at healthy rates, despite sluggish national performance. In general, larger international centres in West Europe perform well, in line with recent market evidence. In f act, growth rates in West Europe are higher than growth rates for the rest of EU countries (see Table 12). The key is the global reach of these markets, allowing them to rise above an uncertain domestic outlook. These forecasts are supported by the take-up indexes forecast from the main Real Estate Agencies reports.

Table 13: Office job forecast by 2015.

	Office jobs in 2009[1]	Office job growth 2010-15 (%)[2]	New office jobs created 2015[1]
Bucharest	251	6.5	109
London	1,249	2.6	212
Helsinki	206	2.6	32
Frankfurt	268	2.4	37

[12] Office employment in the EU-27 fell significantly in 2009 and 2010 as the financial crisis hit hard. Usually, office job employment growth is higher compared with the average of the whole economy (that is, the higher increases and the lower decreases).

Budapest	319	2.4	47
Munich	344	2.2	46
Amsterdam	328	2.2	47
Warsaw	374	2.2	53
Sofia	246	2.1	35
Prague	331	1.8	35
Paris	1,204	1.3	96
Milan	555	1.2	49
EU27	**48,951**	**1.2**	**3,910**

Source: [Sturge, 2010]. Oxford Economics. Notes: [1] 1000 persons. [2] Annual average percentage of growth

Nevertheless, this expected occupied office demand increase will take place slowly, especially in 2011. Thus, although some recent indicators suggested an improvement in the European office market in 2010 (stabilization of rents, occupancy rates recovery and rise of leasing volumes), it is not clear that the office market will recover to its past levels. Next development cycle will not come until uncertainty on the implications of the potential recent Euro crisis to cause further banking losses disappears. In this sense, further banking losses will restrict bank credit, which is necessary for property development. Another uncertainty that needs to be removed is debt government crisis (principally from Portugal, Spain and Italy). Generally, the combination of an uncertain rental outlook and constrained access to development finance means that the start of the next development cycle is still some way off. That is, many economic uncertainties result in a scenario of slow growth in office employment. Clearly, an accelerated economic recovery would help, but current forecasts emphasise downside risks and suggest that employment in financial and business services across Europe will not regain its previous (2008) peak until 2012. In fact, **new office development completions as a percentage of existing stock in 2009 will only be higher than 5% in Frankfurt (5.0%), Madrid (8.5%), Barcelona (8.7%) and Milan (10.9%) in 2012. Meanwhile, this value will be lower in Brussels (3,9%), London (3.5%), Paris (2.5) and Berlin (1,5%)** [Richard Ellis, 2010].

Other expected variables which affect the development of office markets for 2011-2015 [DTZ Research, 2009] are: a slow positive growth for rents (among 2-5%), yield growth among 5 and 8%, and total returns among 8-10%. That means that there are some other indicators that point out slow growth demand, being reflected in slow growth in yields, returns and rents.

Finally, forecasts on ecolabeled office buildings demand are also included. Constant and slow growth rates for office buildings demand over the 2011-2015 period can be expected. To complete the analysis, the demand for ecolabelled office in comparison to non-ecolabelled

office buildings is analysed. In this sense, [**Fuerst and McAllister**, 2009][13] compared occupancy rates between ecolabelled and non-ecolabelled office buildings in the United States, finding **a significant positive relationship between occupancy rate and the ecolabel**. In particular, depending on the age, height, building class, and quality, the occupancy rates are among 3% and 8% higher in labelled offices. Table 14 shows similar results from other studies. **In general, depending on the local market characteristics** and statistical methods14, ecolabel premium in vacancy rates (lower vacancy rates) ranges from 2% to 18%. This means that owners of green buildings would see a higher income return from their portfolio, as they would have greater success in converting theoretical rental value into actual rental income from occupied property. If borne out more widely, this fact is reflected in higher unit values for green buildings.

Table 14: Literature review on occupancy ratio premium for ecolabelled commercial buildings.

Author	Country	Method	Results
Fuerts and McAllister (2009)	US	Hedonic OLS and quartile regressions for occupancy rates. Control for quality and location effects	Premium in vacancy rates ranges from 3% to 8%
Wiley, Benefield, and Johnson (2008)	US	Hedonic OLS and 2SLS regressions for rental and occupancy rates. Control sample seems to be other offices in same metropolitan area. No controls for micro location effects.	Premium in vacancy rates ranges from 10% to 18%.
Miller, Spivey, and Florance (2008)	US	Hedonic OLS regression for sale prices only. Controls for major markets but none for quality.	Premium in vacancy rates ranges from 2% to 5%

3.4.1. Estimate and forecast of existing, new and renovated office buildings in EU 27

In order to establish the amount of existing, new or renovated office buildings, the following assumptions have been developed:

- From the 100% of all buildings, non residential buildings represent a 1% (see Figure 1). From the latter, 18% are assumed to be office buildings according to a break down of surface or area by sector of non residential sector [Levine and Ürge-Vorsatz 2006]
- The maximum lifespan of an office building will be 100 years, after this period of time the building will be knocked down (see section 4.2).
- Office buildings over 50 years old will be subject to a major rehabilitation (e.g. external structures, see section 4.2).

[13] Other previous studies have also found evidence premium in rents for ecolabeled buildings. *Wiley, Benefield, and Johnson (2008)* found rental differentials that ranges from 7 and 17% while *Miller, Spivey, and Florance (2008)*, however, have found no statistically significant rental premium.

[14] Other references in hedonic models in housing are: *Rosen (1974), Brown and Rosen (1982), Palmquist (1984), Kim (1992), Ekeland et al (2002)* and *Garcia and Raya (2011)*. With respect to quartile literature, some useful references are: *Couson and McMillen (2007), McMillen (2008),* and *Garcia and Raya (2011)*

- Knocked office buildings will be replaced by newly built office buildings in a year´s period of time.
- Apart from the replacement of the knocked offices, a net generation of office buildings is considered. Adopting a conservative scenario [Richard Ellis, 2010], a yearly 0.5% new office building construction rate is assumed[15].
- Two scenarios have been designed: one represents the current time being (2011) and the other a future situation in 10 years.

Results are shown in Tables 15 and 16.

Table 15: 2011 estimate of existing, to be renovated and new office buildings

Climatic zone	Existing	To be renovated	Newly built	Total
A1	722,385	161,792	41,911	926,087
B1	6,626,946	1,208,088	876,452	8,711,486
C2	761,185	192,398	30,147	983,730
C1	5,532,054	1,599,923	961,079	8,093,055
Total	13,642,569	3,162,201	1,909,588	18,714,358

Note: All office buildings aged 41-50 suffer rehabilitation. All office buildings over 92 years are knocked down and replaced by the same number of new ones in the same year.

Table 16: Forecast of 2021 existing, to be renovated and new office buildings

Climatic zone	Existing	To be renovated	Newly built	Total
A1	654,549	220,391	97,451	972,392
B1	6,534,632	1,642,073	970,355	9,147,060
C2	706,673	241,196	85,047	1,032,917
C1	6,076,562	1,665,568	755,578	8,497,708
Total	13,972,416	3,769,229	1,908,432	19,650,076

Note: All office buildings aged 41-50 suffer rehabilitation, 50% of the office buildings aged 76-102 are knocked down and the rest remain as existing, New office buildings from the 2011 scenario are included as existing in the 2021 scenario, New office buildings are calculated from the knocked down office buildings (50% of the office buildings aged 76-102) and a yearly increase of 0.5% in relation to the 2011 stock.

[15] Based on Berlin´s office development completion for the three year´s period of time.

4. Environmental Issues

4.1. Environmental performance, market segmentation and penetration.

The environmental performance of buildings is determined by different aspects, being the energy consumption during the use phase the most important one (IPTS, 2008). Moreover, office buildings are also classified among the buildings with the highest energy consumption [Caccavelli, 2002 and Burton and Sala, 2001]. Figure 5 shows the share of energy consumption by end use in EU tertiary buildings [EuroAce, 2005].

Whereas data concerning the energy consumption for residential buildings are available, information on the non residential building stock and its energy performance is rather limited [Spyropoulos, 2011]. Final energy consumption is usually split into three sectors: industry, transport and “other”, including i.e. agriculture, service sector and residential. However, what is included into "other" depends on the references and therefore any sort of comparison among the values should be carried out carefully.

Generally speaking, building energy consumption accounts for 20-40% of the total final energy consumption in developed countries [Pérez-Lombard, 2008]. Moreover, growth in population, enhancement of building services and comfort levels, together with the rise in time spent inside buildings, have raised building energy consumption to the levels of transport and industry [Pérez-Lombard, 2008].

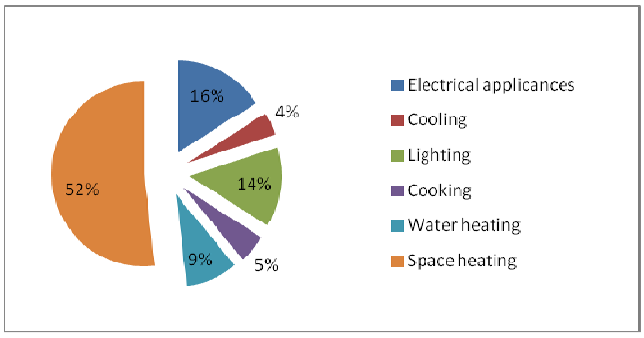

Figure 5 Energy consumption in tertiary[16] buildings [EuroAce, 2005]

[16] The definition of tertiary buildings comes from the original proposal for the Directive on Energy Performance of Buildings (COM (2001) 226 final) and includes offices, wholesale and retail trade, hotels, restaurants, schools, hospitals, sports halls, indoor swimming pools, etc. but excludes industrial buildings.

Annual energy consumption in European office buildings varies from 100 to 1000 kWh/m^2 of conditioned floor space, depending on their location, construction, HVAC (heating, ventilation and air-conditioning) systems, lighting installations, use and type of office equipment, operating schedules, etc [Caccavelli, 2002]. More in detail, Table 17 shows energy consumption in offices by end use [Pérez-Lombard, 2008] (based on data from EIA, BRE and IDAE)17.

Table 17: Energy consumption in offices by end use

Energy end uses	USA (%)	UK (%)	Spain (%)
HVAC	48	55	52
Lighting	22	17	33
Equipment (appliances)	13	5	10
DHW[18]	4	10	-
Food preparation	1	5	-
Refrigeration	3	5	-
Others	10	4	5

Energy consumption during the use phase also represents an important economic cost in the building life cycle. The energy costs of an urban office building in 2008 in the USA range from 15% to 25% of operating expenses [Ciochetti & McGowan, 2010]. This range is lower for office buildings from the 1990´s vintage with costs averaging between 15% and 17% of total operating expenses (excluding real estate taxes), while those buildings from the 1970´s averaged 22% to 26%. Investment in energy efficiency improvements can increase net income by 2%-3%, or even more considering the upward trend of energy prices [Ciochetti & McGowan, 2010].

4.1.1. Market penetration

Some relevant information related to the market penetration of buildings with an improved environmental performance is:

- A survey carried out by the European Energy Network (E^{n}R) in 2007 to review the status and progress of the implementation of the EPBD [EPBD, 2002], showed that "energy performance requirements are more widespread in the residential and public sector than in the commercial sector, being stronger in new buildings than those covering renovations

[17] EIA: Energy Information Administration, Commercial Buildings Energy Consumption Survey (CBECS), U.S. Department of Energy, 2003. BRE: Best Practice Programme Energy Consumption Guide 19, Energy use in offices, Carbon Trust, December 2000. IDAE: Instituto para la Diversificación y el Ahorro Energético, Eficiencia Energética y Energías Renovables (nº8), 2006.

[18] Domestic Hot Water

of existing buildings" [E^{n}R, 2008]. The E^{n}R survey focused on those building sectors which present the highest energy saving potential in all EU Member States: residential, commercial[19] and public buildings.

- In their investigation about the effects of the LEED program [LEED] for new constructions (LEED-NC) and exiting buildings (LEED-EB) in the US market of office buildings, Ciochetti & McGowan concluded that owner-occupiers were the early adopters of LEED-NC and LEED-EB, since they were aware of the long term inherent benefits of the energy efficiency improvements. Moreover, energy improvements triggered "higher employee productivity, retention and recruitment, lower absenteeism, and lower operation costs". However, the authors pointed out that many of the new applicants for LEED-EB are investor-owners due to, among other reasons:
    - the threat of new green construction to compete with newly created stock,
    - green is a new amenity (a new seal of approval that sets their buildings apart from the rest),
    - tenant demand for more energy efficient space[20],
    - investor demand for sustainability and responding to climate change.
- Finally, Ciochetti & McGowan analyzed the return on investment while carrying out energy efficient improvements on six office buildings certified with LEED. Their initial research suggested that "investment in these projects produce sufficient return on investment, increase the predictability of energy consumption, and add value by decreasing operation costs" [Ciochetti, 2010].
- In 2005, EuroAce [AuroAce, 2005] conducted a survey with the aim of finding out the concerns of MS regarding very low energy and passive buildings among the representatives from EU-27 plus Croatia, Norway, and Switzerland. The survey addressed buildings in all sectors: residential, services (commercial and public) and industrial. One of the main conclusions was that one way of promoting very low energy buildings is by direct or indirect actions that make these buildings more attractive. The most popular measures to promote low energy buildings are loans with low interest rates by means of either

[19] Commercial buildings include all those uses which are not related to public or residential ones, that is: offices (private), education buildings (private), hotels and restaurants, and wholesale and retail trade services buildings.

[20] These tenants tend to be companies that place a very high value on the recruitment and retention of their employees and that also see the importance of being able to point to a healthy and sustainable work environment [Ciochetti, 2010].

official subsidies or via private investment organisations and lower taxes or the introduction of CO_2 taxes. Furthermore, mandatory certification schemes are expected to promote these buildings by introducing grades restrictions to buildings without very high energy performance [Engelund, 2008].

- The main conclusion of the IMPRO-Building was that "the current situation of the European residential buildings stock in terms of environmental performance is far from the currently discussed low-energy standards and there lies a tremendous potential for improvements" [IMPRO, 2008]. This conclusion can be tentatively extrapolated to office buildings in general.
- The overall conclusion of Real Estate Research on the Greening of U.S. Investment Real Estate is that "green building is fundamentally altering real estate market dynamics – the nature of product demanded by tenants, constructed by developers, required by governments and favored by capital providers" `[Nelson, 2007].
- In relation to the existing Ecolabel for office buildings in Catalunya (*Distintiu de Garantia de Qualitat Ambiental*) it can be highlighted that since its establishment between 2005 and 2006 only 3 office buildings have been awarded with the ecolabel.

Studies undertaken in the US market office buildings [Ciochetti, 2010] demonstrate that owners and occupiers of the offices were the early adopters of ecolabelling systems. This trend, however, seems to be shifting towards investors-owners due to the associated return on investment in an increasingly competitive "green" market for offices. The construction of green buildings is also altering Real State market dynamics [Nelson, 2007], providing the base case for the development of criteria for an office building ecolabel.

4.2. Average duration of the economic life-cycle of buildings

The working life of a product is defined by EC as "the period of time during which the performance of a product will be maintained at a level that enables a properly designed and executed work to fulfill the Essential Requirements (i.e. the essential characteristics of a product meet or exceed minimum acceptable values, without incurring major costs for repair or replacement)" [EC, 2004].

As Rimsjö points out "the time of use, or the service life, is of central interest for the outcome of the calculations of LCA and LCC". The forecasting of the service life of building components

allows estimating the timing and nature of the maintenance operations as well as the needs for replacement of components [Rimsjö, 2003].

However, the duration of the economic life-cycle of a product, i.e. its service life or working life, is difficult to estimate. A clear distinction has to be made between the "assumed" and the "actual" economically reasonable working life for a product. The latter depends on many factors beyond the control of the producer, such as design, location of use (exposure), installation, use and maintenance [EC, 2004]. Moreover, the building components may get obsolete due to changes in technical, economical, functional or aesthetical requirements before its technical life is ended [Rimsjö, 2003].

The ISO 15686-8 establishes a method to estimate the service life of a product using the reference service life (RSL) data of components or products as a starting point. In order to calculate the estimated service life (ESL) of a product, the RSL needs to be modified by taking into account the in-use conditions of the product, as for example: the exposure of the product to indoor or outdoor agents of degradations and their severity, the maintenance level, etc. [ISO 15686-8].

A design working life of 50 years for all type of building structures is indicated by EN 1990 (EC, 2002). The EPBD recast 2010 states that each MS should determine the estimated economic lifecycle of a building or building element, taking into account current practices and experience in defining typical economic lifecycles.

Another study focused on a sample of 8,182 office buildings for the US [Eichholtz, et al, 2009]. In this sample, the mean age is reported as 49.44 years and the standard deviation of 32.5 years. Looking at the statistic distribution, 53% of the office buildings are over 40 years old. This percentage is similar to the EU share of non-residential buildings above 40 years (see Table 3). Moreover, Ball et all found a similar share of office buildings over 40 years [Ball, 2003]. Thus, assuming a normal distribution for the office building age with a mean age of 45 years and a standard deviation of 30 years[21], **the maximum age of an office building in EU is 103.8 years,** with 95% of probability.

Finally, a study of 24,479 office buildings in 643 submarkets in 81 metropolitan areas in US, provides information on the "years from the last refurbishment" [Fuerst and McAllister, 2009]. The mean of this variable is 28.35 years with a standard deviation of 27.45 years. Considering a normal distribution, **the probability that an office building would be renovated after 50 years is 78.23%.** Similar results were reported by [Eichholtz et al, 2009].

[21] The US mean and standard deviation has been reduced in order to estimated EU values.

4.2.1. Assumed working life of products and systems

The working life of construction products according to European guidelines and standards are indicated in Table 18.

Table18: Assumed working life of construction products. Source: [EOTA, 1999]

Assumed working life of works (years)		*Working life of construction products to be assumed in ETAGs, ETAs and HENs (years)*		
Category	Years	Category		
		Repairable or easy replaceable	Repairable or replaceable with some more efforts	Lifelong[2]
Short	10	10[1]	10	10
Medium	25	10[1]	25	25
Normal	50	10[1]	25	50
Long	100	10[1]	25	100

[1] In exceptional and justified cases, e.g. for certain repair products, a working life of 3 to 6 years may be envisaged (when agreed by EOTA TB or CEN respectively).

[2] When not repairable or replaceable "easily" or "with some more efforts".

ISO 15686-1 reference suggests minimum design lives of components for particular design lives of buildings, based on their accessibility for maintenance (see Table 19).

Table 19: Minimum design life of components. [Source: ISO 15686-1]

Design life of building	*Inaccessible or structural components*	*Components where replacement is expensive or difficult*	*Major replaceable components*	*Building services*
Unlimited	Unlimited	100	40	25
150	150	100	40	25
100	100	100	40	25
60	60	60	40	25
25	25	25	25	25
15	15	15	15	15
10	10	10	10	10

EN 1990 [EC, 2002] also indicates the duration of design working life for particular structures of all buildings:

Table 20: Design working life of components. Source: [EC, 2002]

Design working life (years)	*Examples*
10	Temporary structures
10- 25	Replaceable structural parts
15- 30	Agricultural and similar structures
50	Building structures and other common structures
100	Monumental buildings, bridges, other structures

The lifespan of components in all kind of buildings varies as follows:

Table 21:Design working life of components. Source: [Yang and Pen, 2001]

Design working life (years)	*Examples*
1-3	Information technology
5	Interior partition
10	Electrical systems
25	Mechanical systems
50	Skin (exterior)
100	Structure

Several studies undertaken on the energy performance of office buildings assume a service life of 50 years [Kofoworola and Gheewala, 2009; Juan, Gao and Wang, 2010]. Taking into account the variation amongst sources and in line with the information reported previously, **the maximum lifespan of an office building would be 100 years, after which period the building will be knocked down. After 50 years the external structures of the office building will be renovated. A periodic renovation of replaceable structural parts such as windows and toilettes would happen every 25 years and other temporary structures such as internal partitions would be renovated every 10 years, [** EN 1990]**.**

5. Public Activity

In the case of ecolabel activity, public activity is a crucial element to be considered. In fact, in economics, the concept of externality[22] justifies that most of the environmental activities will be developed by governments. The reason is that enterprises cannot grab many of the benefits of such activities. In this sense, regulators should set incentives to internalise externalities ideally through integrating them into market activities. For example, in 2007 while industry environment expenditure represented 0.5% of EU-27 GDP, government environment expenditure represented 0.7% [Eurostat, 2010]. The importance of the government activity to promote ecolabelled office buildings can also be justified [OTB Research Institute for Housing, Urban and Mobility Study, 2008]. This report provides information about the percentage of office buildings that belong to the government and municipalities for some EU-27 countries e.g, The Netherlands (3%), Germany (20%), France (30%), Austria (17%) and Finland (11%)[23].

This section seeks to examine government activity. Firstly, the size of the EU-27 public expenditure as well as the importance of environmental and construction expenditure in EU-27 government budget is established. In this context, the evolution of the weight of these two aggregates within EU-27 government expenditure will be analysed. Secondly, the recent evolution of EU-27 national budget (that is, deficit and debt information) in order to obtain next future trends will be analysed.

[22] An externality occurs in economics when a decision (for example, to pollute the atmosphere) causes costs or benefits to individuals or groups other than the person making the decision. In other words, the decision-maker does not bear all of the costs or reap all of the gains from his or her action.

[23] Some useful literature on the effects of public activity on housing prices are: Linneman and Voith (1982), Man and Bell (1996), Garcia et al (2010).

Table 23 shows the functional composition of the EU-27 government expenditure in year 2008. The EU-27 average government expenditure amounts to 46.9% of GDP. Undertaking a country by country analysis it can be established that France (52.7%), Sweden (52.2%), Denmark (51.7%) and Belgium (50.0%) are the EU-27 countries with the largest government expenditure, while Slovakia (34.9%) and Bulgaria (35.9%) are the countries with the smallest one. In terms of functional distribution, the EU-27 environment expenditure[24] represents 0.8% of GDP (1.7% of government expenditure) while EU-27 expenditure in construction and housing[25] accounts for 1.4% of GDP (3.0% of government expenditure). The highest environmental expenditure is observed in Malta (1.6% of GDP), Ireland (1.3%), Estonia (1.1%), Spain (1.0%), Czech Republic (1.0%) and Luxembourg (1.0%) while the lowest is observed in: Cyprus (0.3%), Finland (0.3%), Sweden (0.4%) and Austria (0.4%). The reason for the lower percentages in the Nordic countries is that an effective environmental policy was set up some time ago. In relation to construction and housing expenditure, Ireland (3.3%), Cyprus (2.5%) and UK (2.6%) are the governments with the highest share while Greece (0.4%), Estonia (0.6%), Lithuania (0.6%) and Portugal (0.6%) are those with the lower one. Finally, it is remarkable that not only governments' expenditure but also the shares of GDP on environment and construction and housing expenditure remained stable from 2000 in EU-27. Thus, observing Eurostat (2010), for example, in 2005 these percentages were: government expenditure (46.8%), environmental expenditure (0.7%) and construction and housing expenditure (1.4%). Thus, it can be concluded that the **environment expenditure growth has been slightly higher than other aggregates**.

Table 22: Functional distribution of European Governments Expenditure. [Eurostat (2010)]

Countries (2008)	Government Expenditure (GovE)/GDP.	Environment Expenditure (% of GDP)	Environment Expenditure (% of GovE)	Construction and Housing Expenditure (% of GDP)	Construction and Housing Expenditure (% of GovE)
EU-27 (2008)	**46.9**	**0.8**	**1.7**	**1.4**	**3.0**
Belgium	50.0	0.6	1.2	-	-
Bulgaria	35.9	0.7	1.9	1.6	4.5
Czech Republic	42.9	1.0	2.3	1.3	3.0
Denmark	51.7	0.5	1.0	1.2	2.3
Germany	44.0	0.6	1.4	1.0	2.3
Estonia	39.8	1.1	2.8	0.6	1.5

[24] Expenditure carried out to develop activities (involving the use of equipment, labour, manufacturing techniques and practices, information networks or products) where the main purpose is to collect, treat, reduce, prevent or eliminate pollutants and pollution or any other degradation of the environment due to the pressure of human activities.

[25] This item involves: construction expenditure, Housing and Community Amenities expenditure and housing social policies expenditure.

Ireland	42.5	1.3	3.1	3.3	7.8
Greece	49.0	0.6	1.2	0.4	0.8
Spain	41.1	1.0	2.4	1.3	3.2
France	52.7	0.9	1.7	-	-
Italy	48.9	0.8	1.6	1.2	2.5
Cyprus	42.5	0.3	0.7	2.5	5.9
Latvia	38.8	0.9	2.3	1.5	3.9
Lithuania	37.3	0.9	2.4	0.6	1.6
Luxembourg	36.9	1.0	2.7	0.7	1.9
Hungary	48.8	0.8	1.6	1.8	3.7
Malta	44.1	1.6	3.6	1.9	4.3
Netherlands	45.9	0.8	1.7	-	-
Austria	48.7	0.4	0.8	0.6	1.2
Poland	43.2	0.6	1.4	1.4	3.2
Portugal	44.5	0.5	1.1	0.6	1.3
Romania	37.6	0.5	1.3	-	-
Slovenia	44.0	0.8	1.8	0.8	1.8
Slovakia	34.9	0.6	1.7	-	-
Finland	49.3	0.3	0.6	0.7	1.4
Sweden	52.2	0.4	0.8	1.9	3.6
United Kingdom	47.4	0.9	1.9	2.6	5.5

September 2008 was the beginning of the current financial crisis. In this sense, percentages shown in Table 24 are valid to determine the importance of the environment and construction sectors in the European government budgets. The financial crisis forced many European governments to develop expansionary fiscal policies to smooth the effects of the crisis in terms of unemployment. Also, several MS governments came to the rescue of the financial institutions most affected by subprime assets and rising delinquencies. Thus, government annual deficit in EU-27 grew from 0.9% in 2007 to 6.8% in 2009 . As a consequence, EU-27 government debt grew from 58.8% in 2007 to 74.0% in 2009. In 2007 EU-27 as a whole (except Greece and Hungary), accomplished the Stability and Growth Pact which compromises member states to keep the annual deficit budget under a 3% of the GDP and the total national debt under 60% of GDP. In 2009, however, EU-27 did not accomplish these criteria and only few member states (e.g. Germany, Estonia, Luxembourg, Finland and Sweden in terms of deficit criteria) accomplished it individually. In 2009, the countries with the highest government debt were Greece (126.8%), Italy (116.0%) and Belgium (96.8%) while the countries experiencing the highest annual government deficit were: Greece (15.4%), Ireland (14.4%), United Kingdom (11.4%), Spain (11.1%) and Latvia (10.2%).

In this sense, 2010 was the year of EU's debt crisis. The European debt crisis initially began in Greece, who adopted the Euro in 2001 despite being in violation of a requirement establishing that a country's annual deficit should be less than 3% of GDP before entering the Euro. Greece had a deficit well above 3% of GDP in 2001. Goldman Sachs and other large banks lent U.S. dollars to Greece in 2001 when their debt was manageable and agreed to be repaid in Euros so

it could be classified as a currency trade as opposed to debt. They disguised the debt so the EU would think Greece was below the 3% annual debt to GDP threshold, essentially making it possible for a debt ridden country to legally circumvent safeguards against the instability of the EU with sophisticated financing techniques. When Greece couldn't refinance the €11 billion they owed to other European nations in May, much like the subprime borrowers of 2008, the entire European system was on the verge of breaking down. The solution adopted by The European Central Bank was to create even more debt to finance the bad decisions of broke countries and printed money to stimulate their economies.

In the case of Ireland the problem came from the housing crisis. Irish banks had estimated losses that amounted 50% of the Irish GDP after housing prices dropped by 36% from their 2006 highs. With liquidity needs constraining their ability to lend money to a struggling economy, it became clear that foreign assistance was required. This came after the government had reportedly lent these institutions €120 billion, which impacted the status of their sovereign debt. During 2010, many concerns about rising European government deficits and debt levels, led to a crisis of confidence as well as the widening of bond yield spreads and risk insurance on credit default swaps between these countries and other EU members, most importantly Germany. As a solution, up to date, all these countries have developed intensive fiscal austerity policies and EU's Finance Ministers have approved a comprehensive rescue package worth almost a trillion dollars aimed at ensuring financial stability across Europe by creating the European Financial Stability Facility.

To sum up, even though the importance (and slightly growth) of environmental expenditure in EU-27 budget, next years are expected to be difficult to European governments and this situation will influence environment expenditure assignments. **Only when economic recovery occurs and the crisis of confidence is over, the amount of money spent in environmental policy will be the one observed in the years before the financial crisis.**

Table 23: Government's debt and deficit in EU-27. Source: [Eurostat, 2010]

	Government Deficit (% of GDP)			Government Debt (% of GDP)		
Countries	**2007**	**2008**	**2009**	**2007**	**2008**	**2009**
EU27	**-0.9**	**-2.3**	**-6.8**	**58.8**	**61.8**	**74.0**
Belgium	-0.3	-1.3	-6.0	84.2	89.6	96.2
Bulgaria	1.1	1.7	-4.7	17.2	13.7	14.7
Czech Republic	-0.7	-2.7	-5.8	29.0	30.0	35.3
Denmark	4.8	3.4	-2.7	27.4	34.2	41.4
Germany	0.3	0.1	-3.0	64.9	66.3	73.4
Estonia	2.5	-2.8	-1.7	3.7	4.6	7.2
Ireland	0.0	-7.3	-14.4	25.0	44.3	65.5
Greece	-6.4	-9.4	-15.4	105.0	110.3	126.8

Spain	1.9	-4.2	-11.1	36.1	39.8	53.2
France	-2.7	-3.3	-7.5	63.8	67.5	78.1
Italy	-1.5	-2.7	-5.3	103.6	106.3	116.0
Cyprus	3.4	0.9	-6.0	58.3	48.3	58.0
Latvia	-0.3	-4.2	-10.2	9.0	19.7	36.7
Lithuania	-1.0	-3.3	-9.2	16.9	15.6	29.5
Luxembourg	3.7	3.0	-0.7	6.7	13.6	14.5
Hungary	-5.0	-3.7	-4.4	66.1	72.3	78.4
Malta	-2.3	-4.8	-3.8	61.7	63.1	68.6
Netherlands	0.2	0.6	-5.4	45.3	58.2	60.8
Austria	-0.4	-0.5	-3.5	59.3	62.5	67.5
Poland	-1.9	-3.7	-7.2	45.0	47.1	50.9
Portugal	-2.8	-2.9	-9.3	62.7	65.3	76.1
Romania	-2.6	-5.7	-8.6	12.6	13.4	23.9
Slovenia	0.0	-1.8	-5.8	23.4	22.5	35.4
Slovakia	-1.8	-2.1	-7.9	29.6	27.8	35.4
Finland	5.2	4.2	-2.5	35.2	34.1	43.8
Sweden	3.6	2.2	-0.9	40.0	38.2	41.9
United Kingdom	-2.7	-5.0	-11.4	44.5	52.1	68.2

6. Conclusions

In relation to the importance of the office building with respect to overall buildings and their classification:

- The vast majority of buildings in the EU are residential (99%). Office buildings are a part of the remaining 1% of non-residential buildings.
- Office buildings are concentrated in: moderate climatic zone (4,382.2 million of m^2), large office buildings (4,278.7 million of m^2) and buildings erected before 1975 (6,277.2 million of m^2).

In relation to recent office buildings market indicators and their relationship with general economic indicators:

- Office rents and vacancy ratios can be explained by changes in each country´s contemporaneous national GDP -basically-, inflation and the unemployment rate.
- Economic indicators show a scenario of clear economic recovery from the bust experienced in 2009 (since GDP growth is positive and higher in 2010 with respect to 2009), which can be interpreted as a sign of short term recovery of office building demand. However, investment component-which is the component more related to the office building market- is still decreasing for the EU-27 (-0.6%), which can be interpreted as an absence of economic recovery consolidation. That is, recovery is

unstable at this moment. The absence of a clear inflationary pattern (although it seems that EU-27 has avoided deflation risk) and higher and difficult to reduce unemployment rates, reinforce this point. Obviously, a higher dispersion is found when individual countries are analyzed . Thus, Germany, Luxembourg, Malta, Poland, Slovakia, Finland, Sweden and the United Kingdom show a stable economic recovery (that is a higher probability of demand for office buildings), while Portugal, Italy, Greece, Spain, Ireland, Bulgaria, Romania, Latvia, Lithuania, Hungary and Slovenia show recession or stagnation scenario (that is a lower probability of demand for office buildings).

- Office Market indicators from cities from up to 17 of the EU-27 countries show rising availability (higher than 10%), weak demand and widespread rental declines (18%) across Europe since 2008 for office buildings.
- Although quantitatively is less important, the non-residential building sector (and the office building as well) shares certain trends and characteristics with the overall building sector. In addition, knowing future trends for the overall building/construction sector could provide us some clues in order to establish future trends for the office building sector (in both cases shares its relationship with the evolution of the overall economy, for example). The analyses characterises the building sector in the UE as an important (especially for some countries) but not very productive sector (with the exception of some East European countries in which this sector is underdeveloped). The office building sector shares these characteristics, although some innovations such as an ecolabel can be seen as a way to modernise, renovate or even increase the efficiency of the sector.
- In terms of short-term indicators for the construction sector, the presented information describes a sector with lower and decreasing demand (and, therefore wages). In this sense, a continuous adjustment to the construction sector is expected for years 2011 and 2012 with an eventual recovery in year 2013 because, as forecasted, 2011 and 2012 will be the years for the overall economic recovery. The construction sector is a procyclic sector with some lag with respect to overall economy, so the recovery of the construction sector is expected to take place later on. In terms of the office building sector, this fact implies that new office building construction is also expected for 2013. That is, this lag in the construction sector in relation to overall activity, is expected to be lower for the office building sector. Thus,

and due to its close relationship to economic evolution, it can be expected that the reduction of availability of space will start in in 2011 and 2012.

- Finally, in terms of short-term indicators for, specifically, the office building sector, the important decrease in the number of permits in the office building sector in 2009 (32.41%) can be observed. This decreasing pattern is particularly significant in: Lithuania (74.38%), Slovakia (50.81%), Spain (46.22%) and Bulgaria (40.89%). It is expected that during 2010-2011 the scenario for building permits will change from decline accelerating to decline slowing and, for some countries, a growth accelerating scenario will start.

In relation to the forecast for office building demand, in particular, ecolabelled office building demand:

- Economic growth in the EU-27 will accelerate over the 2010-2015 period. Thus, from the forecasted 1.7% growth in GDP for EU-27 economies in 2011, a 2.4% GDP annual growth, on average, will be reached during 2012-2015. Usually, one of the first components of GDP to recover when the economy begins to grow is investment. In this regard, it can be seen that the annual percentage of Growth Gross Fixed Capital formation increases rapidly form -0.6% (2010) to 4.2% (2012).
- Previous evidence about economic growth will result in increased office employment by an annual 1.2% in the EU-27. Nevertheless, this expected increase for occupied office demand, will be slow, especially in 2011, so the office market will not recover its past levels immediately. In terms of other variables which affect office markets, DTZ Research expects for 2011-2015: slow positive growth for rents (among 2-5%), yield growth among 5 and 8%, and total returns among 8-10% [Dtz, 2009].
- Demand for ecolabelled office buildings is likely to be higher than demand for non-ecolabelled office buildings. Fuerst and McAllister found a significant positive relationship between occupancy rate and the ecolabel [Fuerst & McAllister, 2009]. Depending on local market characteristics and methods, ecolabel premium in vacancy rates ranges from 2% to 18%. This would imply that owners of green buildings would see a higher income return from their portfolio, as they would have greater success in converting theoretical rental value into actual rental income from occupied property.

In relation to public activity importance and trends:

- Public activity is a crucial element to be considered. In fact, in economics, the concept of externality justifies that most of the environmental activities will be developed by governments. The percentage of office buildings from the government and municipalities for some EU-27 countries e.g: The Netherlands (3%), Germany (20%), France (30%), Austria (17%) and Finland (11%).
- The EU-27 average government expenditure size was 46.9% of GDP. In terms of functional distribution, the EU-27 environment expenditure represents 0.8% of GDP (1.7% of government expenditure) while EU-27 expenditure in construction and housing accounts for 1.4% of GDP (3.0% of government expenditure). Finally, not only governments' expenditure but also percentages of GDP on environment and construction and housing expenditure have remained stable from 2000 in EU-27, although, environment expenditure growth has been slightly higher than other aggregates.
- In this sense, one can also argue that often public authorities try to fight economic downturns through public investments, which e.g. can be public construction procurement. However, the possibilities to do so depend on budgets constraints.
- Financial crisis forced many European governments to develop expansionary fiscal policies in order to smooth the effects of the crisis in terms of unemployment. Thus, government annual deficit in EU-27 has grown from 0.9% in 2007 to 6.8% of GDP in 2009. As a consequence, EU-27 government debt has grown from 58.8% in 2007 to 74.0% in 2009. In 2009, EU-27 did not accomplish the Stability and Growth Pact and only few member states (e.g. Germany, Estonia, Luxembourg, Finland and Sweden in terms of deficit criteria) accomplished it individually.
- As a result, 2010 was the year of EU's debt crisis. Some countries have developed intensive fiscal austerity policies and EU's Finance Ministers have approved a comprehensive rescue package worth almost a trillion dollars aimed at ensuring financial stability across Europe by creating the European Financial Stability Facility. Only when economic recovery occurs and the crisis of confidence is over, the amount of money spent in environmental policy will be the one observed in the years before the financial crisis. So, we can expect that in next years subsidies of the governments to promote green buildings will be reduced, since even though environmental policies will not loose relative importance, its importance will be reduce in absolute terms.

In relation with data availability:

- unfortunately, there is no official data on office buildings stock in EU-27, only for few countries some estimates have been found from different sources.
- Moreover, data on the office sector are often outdated and assembled from sector estimates, as a result of which their statistical validity can be doubted.
- Furthermore, the comparability of data between countries may be low because different definitions may have been used in the different countries. To sum up, office building data is not official and is rarely harmonized between countries.

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