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Electricity Consumption and Efficiency Trends in the EU-27

Paolo Bertoldi
Bettina Hirl
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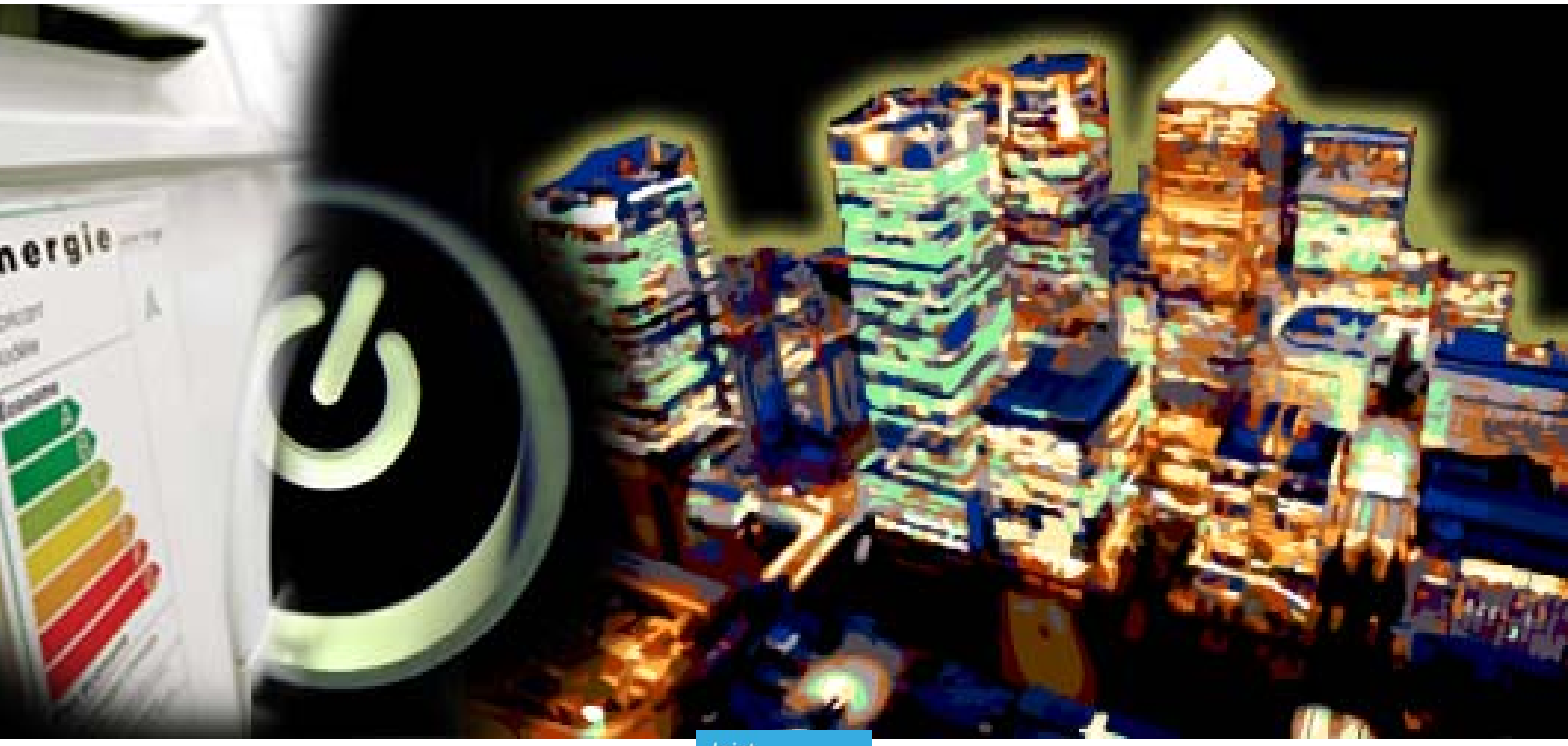

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1. Introduction

This report aims to show the present status of energy consumption in the residential and tertiary sectors in the EU-27 with a special focus on the electricity consumption of main household appliances and equipment. In addition, the report demonstrates the energy efficiency progress and estimates of saving potential of electrical energy in the EU-27 residential and tertiary sectors. The report summarises the most recent policy actions introduced at EU level and also outlines some of the important national policies regarding energy efficiency and energy consumption.

The report consists of three main parts. The first part (chapter 2) shows and analyses recent energy data for the residential sector. This includes data on total energy, electricity and gas consumption as well as consumption drivers like the economic and population growth, household characteristics and energy prices. The second part of the report (chapter 3) analyses energy consuming household appliances with a focus on electricity using appliances and lighting. The third part (chapters 4 and 5) concentrates on the tertiary sector showing the latest developments in energy efficiency and consumption of office equipment and data centres including consumption trends of office equipment and lighting.

2. The residential sector

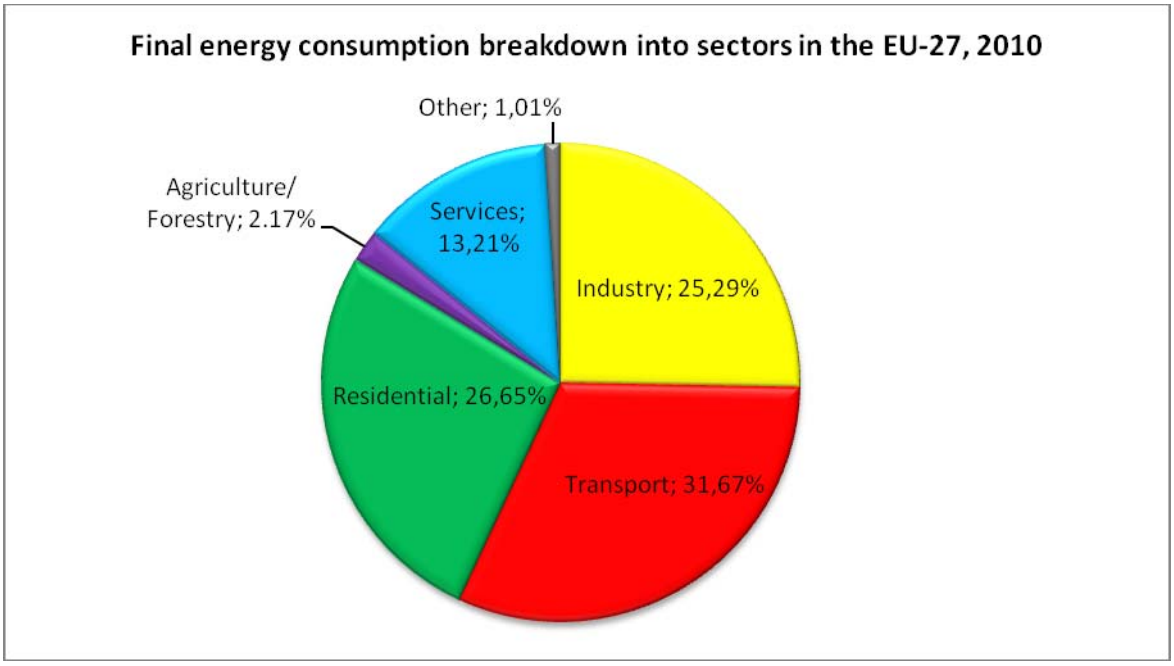
2.1. Energy consumption trends in the residential sector

This chapter analyses the latest available data on energy consumption in the residential sector. Data on total final energy consumption, final electricity consumption and final gas consumption of the residential sector are presented and set in context with energy consumption drivers such as economic growth (gross domestic product per capita), population growth, weather conditions and household characteristics (number of households, size of dwellings).

The overall finding of this chapter is that the energy consumption trends for the residential sector started to decrease in the last years. However, in 2010 final residential energy consumption grew again substantially reaching the highest level of the last 20 years. Looking at the consumption statistics, it has been found that between 2005 and 2010 final energy consumption in the EU-27 in the residential sector grew by 1.69%, reaching the lowest consumption level of the last 20 years in 2007. This important decrease (-4% compared to 2006) in 2007 can be explained with warmer temperatures during that year that led to a lower number of heating degree days.

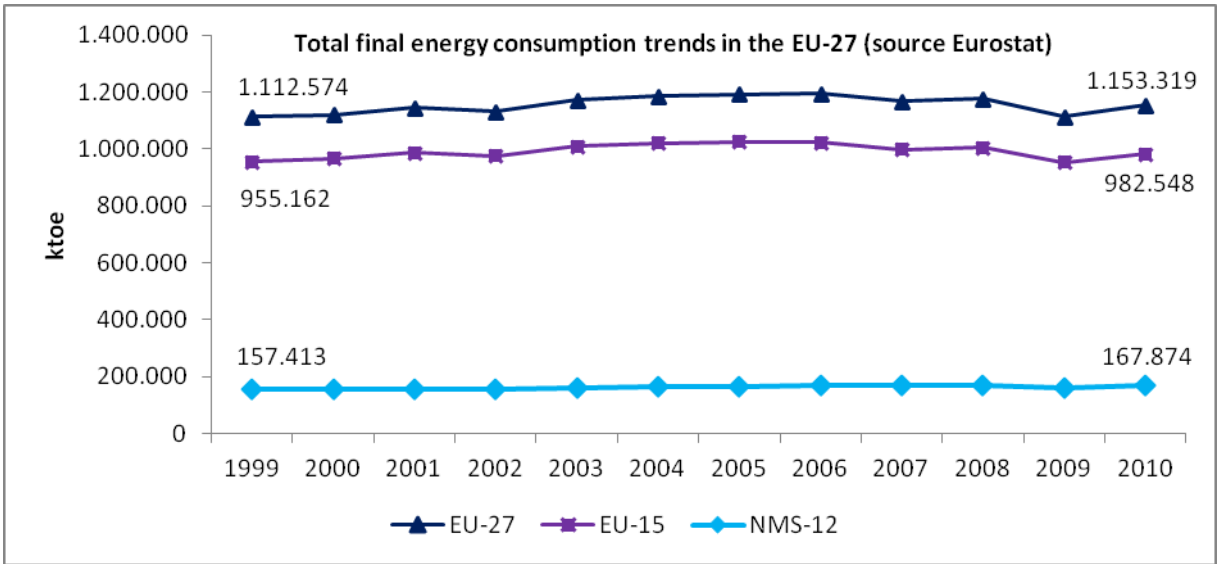
Final residential energy consumption accounted for 26.65% of total final energy consumption in the year 2010. Only the transport sector had a bigger share of total consumption (31.67%). The industry and the services sectors are both smaller in terms of final energy consumption with a share of 25.29% and 13.21% respectively. The residential sector plays therefore an important role in energy efficiency programmes and policies.

Fig. 1: Energy consumption breakdown (source Eurostat)



In the year 2010 total final energy consumption in the EU-27 reached 1,153,319 ktoe. In 1990, total consumption in the EU-27 was 1,078,628 ktoe. This equals a growth of 6.92% during the last 20 years. Up to the year 2005 consumption was growing rapidly every year reaching the consumption peak of 1,192,536 ktoe in 2005. From then on, consumption started to decrease until 2009. Between 2008 and 2009 total final energy consumption decreased by -5.2%. However, between 2009 and 2010 it grew by 3.56%.The decrease in total consumption can be related to the financial and economic crisis in the year 2009, whereas the increase in 2010 is likely due to economic rebound effects. Between 2004 and 2009 total final energy consumption in the EU-27 fell by - 6.11% and by -3.29% between 2005 and 2010 (see Tab.1). The total final energy consumption level of 2009 was almost equal to the consumption 10 years earlier in 1999 (0.10% bigger than in 1999). In the EU-15, total energy consumption decreased by 4.19% between 2005 and 2010; in the 12 New Member States (NMS-12), total energy consumption increased by 0.53% in the same period.

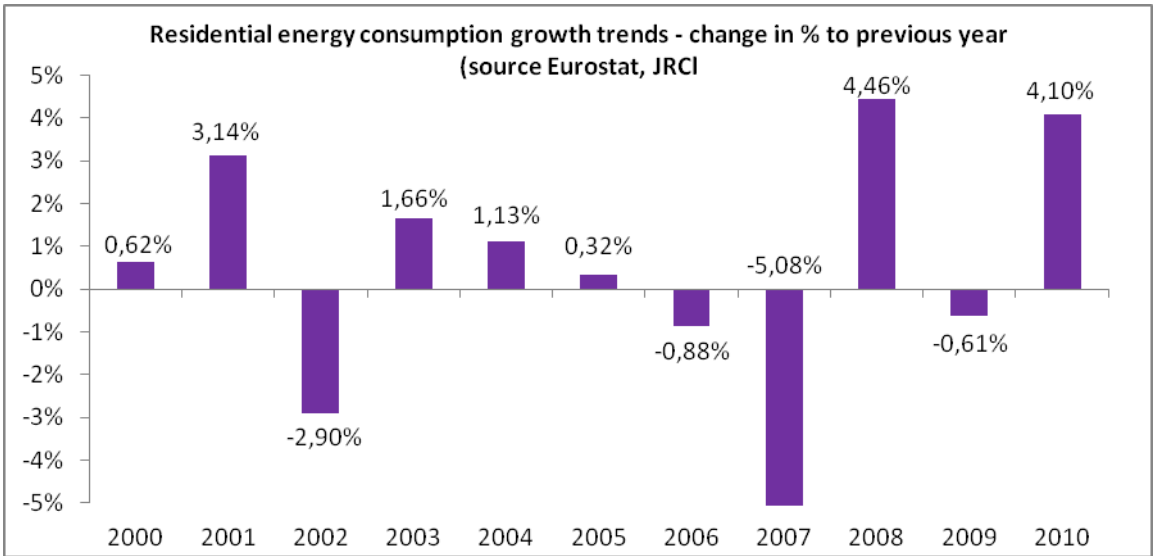
Fig. 2: Total final energy consumption in the EU-27 (source Eurostat)



Final energy consumption in the residential sector in the EU-27 was 307,321 ktoe in 2010. In the year 1990, final residential energy consumption was 273,384 ktoe. In the last 20 years, residential consumption grew therefore by 12.41% reaching a peak in the year 2005 and decreasing until the year 2009. The trend follows the same pattern as total energy consumption does.

Between 2004 and 2009, residential energy consumption in the EU-27 fell by -2.00% but grew by 1.69% between 2005 and 2010. Between 2009 and 2010 it increased by 4.1% whereas it decreased by -0.61% between 2008 and 2009. In the EU-15 residential consumption fell by - 2.25% in the same period and in the NMS-12 the decrease was -0.7%. The decrease in the EU-27 between the years 2008 and 2009 was -0.61%. Between 2006 and 2007 final residential energy consumption fell by -5.08%. This important decrease can mainly be explained by the general warmer temperatures in the year 2007 compared to average temperatures resulting in lower actual heating degree days. The increase in energy consumption in the year 2010 could be related to weather conditions as well. The winter of 2009/2010 was unusually cold in Europe whereas in the summer 2010 many parts of Europe experienced above average temperatures.

Fig. 3: Residential energy consumption growth trends - change in % to previous year (source Eurostat, JRC)



Tab. 1: Final energy consumption in the EU-17 (source Eurostat, JRC)

Consumption

			Total	Residential
EU-27	2010	(ktoe)	1,153,319	307,321
	2009	(ktoe)	1,113,671	295,206
	2008	(ktoe)	1,175,235	297,019
	2007	(ktoe)	1,166,798	284,345
	2006	(ktoe)	1,193,356	299,558
	2005	(ktoe)	1,192,536	302,209
	2004	(ktoe)	1,186,189	301,236
	2003	(ktoe)	1,171,696	297,866
	2002	(ktoe)	1,131,801	292,999
	2001	(ktoe)	1,144,396	301,745
	2000	(ktoe)	1,120,145	292,551
	1999	(ktoe)	1,112,574	290,739
	1990	(ktoe)	1,078,628	273,384

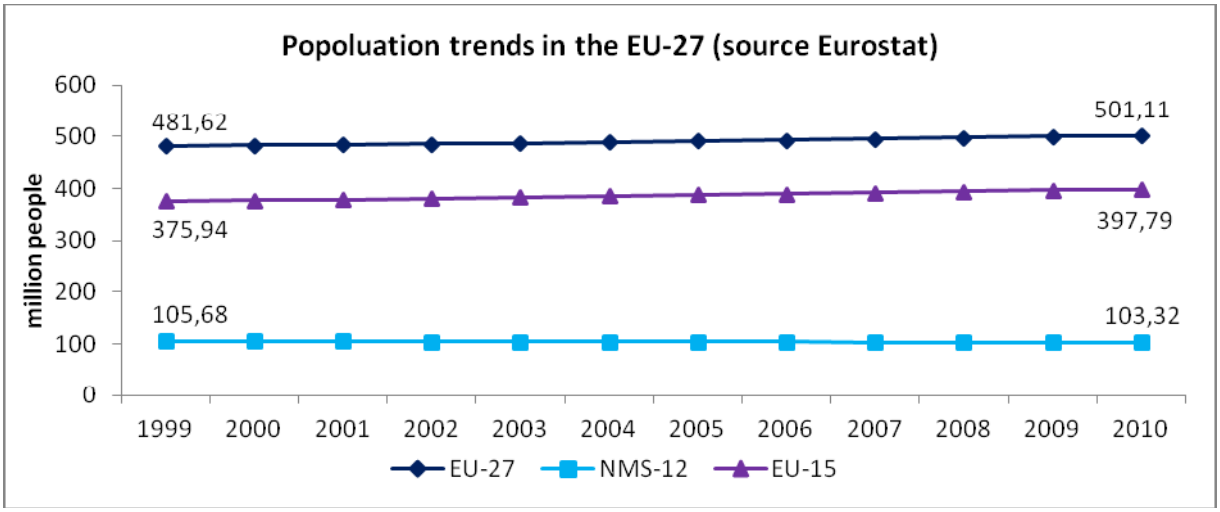
Growth rates

EU-27	1990-2010	(ktoe)	6.92%	12.41%
	2000-2010	(ktoe)	2.96%	5.05%
	2005-2010	(ktoe)	-3.29%	1.69%
EU-15	1990-2010	(ktoe)	14.01%	16.58%
	2000-2010	(ktoe)	1.75%	4.04%
	2005-2010	(ktoe)	-4.19%	0.94%
NMS-12	1990-2010	(ktoe)	-22.57%	-6.35%
	2000-2010	(ktoe)	8.64%	8.11%
	2005-2010	(ktoe)	0.53%	3.49%

Factors influencing residential energy consumption

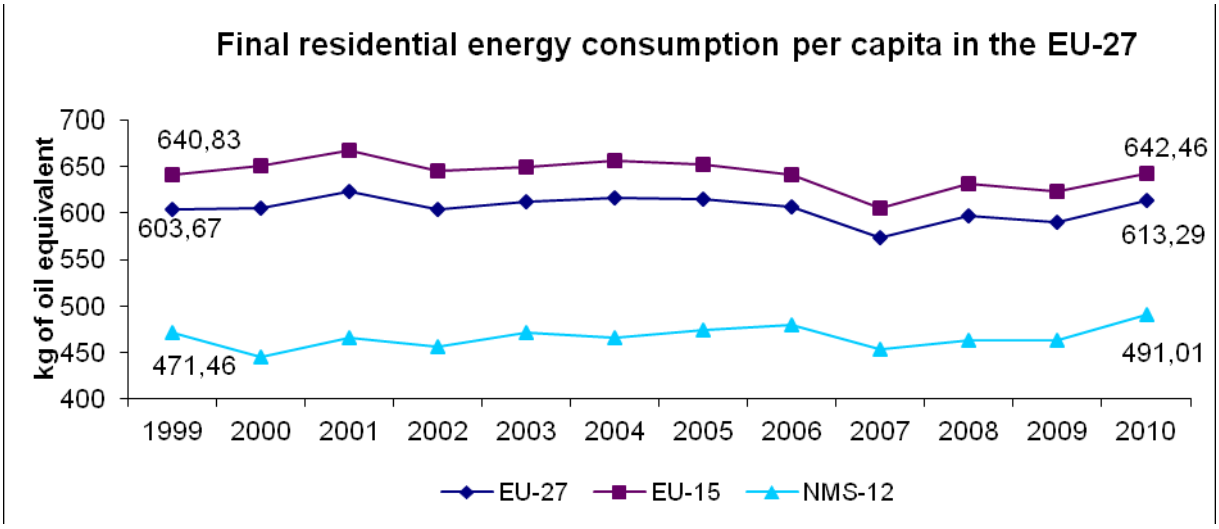
When looking at energy consumption statistics it is important to consider other factors influencing energy consumption such as economic development and weather conditions. No quantitative analysis aming to assess the influence of these factors is presented in this report. Nevertheless, possible explanations for consumption patterns can be attempted by simply comparing energy consumption with the trends observed for some of these factors. This paragraph analyses in particular the trends of the following parameters: Population, GDP per capita, weather conditions (actual heating degree days), number of dwellings per country, average persons per household. This can in principle help to better understand the relation between energy consumption and efficiency trends in the residential sector. For instance, a decrease of total energy consumption could be explained by a decreasing population and not by a more efficient use of energy.

Fig. 4: Population trends in the EU-27 (source Eurostat)



Between 1999 and 2010 population in the EU-27 grew by 4.05%. In the same period residential energy consumption grew by 5.7%. Looking at per capita figures it can be observed that residential per capita consumption in the EU-27 grew only by 0.25% in the same period. In the EU-15 and in the NMS-12 residential per capita consumption also increased between 1999 and 2010. Looking at population growth again it results that population in the NMS-12 actually decreased between 1999 and 2010 (by -2.23%). In the EU- 15, on the other hand, population grew by 5.81% in the same period. Therefore the increase in the total residential energy consumption observed in this period in the NMS-12 is very likely to depend on much higher increase in the per capita energy consumption compared to EU-15.

Fig. 5: Final residential energy consumption per capita in the EU-27 (source Eurostat)



Another factor that can influence energy consumption is the economic development and economic situation of the countries. GDP per capita[1] in the EU-27 has been increasing continuously between 1999 and 2008 with a drop in GDP in 2009 due to the economic and financial crisis worldwide. Between 2009 and 2010 GDP per capita increased again by 3.83% in the EU-27. Looking at GDP per capita across countries in the EU-27 for the year 2010 a very large dispersion across the Member States can be identified (see Fig.6). GDP per capita in Bulgaria was EUR 4,800 in 2010 whereas GDP in Luxembourg was EUR 79,500. The average GDP per capita in the EU-27 was EUR 24,400 in the year 2010. In the year 1999 the average GDP per capita in the EU-27 was EUR 17,800, EUR 21,800 in the EU-15 and EUR 7,308 in the NMS-12. 10 years later (2009) the average GDP per capita in the EU-27 reached 23,500 euro, 27.400 euro in the EU-15 and 13,917 euro in the NMS-12. Compared to an increase of 32% in GDP per capita between 1999 and 2009, final residential energy consumption per capita fell by 2.1% in the same period. Between 2000 and 2010 GDP per capita in the EU-27 grew by 21.72%. The growth in GDP per capita can be attributed to important economic development during these years, despite the population increase observed. Comparing economic growth and energy consumption growth it can be concluded that the significant economic growth has not been accompanied by the same increase in energy consumption.

It is clear that economic development is positively correlated with total final energy consumption. However, especially in the residential sector economic growth in the EU was accompanied by a more efficient way of using energy. In the household sector this increase

[1] all GDP numbers are given in current prices as of the year 2010 (source: Eurostat).

in efficient use is mainly due to more efficient appliances and equipment, and more efficient heating systems and better insulated buildings in general. However, as also the increase in consumption in the year 2010 shows, it is important that still existing potentials for energy efficiency improvements are exploited.

Fig. 6: GDP per capita in current prices in the EU-27 (source Eurostat)

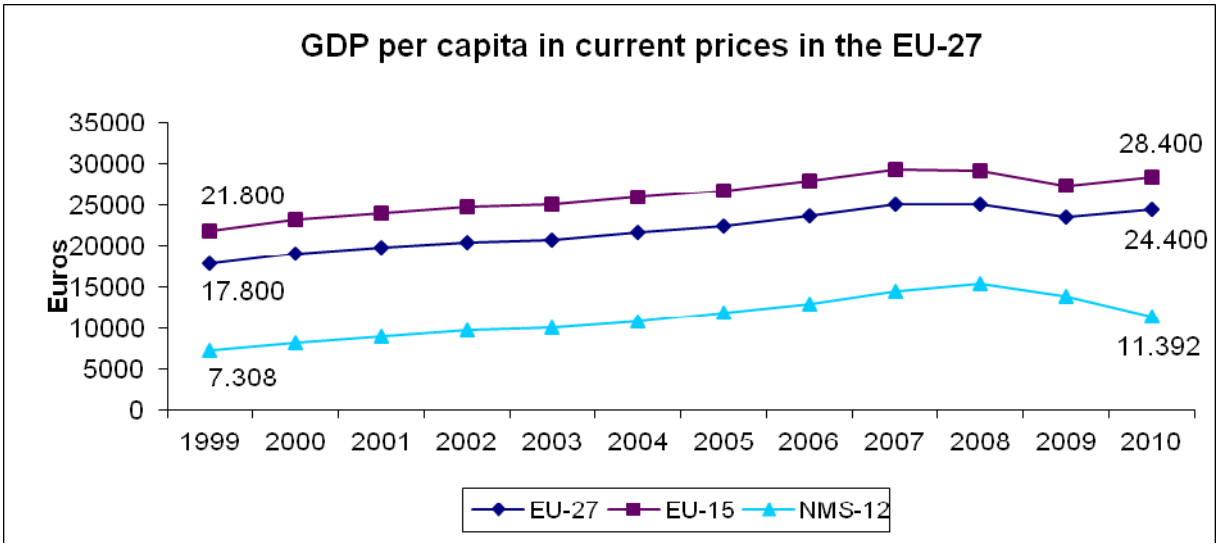
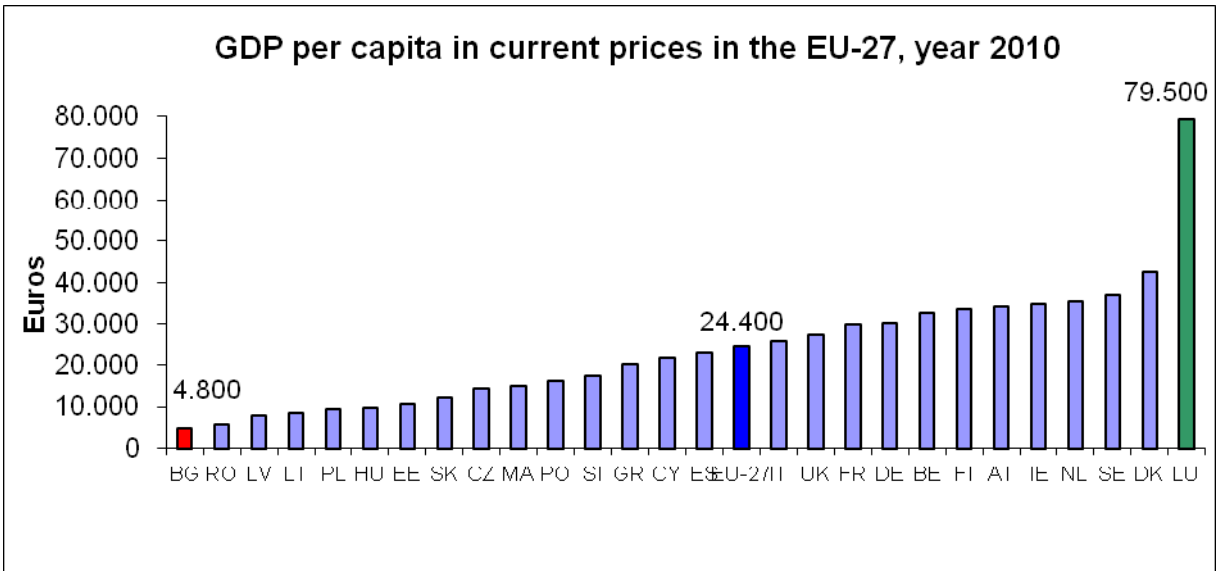


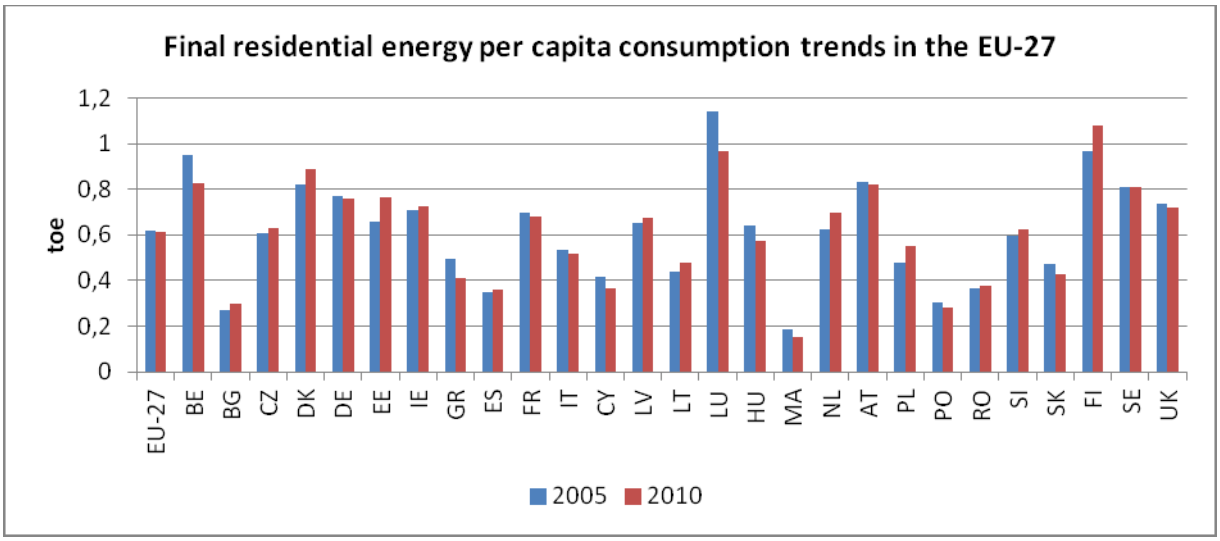
Fig. 7: GDP per capita in the EU-27 (source Eurostat)



Given the large dispersion in GDP per capita in the EU-27 it is of interest to see average energy consumption figures for each of the Member States. Data related to final residential energy consumption per capita in the year 2010 indicate that Finland has the highest consumption per capita and Malta the lowest. The three countries with the highest consumption per capita (Denmark, Finland, and Luxembourg) also have above average GDP

per capita. Higher GDP levels may indeed lead to buy more energy using equipments at home resulting hence in higher energy consumption. But as already mentioned above, economic growth can also lead to more energy efficient equipment resulting in lower energy consumption levels. If residential energy consumption per capita in the EU in the years 2005 and 2010 are compared it can be concluded that consumption in the EU-27 remained almost constant whereas there are significant changes in the individual Member States. Consumption per capita dropped significantly in Belgium and Luxemburg whereas it increased in Denmark and Finland, for instance.

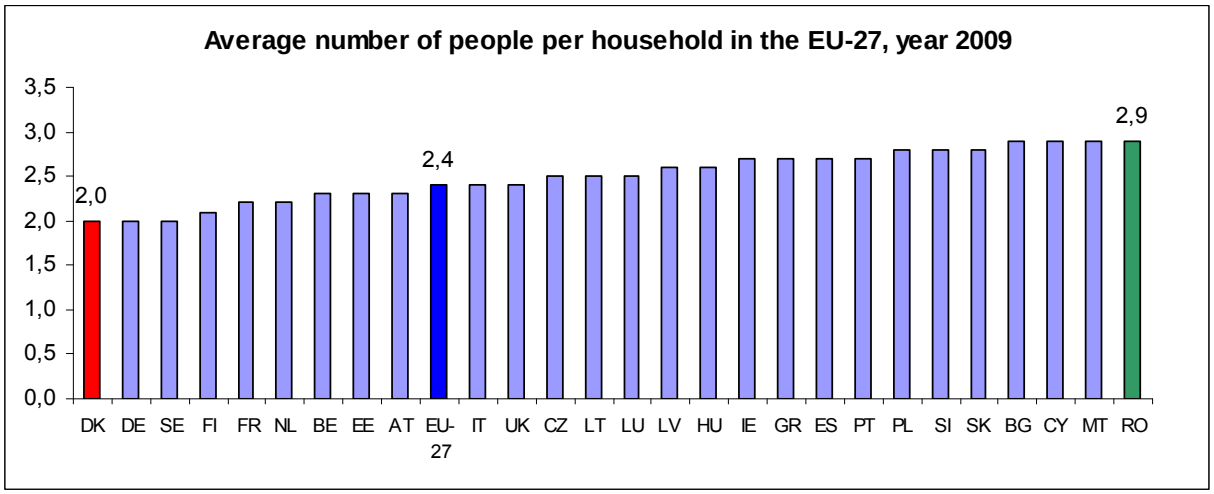
Fig. 8: Residential energy consumption per capita in the EU-27, 2005 & 2010 (source Eurostat, JRC)



Per capita consumption is also influenced by the number of people living together in one household. Single and small households have a higher per capita consumption than large family households. Most energy- using equipment is shared by the people living together in one household, especially heating and cooling, white appliances and also most electronic equipment. The average household size in terms of number of people in the EU-27 was 2.4 persons per households in the year 2009. Denmark had the lowest average number of people per household (2.0) and Romania the highest (2.9). Luxembourg with the highest GDP per capita has also above EU-27 average household size. Generally, there is a negative correlation between household size and economic development. People in wealthier countries tend to live in smaller households whereas large households are often identified in countries with below average per capita GDP.

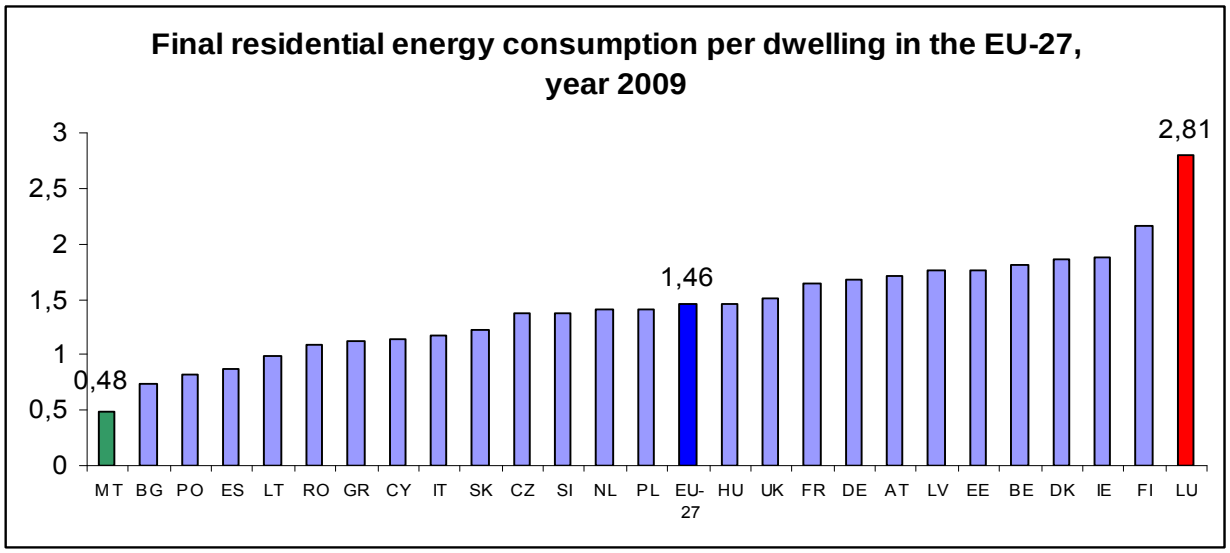
The overall development in Europe is an increase in population accompanied by an increase in the number of smaller households which leads to an increase of energy consumption per household.

Fig. 9: Average number of people per household in the EU-27, year 2009 (source Eurostat)



The average final residential energy consumption per dwelling in the EU-27 in the year 2009 was 1.46 toe. Average consumption per dwelling in Luxembourg was 2.81 toe and in Malta it was 0.48 toe. A positive correlation between consumption per dwelling and GDP per capita and a negative correlation between household size and consumption per capita can be observed.

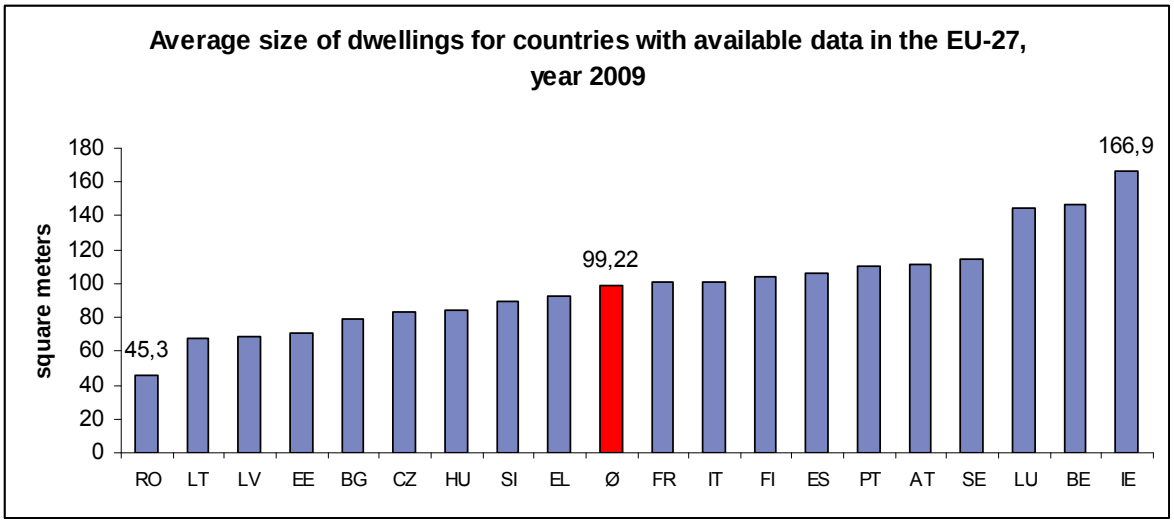
Fig. 10: Residential energy consumption per household in the EU-27, year 2009 (source Eurostat)



Besides the number of people per household the actual size in square meters is another indicator of the energy consumption level of a household. Large households in terms of size in square metres (sqm) generally have a higher heating and cooling demand and higher energy consumption by lighting equipment. Romania is the Member State with the largest average household in terms of people per household but has the smallest average size in square meters in the given sample. Belgium, Ireland, and Luxembourg are the Member

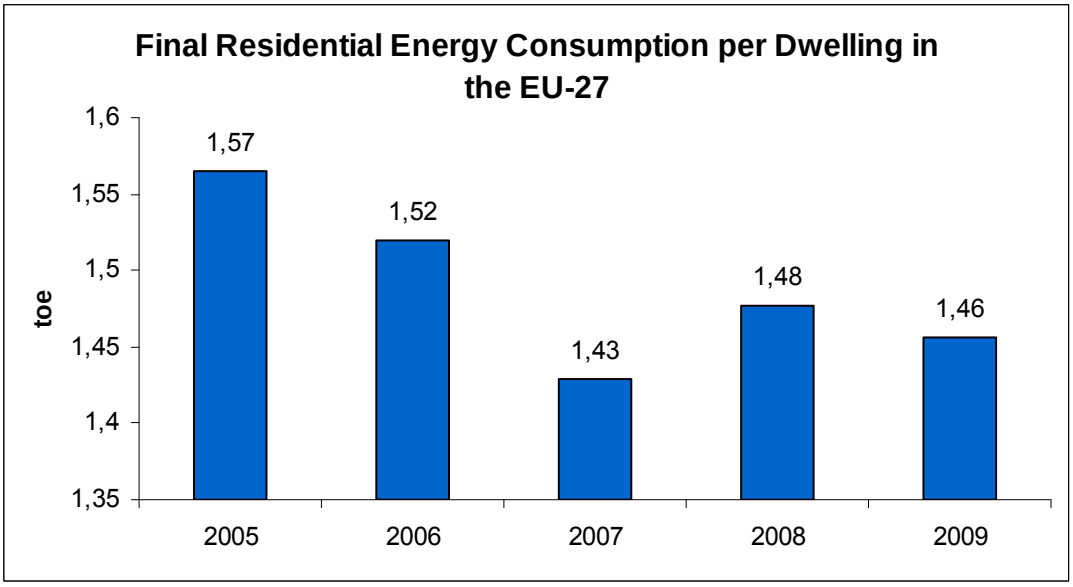
States with the largest area, they are also in the group of countries with the highest consumption per dwelling and per capita.

Fig. 11: Average size of dwellings in square meters, year 2009 (source Eurostat)



Looking at the trends in final residential energy consumption in the EU-27 it has been observed that consumption per dwelling has been decreasing during the last five years. In 2005 residential consumption per dwelling was 1.57 toe. In 2009 consumption was 1.46 toe per dwelling, meaning a decrease of -7%. There is a drop in the year 2007 to 1.43 toe compared to 1.52 toe in 2006 and 1.48 in 2008 that can be explained as mentioned above by warmer temperatures in that year and thus less energy use for heating.

Fig. 12: Residential energy consumption per dwelling in the EU-27, years 2005-2009 (source Eurostat, JRC)

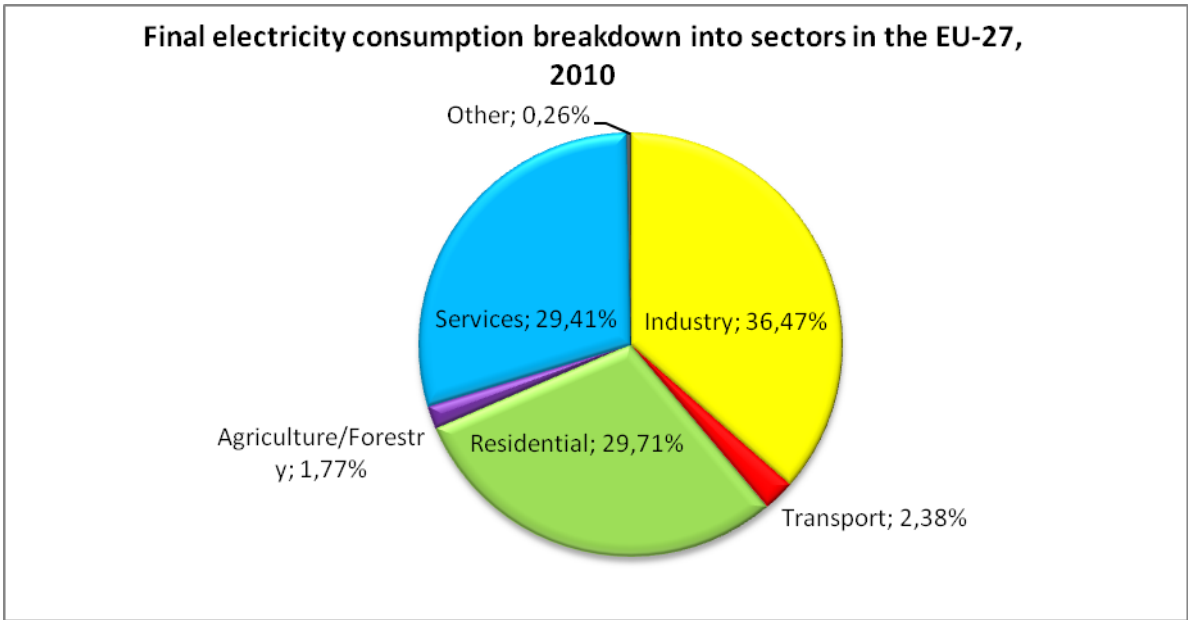


In the long term the average size of dwellings is decreasing (less persons per household). This contributes to a lower energy consumption per household but also contributes to an increase in consumption per capita. Between 2005 and 2009 the average size of dwellings did, however, not change. The decrease in consumption per dwelling during the same period can thus not be explained by smaller households.

2.2. Electricity consumption trends in the residential sector

Final residential electricity consumption accounted for 29.71% of total final electricity consumption in the year 2010. It was therefore the second most consuming sector after the industry sector with 36.47%, and just before the 29.41% of the services sector. Other sectors accounted for 0.26%. Final electricity consumption in the residential sector in the EU-27 is still on the rise and efforts to promote energy efficiency in electricity using household appliances and equipment are hence especially important.

Fig. 13: Final electricity consumption breakdown into sectors in the EU-27 (source Eurostat)



Between 1990 and 2010 final residential electricity consumption in the EU-27 grew by 39.58%. In the EU-15 it grew by 39.27% and in the NMS-12 by 42.20%. In the year 2010 the consumption level of electricity by households in the EU-27 reached 842,663 GWh; its highest point in 20 years. In 1990 residential electricity consumption was 603,692 GWh, in 2000 it was 738,289 GWh and in 2005 it was 804,861 GWh.

Tab. 2: Final electricity consumption in the EU-27 (source Eurostat, JRC)

Consumption

			Total	Residential
EU-27	2010	(GWh)	2,836,637	842,663
	2009	(GWh)	2,718,922	839,111
	2008	(GWh)	2,860,768	826,034
	2007	(GWh)	2,847,439	810,435
	2006	(GWh)	2,827,913	816,986
	2005	(GWh)	2,769,624	804,861
	2004	(GWh)	2,731,936	786,625
	2003	(GWh)	2,671,802	773,130
	2002	(GWh)	2,609,876	746,222
	2001	(GWh)	2,582,691	738,289
	2000	(GWh)	2,517,805	713,389
	1999	(GWh)	2,447,396	708,167
	1990	(GWh)	2,150,328	603,692
EU-27	1990-2010	(%)	31.92%	39.58%
	2000-2010	(%)	12.66%	18.12%
	2005-2010	(%)	2.42%	4.70%
EU-15	1990-2010	(%)	36.89%	39.27%
	2000-2010	(%)	11.88%	17.64%
	2005-2010	(%)	1.78%	4.05%
NMS-12	1990-2010	(%)	4.31%	42.20%
	2000-2010	(%)	18.70%	22.13%
	2005-2010	(%)	7.36%	10.24%

Whereas total electricity consumption has been rising over the last years (with the exception of the year 2009), the growth rates of electricity consumption have been decreasing. Between the years 1999 and 2000 total final electricity consumption in the EU-27 grew by 2.88%, while between the years 2007 and 2008 the growth rate was only 0.47%. Between 2008 and 2009 electricity consumption decreased of almost -5% (-4.96%). Between 2009 and 2010 final electricity consumption was growing again by 4.33%, the highest annual growth rate in the last ten years. This growth can likely be related to the economic rebound after the year 2009; in 2010 GDP per capita was growing again.

Tab. 3: Final residential electricity consumption of the EU-27 Member States (source Eurostat)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
EU-27	714,320	738,931	746,837	781,148	795,814	805,494	818,092	811,110	815,662	821,495	842,663
BE	23,738	24,396	25,921	26,026	26,543	26,007	22,722	21,856	19,982	20,210	20,276
BG	9,858	9,751	9,306	9,311	8,770	9,046	9,305	9,376	10,027	10,302	10,559
CZ	13,822	14,239	14,121	14,508	14,525	14,719	15,198	14,646	14,703	14,687	15,028
DK	10,215	10,159	10,190	10,262	10,332	10,449	10,573	10,349	10,280	10,096	10,389
DE	130,500	134,000	136,500	139,100	140,400	141,300	141,500	140,100	139,500	139,200	141,700
EE	1,466	1,585	1,584	1,594	1,618	1,620	1,675	1,773	1,845	1,884	2,023
IE	6,375	6,728	6,579	6,966	7,346	7,512	8,083	8,063	8,526	8,105	8,507
GR	14,207	14,546	15,775	16,444	16,852	16,875	17,676	17,957	18,126	18,131	18,130
ES	43,619	49,685	50,636	54,235	58,046	62,584	70,734	71,328	73,149	75,344	77,604
FR	128,720	133,887	132,998	141,554	147,088	144,548	147,104	145,755	150,899	151,733	162,470
IT	61,112	61,553	62,957	65,016	66,592	66,960	67,635	67,220	68,389	68,924	69,550
CY	1,055	1,042	1,157	1,295	1,316	1,433	1,500	1,608	1,683	1,722	1,738
LV	1,189	1,239	1,317	1,421	1,467	1,572	1,728	1,794	2,031	2,000	1,938
LT	1,767	1,818	1,811	1,918	2,090	2,162	2,374	2,489	2,730	2,725	2,590
LU	792	801	808	822	839	845	831	844	776	904	925
HU	9,792	10,130	10,440	11,063	11,032	11,115	11,451	11,250	11,460	11,235	11,202
MA	559	540	570	629	615	623	659	658	645	570	475
NL	21,808	22,111	22,815	23,329	23,531	24,232	24,833	24,294	24,798	24,156	24,703
AT	14,962	16,209	16,730	17,275	17,119	17,489	17,471	17,301	17,543	17,723	18,057
PL	21,034	21,376	21,659	24,852	25,476	25,253	26,467	26,369	27,115	27,534	28,615
PT	10,056	10,625	11,382	11,835	12,432	13,242	13,406	13,863	13,444	14,190	14,522
RO	7,652	7,724	7,771	8,243	8,043	9,234	9,999	10,389	10,400	11,021	11,329
SI	2,601	2,675	2,704	3,008	3,012	2,951	3,055	3,021	3,182	3,137	3,219
SK	5,419	5,222	5,157	5,039	4,817	4,701	4,577	4,602	4,531	4,428	4,362
FI	18,140	19,373	19,942	20,404	20,338	20,648	21,342	21,491	21,169	22,047	23,649
SE	42,020	42,180	41,473	41,998	41,375	42,663	41,490	39,638	38,929	40,946	40,422
UK	111,842	115,337	114,534	123,001	124,200	125,711	124,704	123,076	119,800	118,541	118,681

Fig. 14: Final total electricity consumption in the EU-27 (source Eurostat)

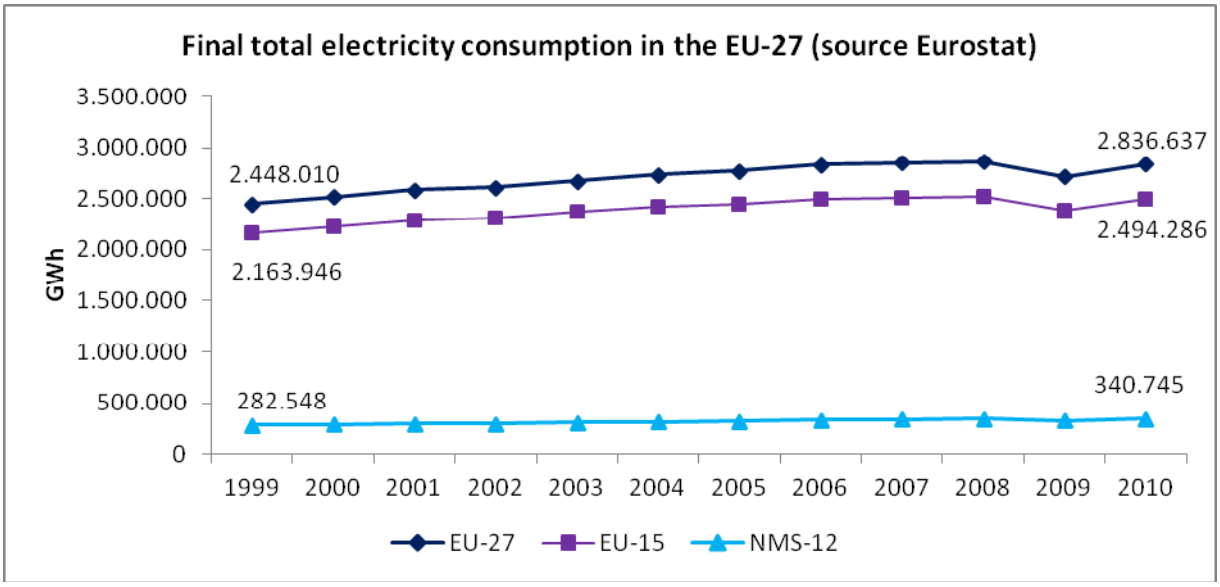
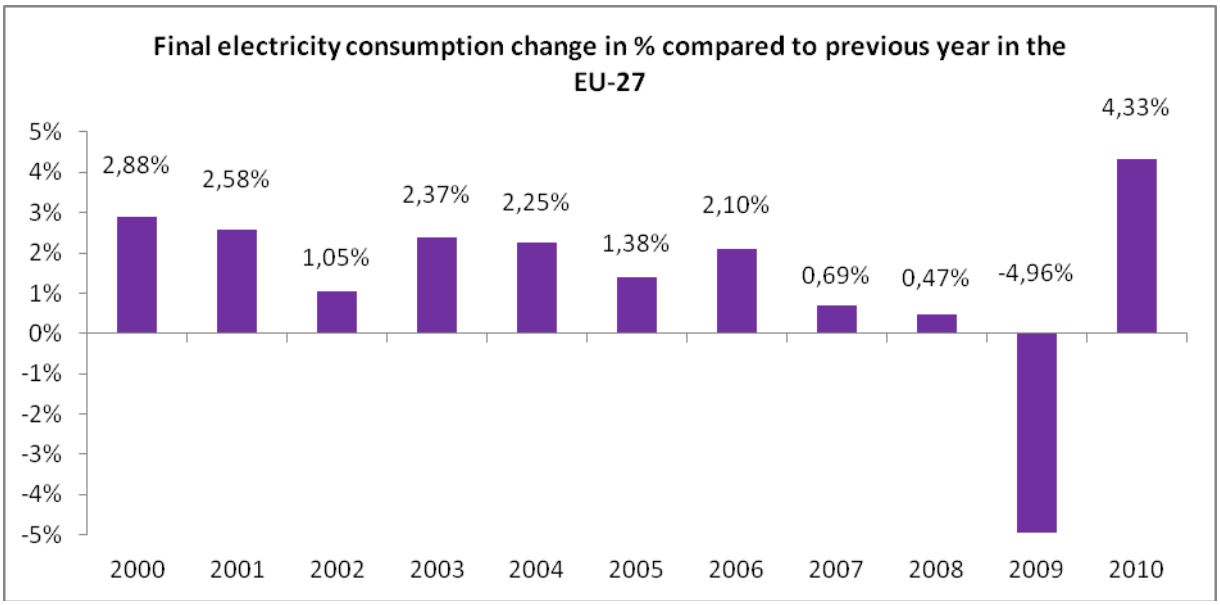


Fig. 15: Final total electricity consumption growth rates in the EU-27 (source Eurostat, JRC)



Final electricity consumption per capita in the EU-27 decreased between the years 2008 and 2009 (by -4.96%). Until the year 2008, per capita electricity consumption was rising. Between 1999 and 2010 it increased by 7.07%. Electricity consumption per capita in the year 2010 was 6271 kWh in the EU-15, 5661 kWh in the EU-27 and 3314 kWh in the NMS-12.

Fig. 16: Final total electricity consumption per capita trends in the EU-27 (source Eurostat, JRC)

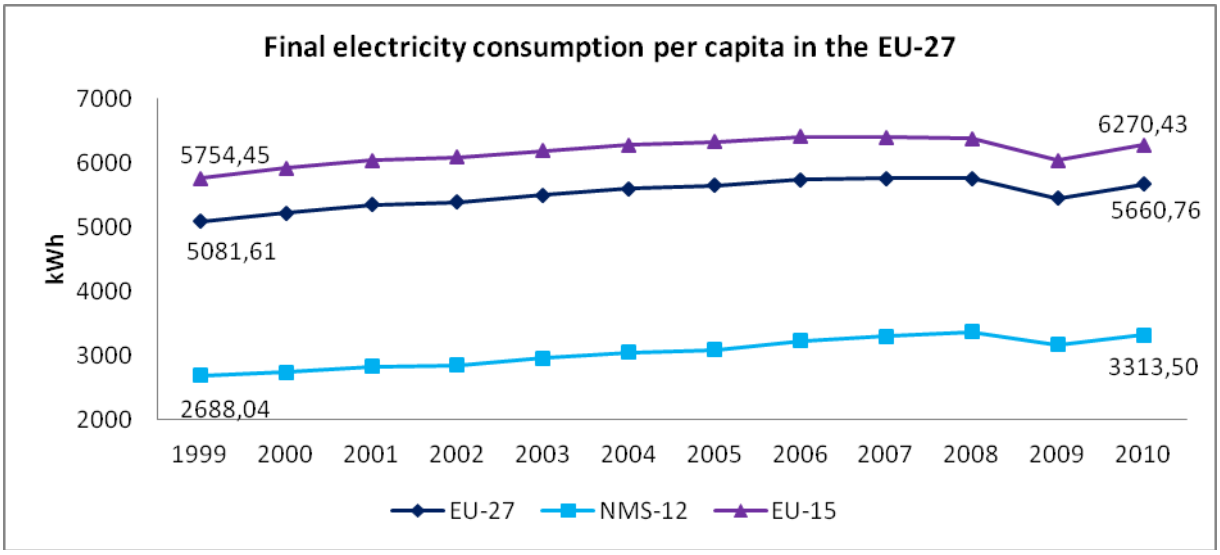
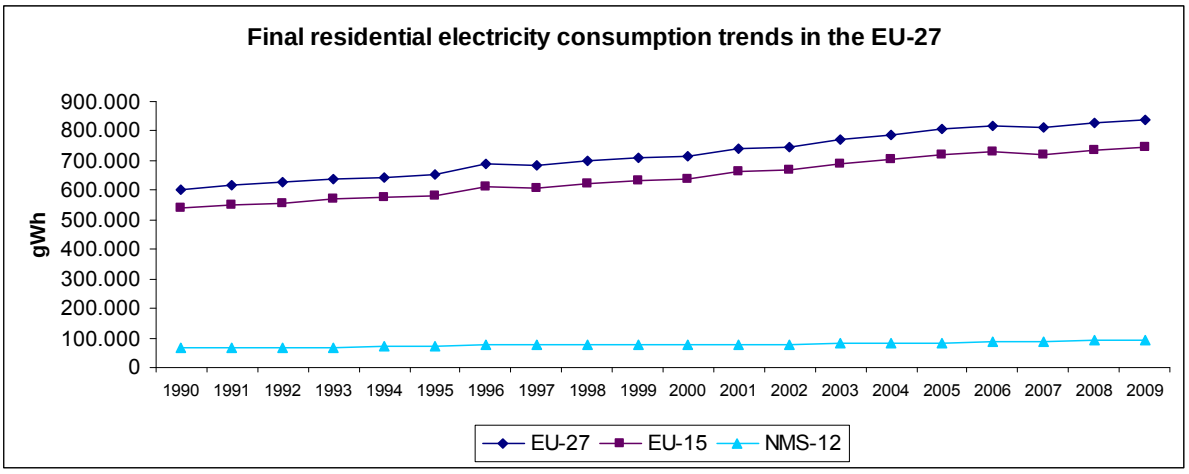


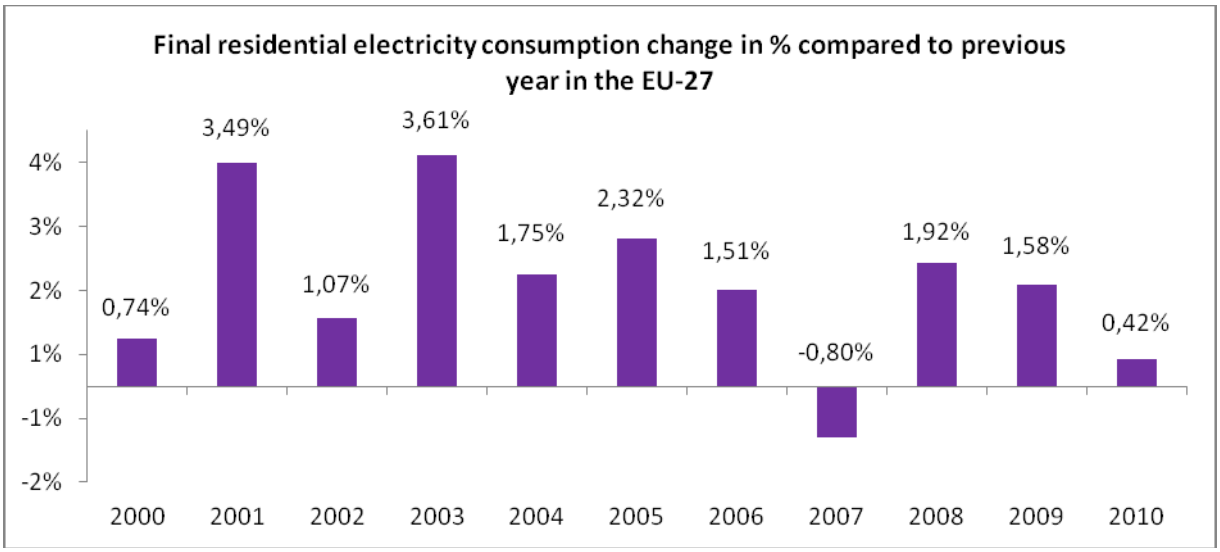
Fig. 17: Final residential electricity consumption trends in the EU-27 (source Eurostat)



In the residential sector, electricity consumption growth rates decreased to overall lower levels than ten to five years ago. In 2007 the growth rate compared to the previous year was even negative. But again this can be related to higher temperatures during that year (implying less energy use for heating). Between 2000 and 2001 the growth rate of residential electricity consumption was 3.49% whereas it was 1.58% between 2008 and 2009. From 2005 on there is a trend of lower growth rates for residential electricity consumption on average. The 3.61% growth in electricity consumption between 2002 and 2003 marked the highest growth rate during the last ten years. Considering the on average lower growth rates

during the last five years, it can be expected that future electricity consumption will finally start to decrease.[2] Between 2009 and 2010 final residential electricity consumption only grew by 0.42%, the lowest growth rate in the ten years with the exception of the year 2007.

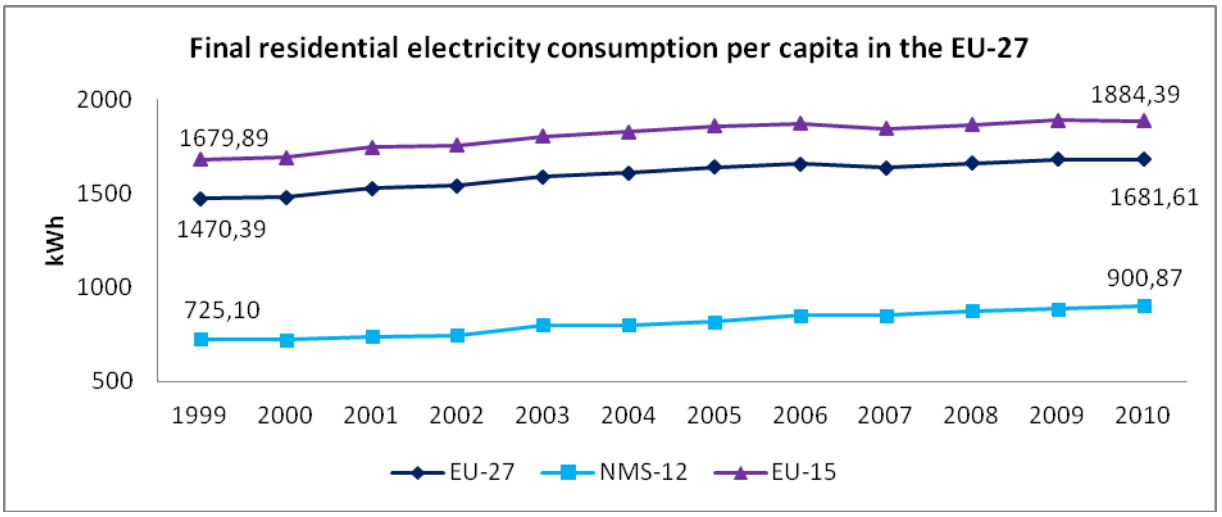
Fig. 18: Final residential electricity consumption growth rates in the EU-27 (source Eurostat, JRC)



Interestingly, residential electricity consumption per capita does not decrease between the years 2008 and 2009. It increases of 1.17% in the EU-27, 1.15% in the EU-15 and 9.43% in the NMS-12. These numbers are in line with the growth rate of total residential electricity consumption between 2008 and 2009 (1.58%). The overall decrease in electricity consumption per capita (-4.96%) showed in Fig.15 were hence achieved thanks to sectors different from the residential one.

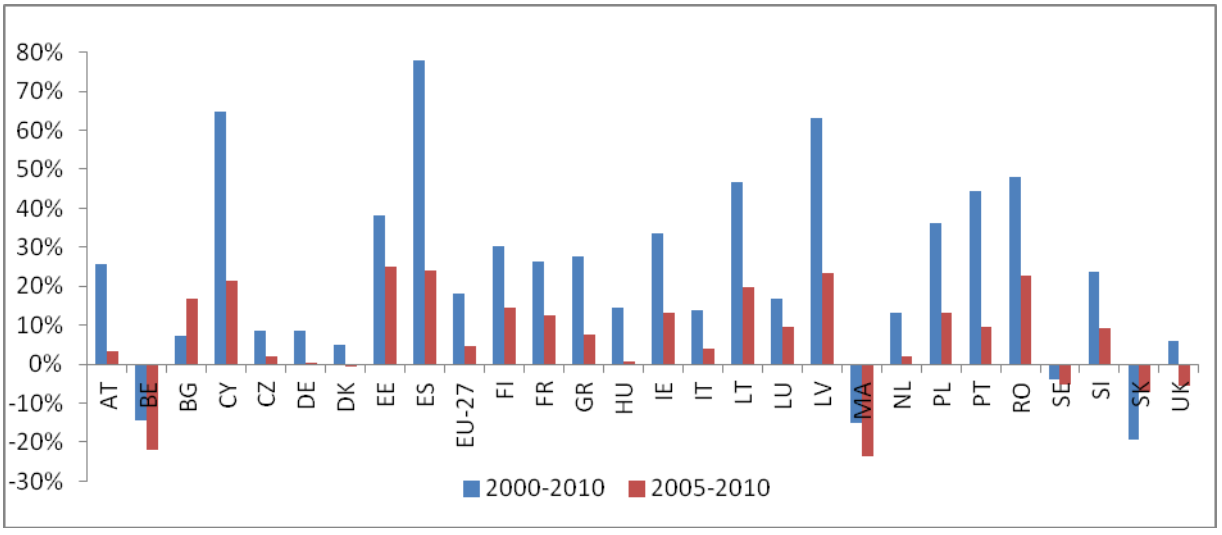
[2] This will also depend on whether electricity will be used more for heating purposes and transport (plug-in electric vehicles).

Fig. 19: Residential electricity consumption per capita trends in the EU-27 (source Eurostat, JRC)



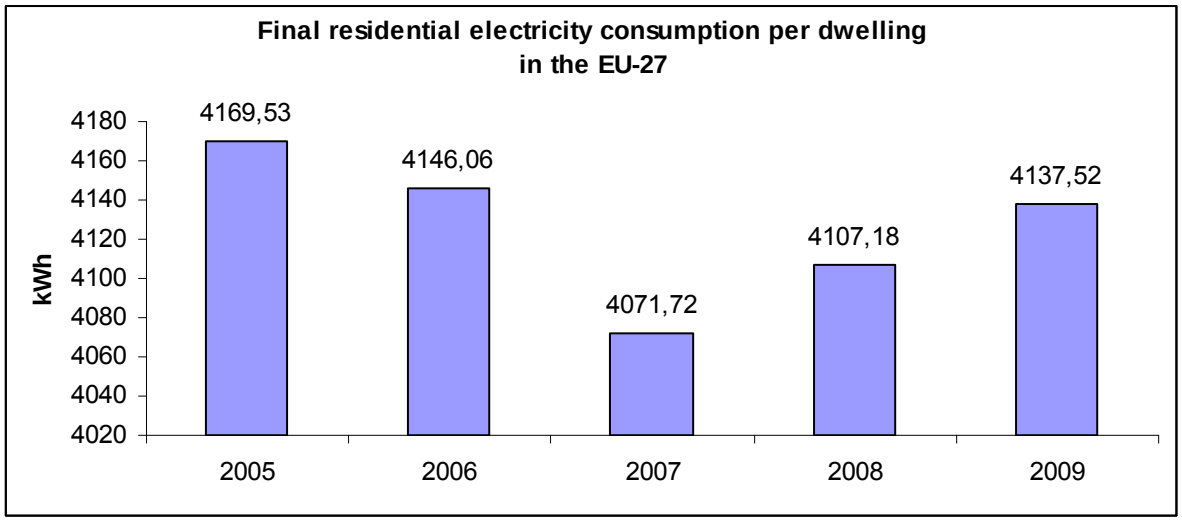
Between 2000 and 2010 the EU Member States with the lowest growth rates (or even negative growth rates) in residential electricity consumption were Slovakia (-19.51%), Malta (-15.03%), Belgium (-14.58%) and Sweden (-3.8%). The ones with the highest growth rates are Spain (77.91%), Cyprus (64.74%) and Latvia (62.99%). Between 2005 and 2010, six EU Member States had negative growth rates in residential electricity consumption, meaning final residential consumption was decreasing. The Member States with negative growth rates were: Malta (-23.76%), Belgium (-22.04%), Slovakia (-7.21%), the United Kingdom (-5.59%), Sweden (-5.25), and Denmark (-0.57%).

Fig. 20: Final residential electricity consumption growth rates in the EU-27 (source Eurostat, JRC)



Looking at consumption per dwelling in the last five years (2005-2009) a very low consumption level in the year 2007 is observed (due to warmer temperatures in this year, see Fig. 21). Final residential electricity consumption per household was 4169 kWh in 2005 and 4137 kWh in 2009. Compared with the years 2005 and 2006 electricity consumption per dwelling is decreasing in the year 2009. However, compared to consumption levels in the years 2007 and 2008 (4071 kWh and 4107 kWh respectively) consumption per dwelling is increasing. As already mentioned, the low consumption level in 2007 is likely to be caused by climatic conditions (warmer temperatures in this year).

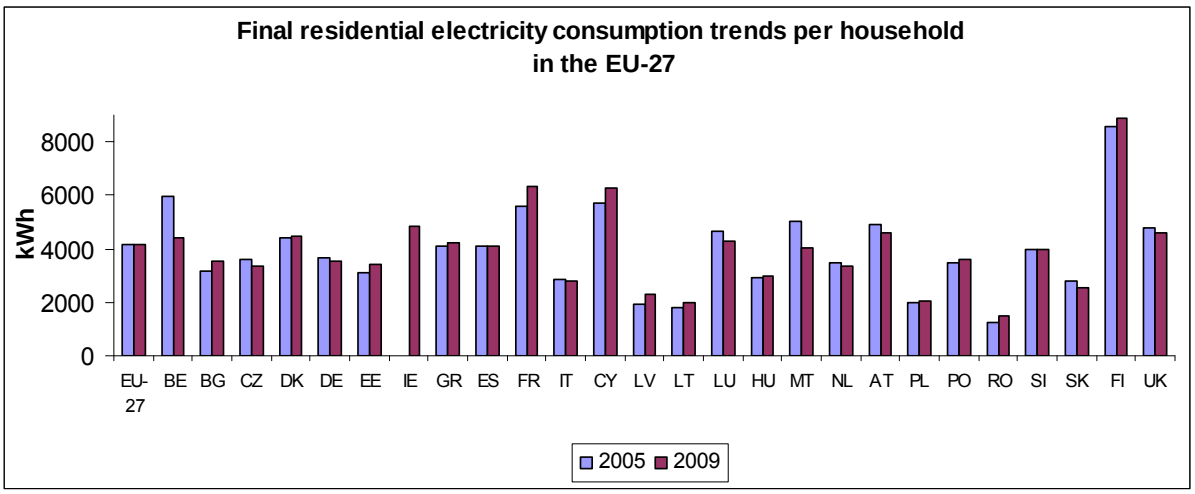
Fig. 21: Final residential electricity consumption per dwelling in the EU-27 (source Eurostat)



It is important to note that Fig. 21 only shows residential electricity consumption per dwelling and not total electricity consumption divided by the number of households.

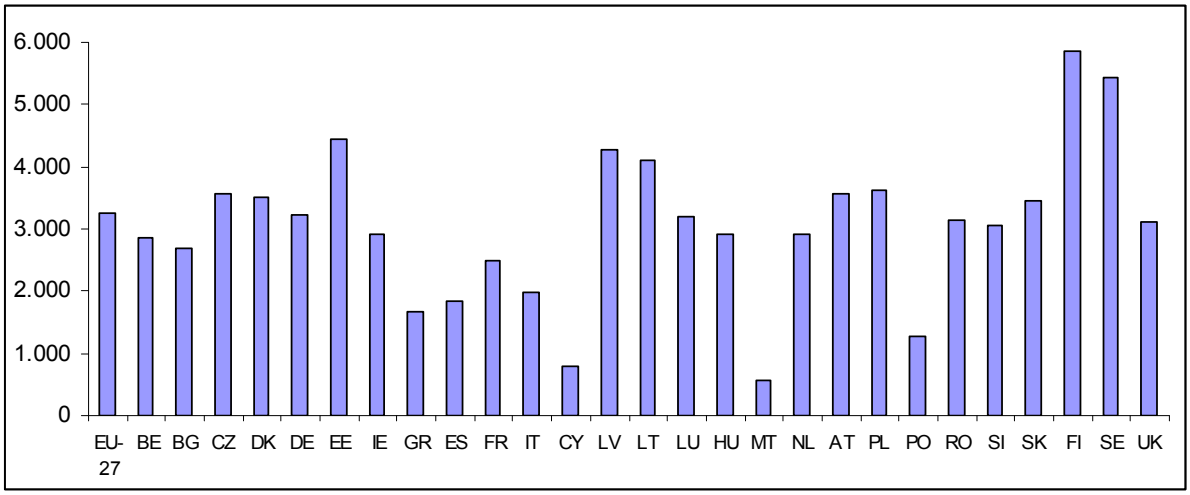
Looking at residential electricity consumption per household across EU Member States, a large dispersion of consumption levels is registered. Finland has the highest residential electricity consumption per household. This is mainly due to above EU-average heating consumption of households and the use of saunas which can be found in many households in Finland. It can also be observed that consumption variation between 2005 and 2009 is positive for some Member States, e.g. Finland, France and Cyprus, whereas it is negative for other Member States like, for instance, Belgium, Germany and Luxembourg.

Fig. 22: Final residential electricity consumption trends per household in the EU-27 (source Eurostat)



Consumption per household does not show the consumption pattern of a typical household but it includes a wide variety of very different households with different characteristics. The average includes very small households and large family households as well as low income and high income households etc.

Fig. 23: Mean heating degree days (1980-2004) in the EU-27 (source Eurostat)



It is also worth mentioning that Finland and Sweden had the highest mean heating degree days in the period between 1980 and 2004 whereas Cyprus and Malta had the lowest.

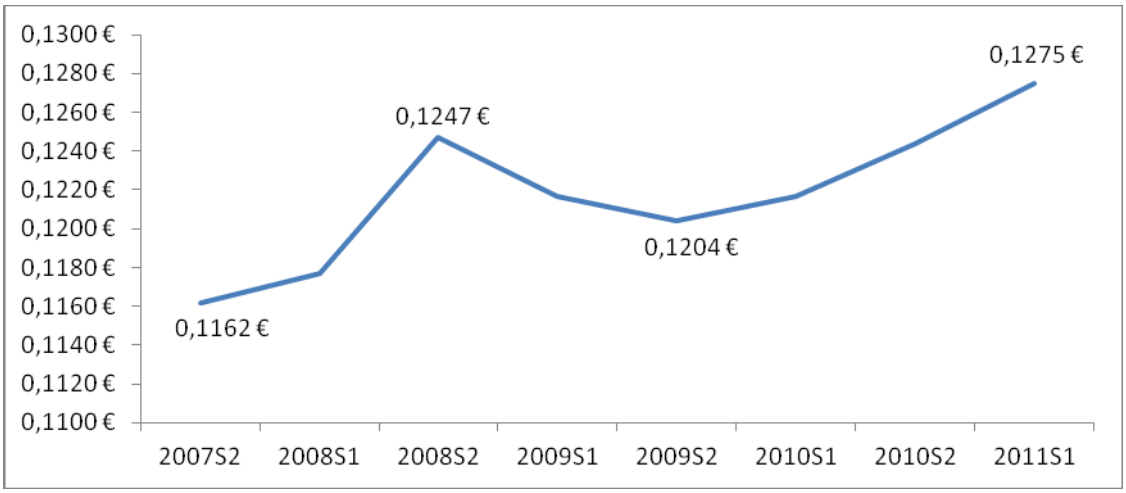
Fig. 24: Electricity prices for domestic consumers across the EU-27 in 2011 (source Eurostat)

Consumption: 3,500 kWh/year		Consumption: 7,500 kWh/year	
EU-member state	€ per kWh electricity	EU-member state	€ per kWh electricity
Austria	€ 0.2079	Austria	€ 0.1888
Belgium	€ 0.2137	Belgium	€ 0.1911
Bulgaria	€ 0.0907	Bulgaria	€ 0.0909
Cyprus	€ 0.2044	Cyprus	€ 0.2029
Czech Rep,	€ 0.1461	Czech Rep,	€ 0.1212
Denmark	€ 0.2947	Denmark	€ 0.2553
Estonia	€ 0.1089	Estonia	€ 0.1061
Finland	€ 0.1501	Finland	€ 0.1313
France	€ 0.1396	France	€ 0.1254
Germany	€ 0.2671	Germany	€ 0.2511
Greece	€ 0.1320	Greece	€ 0.1527
Hungary	€ 0.1714	Hungary	€ 0.1632
Ireland	€ 0.2050	Ireland	€ 0.1840
Italy	€ 0.2041	Italy	€ 0.2568
Latvia	€ 0.1125	Latvia	€ 0.1126
Lithuania	€ 0.1307	Lithuania	€ 0.1268
Luxembourg	€ 0.1926	Luxembourg	€ 0.1796
Malta	€ 0.1703	Malta	€ 0.1803
Netherlands	€ 0.1892	Netherlands	€ 0.2336
Poland	€ 0.1509	Poland	€ 0.1458
Portugal	€ 0.1813	Portugal	€ 0.1650
Romania	€ 0.1134	Romania	€ 0.1119
Slovakia	€ 0.1768	Slovakia	€ 0.1575
Slovenia	€ 0.1557	Slovenia	€ 0.1422
Spain	€ 0.2013	Spain	€ 0.1839
Sweden	€ 0.1967	Sweden	€ 0.1707
United Kingdom	€ 0.1587	United Kingdom	€ 0.1432

Electricity prices differ to a large extent across the European Union. Denmark and Germany have relatively high electricity prices, i.e. 0.2947 per kWh electricity and 0.2671 per kWh electricity for a consumption of 3500 kWh/year in 2011. Bulgaria and Estonia have comparatively low electricity prices with 0.0907 € and 0.1089 € per kWh electricity used in 2011 (see Fig. 24 above). During the last years, electricity prices have increased in the EU.

From an average price of 0.1162 € per kWh electricity used in 2007 the price increased to 0.1275 € per kWh electricity used in the first semester of 2011 (for a consumption band between 2550 and 5000 kWh /year). This means an increase of 9.72% during this period.
The influence of the price of electricity consumption is, however, not that large since electricity demand is generally quite inelastic.

Fig. 25: Residential electricity price trends in the EU-27 - € per kWh of electricity (source Eurostat)[3]



2.3. Gas consumption trends in the residential sector

Total final gas consumption started to decrease in the year 2004 until the year 2009. In the EU-27 total gas consumption fell by -5.73% between 2005 and 2010, by -5.28% in the EU-15 and by -8.52% in the NMS-12. In 2010 total gas consumption in the EU-27 was 268,516 ktoe compared to 229,009 ktoe in 1990 (resulting in a 17.25% increase by the year 2010). Final gas consumption has been decreasing since 2005 until 2009. In 2010 it restarted to grow. This increase in consumption in 2010 can be attributed to a certain part to the unusual cold winter 2010 and to the economic rebound effect after the crisis in 2009. In the residential sector the pattern is similar and also decreasing until 2010. In 2009 final residential gas consumption in the EU-27 was 115,612 ktoe compared to 122,795 in 2004 (decrease of 5.58% in these five years). In 2010 final residential gas consumption in the EU-27 was 119,075 ktoe. Between 1990 and 2010 final residential gas consumption in the EU-27 increased by 52.26%; between 2000 and 2010 it increased by 5.98% (see Tab.4). Between

[3] Band DC : 2 500 kWh < Consumption < 5 000 kWh

2005 and 2010, final residential energy consumption decreased by -3.15% with 2005 being the peak in consumption (122,944 ktoe).

Tab. 4: Final gas consumption trends in the EU-27 (source Eurostat, JRC)

Consumption			Total	Residential
EU-27	2010	(ktoe)	268,516	119,075
	2009	(ktoe)	252.577	115,612
	2008	(ktoe)	269.698	116,368
	2007	(ktoe)	266.366	113,039
	2006	(ktoe)	278.039	119,948
	2005	(ktoe)	284.824	122,944
	2004	(ktoe)	285.56	122,795
	2003	(ktoe)	285.424	118,638
	2002	(ktoe)	269.996	111,891
	2001	(ktoe)	273.909	112,534
	2000	(ktoe)	266.443	112,360
	1999	(ktoe)	260.461	103,543
	1990	(ktoe)	229.009	78,204
Growth rates				
EU-27	1990-2010	(%)	17.25%	52.26%
	2000-2010	(%)	0.78%	5.98%
	2005-2010	(%)	-5.73%	-3.15%
EU-15	1990-2010	(%)	30.46%	54.82%
	2000-2010	(%)	0.61%	5.76%
	2005-2010	(%)	-5.28%	-3.20%
NMS-12	1990-2010	(%)	-29.47%	34.43%
	2000-2010	(%)	1.87%	7.77%
	2005-2010	(%)	-8.52%	-2.75%

Tab. 5: Final residential gas consumption in the EU-27 Member States in ktoe (Source Eurostat)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
EU-27	112,362	112,602	111,883	118,675	122,840	122,966	119,970	113,087	116,419	115,603	119,075
BE	3,293	3,622	3,456	3,599	3,765	3,726	3,457	3,279	3,299	3,313	3,826
BG	0	1	1	3	6	14	24	33	39	51	49
CZ	2,049	2,377	2,230	2,402	2,351	2,311	2,275	2,036	2,047	2,059	2,382
DK	658	699	671	717	713	705	683	635	633	641	751
DE	23,441	24,729	24,728	26,903	28,383	29,027	28,813	28,164	29,024	28,805	22,976
EE	42	42	37	37	39	45	46	49	49	51	55
IE	438	481	475	538	600	606	631	592	667	623	708
GR	5	5	9	19	35	73	139	177	208	256	255
ES	2,020	2,261	2,534	2,962	3,035	3,187	3,662	3,779	3,640	3,687	4,027
FR	17,180	12,908	13,226	13,154	14,764	14,452	14,614	12,941	14,003	14,194	13,871
IT	14,975	15,746	15,301	17,273	17,937	18,746	17,017	15,942	16,015	16,821	18,698
LV	63	72	79	88	95	100	103	110	112	103	124
LT	104	107	110	117	127	134	140	147	146	145	158
LU	157	173	175	188	204	204	189	188	201	196	196
HU	3,025	3,304	3,413	3,947	3,568	3,928	3,644	3,174	3,294	3,182	3,238
NL	7,968	8,278	7,825	8,014	7,900	7,522	7,371	6,634	7,107	7,462	8,641
AT	1,123	1,256	1,174	1,240	1,211	1,285	1,235	1,157	1,173	1,220	1,340
PL	3,052	3,198	3,039	3,051	3,021	3,229	3,315	3,170	3,141	3,223	3,547
PT	99	120	147	158	181	200	203	220	230	264	299
RO	2,217	1,995	2,352	2,561	2,544	2,301	2,548	2,067	2,189	2,147	2,206
SI	59	62	68	86	98	98	93	85	102	106	114
SK	1,642	1,657	1,603	1,609	1,487	1,418	1,283	1,110	1,182	1,206	1,332
FI	23	27	30	29	31	30	34	37	39	43	48
SE	103	120	76	69	70	71	56	54	53	75	85
UK	28,626	29,362	29,126	29,909	30,677	29,552	28,395	27,307	27,824	25,731	30,149

Between 2006 and 2007 final residential gas consumption fell by 5.76%. Between the years 2007 and 2008 it increased again by 2.94%. The low consumption level in 2007 can, again, be explained by higher temperatures resulting in below average heating degree days. Comparing Fig. 26 and Fig. 27 (see below), it can be observed that there is a bend in all curves at the data point of the year 2007. This bend shows that there is a positive correlation between heating degree days (lower temperatures) and gas consumption.

Fig. 26: Final residential gas consumption in the EU-27 (source Eurostat)

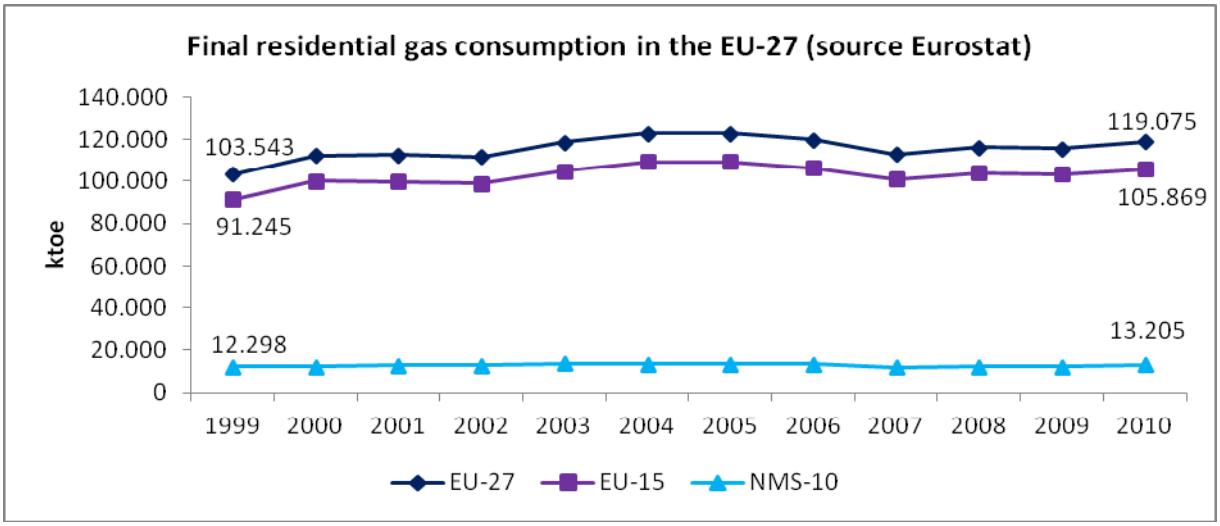


Fig. 27: Total final gas consumption trends in the EU-27 (source Eurostat)

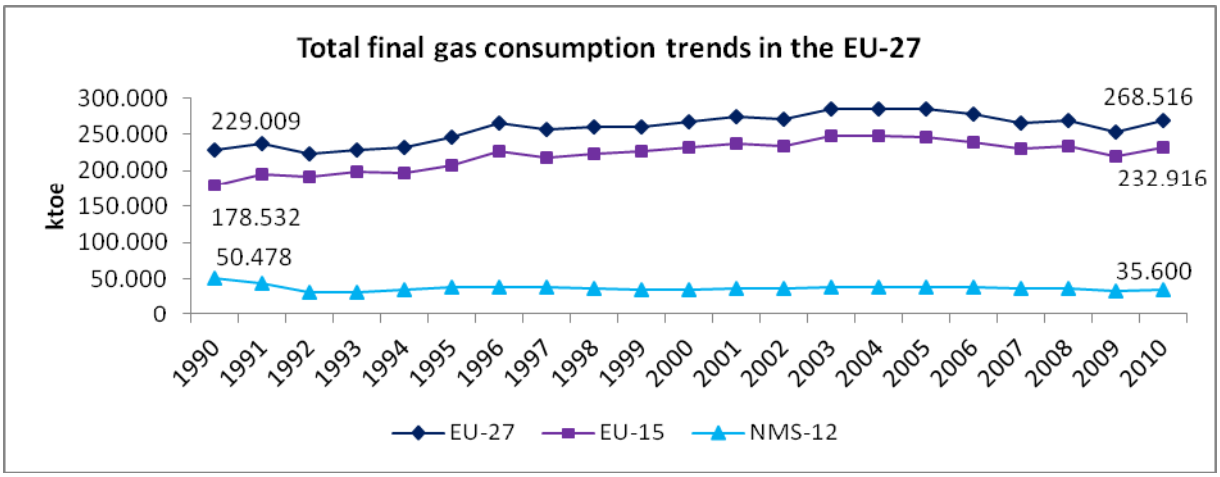
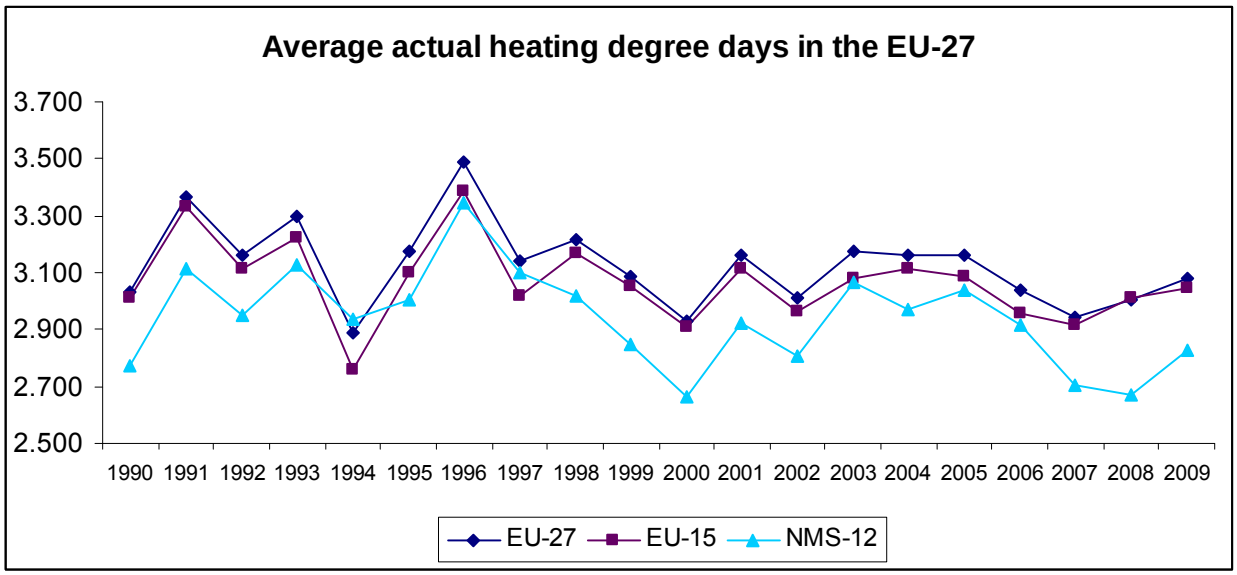
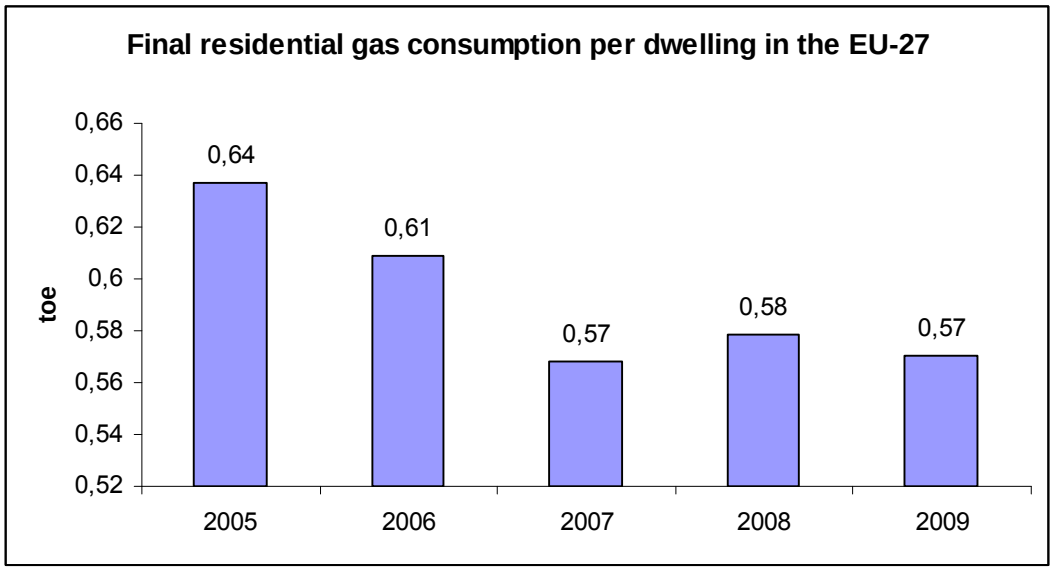


Fig. 28: Actual heating degree days in the EU-27 (source Eurostat)



The correlation between gas consumption and heating degree days is also visible in the residential gas consumption per dwelling showed in the figure below. In 2005 the average residential gas consumption per dwelling in the EU-27 was 0.64 tons of oil equivalent. Since then gas consumption per dwelling is decreasing. From 2006 to 2007 consumption per dwelling fell by -6.6%. This significant decrease can also be contributed to the below average temperatures in the year 2007. Between 2005 and 2006 consumption per dwelling fell by 4.6%. After the year 2007 consumption per dwelling increased a little bit, by 1.75% between 2007 and 2008. However, from 2008 to 2009 the growth rate in consumption per dwelling was again negative (-1.72%). Overall, the trend in residential gas consumption per dwelling over the last five years is decreasing.

Fig. 29: Final residential gas consumption per dwelling in the EU-27 (source Eurostat)



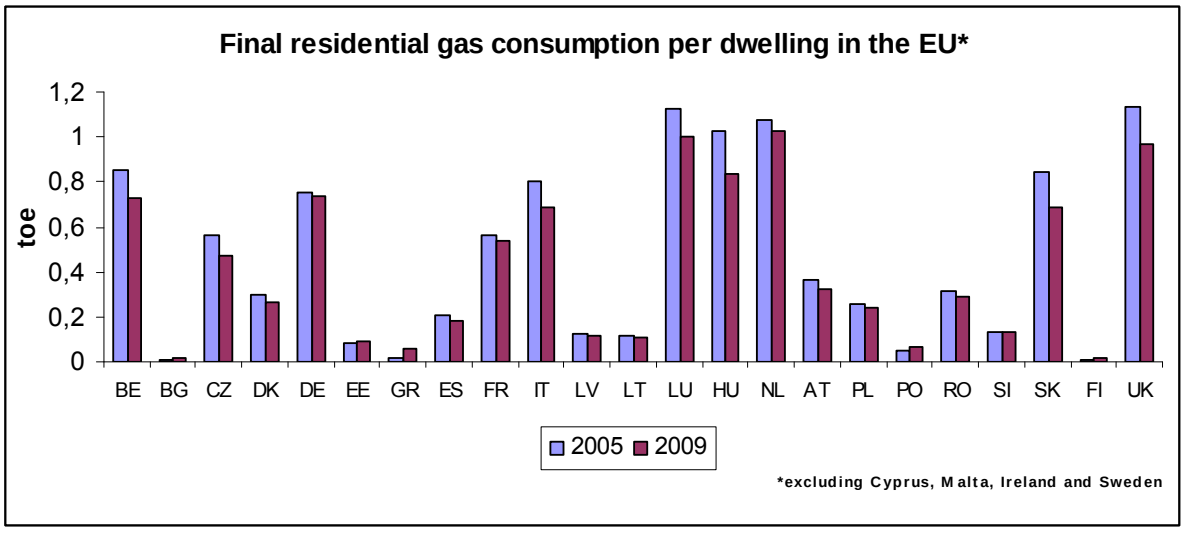
Comparing residential gas consumption per dwelling across the European Union, substantial differences in consumption levels can be observed. Countries with relatively high per dwelling consumption are Hungary, Luxembourg, the Netherlands, and the United Kingdom. Very low consumption levels per dwelling can be found in Estonia, Greece, Latvia, Lithuania, Poland and Slovenia and Finland. Finland, Poland, and Slovenia have big district heating systems for buildings which drive consumption level per dwelling down.[4] Heating with electricity (including heat pumps) is another alternative to gas heating present in these countries. For all the countries with high consumption levels per dwelling, consumption is lower in 2009 than in 2005. Since the actual heating degree days in these countries are on

[4] Cyprus, Malta, Ireland and Sweden are not considered in the analysis due to missing data points of gas consumption since they do not have a natural gas network. Cyprus and Malta have a very mild climate in addition.

similar levels in both years this drop in consumption is not likely to be related to weather conditions.

This report does not discuss building energy efficiency improvements, such as more insulation as result of policies and programmes but focuses on appliances and equipment. Nevertheless, it is important to mention that building performance policies and programmes (mainly financial incentives) as fostered e.g. by the Energy Performance of Building Directive (EPBD) have a substantial influence on gas consumption of households for heating. They have also an important influence on electricity consumption for cooling (air-conditioning). The EPBD was adopted in May 2002 (and the recast in 2010) and calls for increased national regulation for energy efficiency in new and renovated buildings. The directive also sets the framework for national requirements for building systems, such as heating systems and larger ventilation systems.

Fig. 30: Final residential gas consumption per dwelling in the EU (source Eurostat)



Tab. 6: Gas price trends for households in the EU- 27 in € per GJ (source Eurostat)

	2007S2	2008S1	2008S2	2009S1	2009S2	2010S1	2010S2
EU-27	11,1455	11,8115	13,8404	12,7012	11,4422	11,1316	12,0556
Belgium	11,1400	13,0100	16,3700	13,5400	11,4500	11,7500	13,3000
Bulgaria	7,4803	8,2012	9,0500	10,9469	8,0581	8,5080	9,9817
Czech Republic	8,4540	10,2536	12,3418	11,5531	11,0198	10,8661	11,9601
Denmark	16,3084	:	13,1277	12,3959	13,2777	14,6034	14,9230
Germany	12,6800	13,3200	16,1400	13,4800	12,0900	11,5400	11,6800
Estonia	6,1748	7,3897	8,3818	8,9926	8,0260	7,7148	8,6572

Ireland	14,8400	13,2900	15,9000	15,7600	13,4700	12,0700	12,1200
Spain	13,9210	13,7770	15,6360	14,6400	12,8237	12,7863	12,7111
France	12,2000	12,2900	13,7090	13,0100	13,8500	12,2500	13,3900
Italy	11,1380	12,0310	13,5540	14,1580	9,6930	10,4490	13,8350
Latvia	7,3322	8,2749	13,2013	13,2097	9,5724	7,9209	10,2369
Lithuania	5,5245	7,7517	9,0050	9,9989	9,3784	8,6206	10,4019
Luxembourg	8,7200	14,1000	12,7300	12,1900	10,9400	10,6000	11,6000
Hungary	8,8488	9,3641	10,7727	11,1477	10,5854	11,8967	12,3012
Netherlands	11,7300	12,0090	13,4050	14,4330	10,6800	11,1900	11,5090
Austria	12,3800	11,8800	12,5500	13,1300	12,4700	12,5400	12,0700
Poland	9,1348	9,4774	11,7191	8,8525	10,4750	9,6777	11,5080
Portugal	17,2663	16,5390	16,6450	15,6800	15,7313	15,7050	16,3690
Romania	6,3128	5,9497	6,1445	4,8414	4,0524	4,1793	4,0229
Slovenia	10,9900	12,1400	15,6800	14,4400	11,6800	12,5607	14,3333
Slovakia	9,7257	9,5997	10,8599	10,7810	11,1030	10,1770	10,4120
Sweden	14,3798	14,7723	16,9480	13,9953	15,4031	16,4473	17,4247
United Kingdom	9,4392	10,4643	12,7323	11,2776	11,2810	10,7288	11,1646

3. Electricity end-use in the residential sector

The chapter starts with the electricity consumption breakdown in the residential sector. The following part gives an overview of the current regulation regarding energy efficiency in the EU. The next sub chapters describe and analyse the current status of energy efficiency of the different electricity end-use appliances in the residential sector.

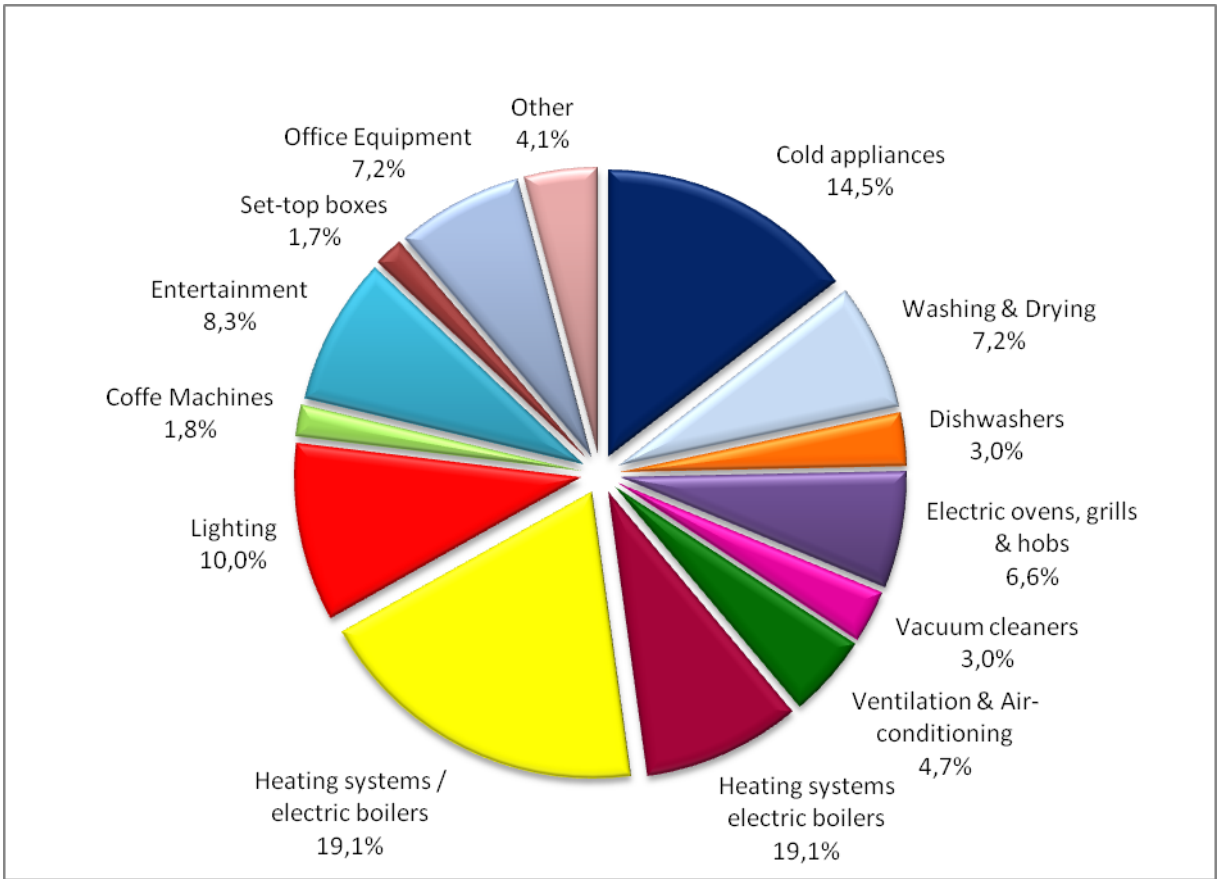
3.1. Electricity consumption breakdown

Residential electricity consumption is still rising. Although many appliances are becoming more efficient, the number of appliances is rising, appliances are used more often and for longer periods of time, and many appliances have more functions or special features that require more energy.

The general trend in the residential sector is therefore an increase in electricity consumption. There are, however, important differences between different household electricity end-users. The electricity consumption of residential lighting is, for instance, decreasing. This decrease is to a large extent the result of the phasing-out of less energy efficient incandescent light

bulbs. Also the large promotion of CFLs in many EU Member States even before the phase out period contributed to this success. The JRC estimates lighting electricity consumption in the residential sector to be 10.5% of total electricity consumption in 2007.

Fig. 31: Residential electricity consumption breakdown in the EU-27, 2009 (source JRC)



The Joint Research Centre (JRC) Electricity Consumption Breakdown (see Fig. 31) is the result of an on-going survey of statistical data and analysis of several studies and reports started in 2006. The estimates are in line with other similar consumption breakdowns such as the REMODECE project consumption breakdown [ALM2011, REM2009]. Although both consumption breakdowns use very different methodology (the REMODECE breakdown is based on measurements and surveys in a limited number of households in the EU), the overall pictures are similar.

3.2. Overview on current regulation in the residential sector in the EU

Energy efficiency legislation of household appliances in the European Union focuses on two main approaches: labelling and standard product information and minimum energy

performance standards (eco-design). In the last two years two revised important directives on energy efficiency policies have been published: directive 2010/30/EU on labeling (*directive on the indication by labeling and standard product information of the consumption of energy and other resources by energy-related products*) and directive 2009/125/EC on eco-design (*directive establishing a framework for the setting of ecodesign requirements for energy-related products*). Both directives were new versions of already existing directives (directive 92/75/EEC for labeling and directive 2005/32/EC for design of energy-using products.

Eco-design

In 2005, the Ecodesign Directive (2005/32/EC) for energy-using products was adopted; it was revised in 2009 to cover also energy-related products. It is the main policy tool in the EU directed at reducing energy consumption of any good that has an impact on energy consumption during use which is placed on the market and/or put into service.

The Ecodesign Directive is a framework directive. This means that the directive does not provide directly specific ecodesign requirements for specific products but gives a general framework for specific requirements. In the Ecodesign Directive the conditions and criteria for the eco-design requirements through subsequent implementation measures are defined. The Ecodesign Directive indicates that implementing measures or self regulating initiatives (voluntary agreements) should be adopted for products with a significant European sales volume (approximately >200,000/year), a significant environmental impact (approx. >1,000PJ/year) and a significant potential for improvement (approximately > 20%).

Tab. 7: Overview of Eco-design measures, 2011 (source EC)

Product group	EcoDesign Measure
Dishwashers	implemented 11/2010
Washing Machines	implemented 11/2010
Air-conditioning	implemented 03/2012
Space and Combination Heaters	not implemented yet
Water Heaters	Not implemented yet
Computers and Servers	not implemented yet
Directional Lighting	not implemented yet
Domestic lighting	implemeted 09/2009
External Power Supplies	implemented 04/2009
Laundry driers	implemented 10/2012
Ovens , hobs and grills	not implemented yet
Refrigerators and Freezers	implemented 07/2009
Residential ventilation	not implemented yet
Simple Set-Top Boxes	implemented 02/2009
Complex Set-Top Boxes	VA implemented 07/2010
Standby and off Mode	implemented 12/2008
Televisions	implemented 07/2009
Imaging equipment	VA implemented 01/2011

Labellling

Directive 92/75/EC on the indication by labelling and standard product information of the consumption of energy and other resources by household appliances introduced the European energy labeling scheme. The directive applies to the following appliances:

- refrigerators, freezers and their combinations;
- washing machines, dryers and their combinations;
- dishwashers;
- ovens;
- water heaters and hot-water storage appliances;
- lighting sources;
- air-conditioning appliances.

Directive 92/75/EC has been replaced by Directive 2010/30/EU which became effective in July 2011. According to the new labelling directive, new energy efficiency classes in addition to the already existing classes (A-G) on the basis of the Energy Efficiency Index (EEI) can be added (e.g. A+, A++, A+++) and the coverage is extended also to non residential equipment. The maximum of seven energy classes must be kept.

3.3. White appliances

White appliances include refrigerators and freezers (cold appliances), washing machines, dishwashers and dryers. Energy efficiency policies in the white appliances sector turned out to be very successful. The success is due to a combination of EU legislation (energy labeling and minimum energy performance standards, national programmes (e.g. tax deductions in Italy, scrapping bonus for cold appliances in Austria, price rebate schemes in Spain, supplier obligations and White Certificate scheme in France, Italy and the United Kingdom[5]) as well as the old voluntary agreements of manufacturers (Conseil européen de la construction d'appareils domestiques (CECED) – European Committee of Domestic Equipment Manufacturers).[6] Within the framework of the Eco-design Directive preparatory studies for cold appliances, washing machines and dishwashers have been finalized and minimum ecodesign requirements have already been adopted; for ovens, hobs and grills working groups started in June 2009.

Looking at the success of the energy label for white appliances it can be observed that in the period between January and February 2011, already 15% of washing machines are better than energy class A (A+, A++ and A+++), for dishwashers this share is already 10%. For cooling and freezer appliances these shares are 51% and 56% respectively.

[5] Obviously the list of national programmes mentioned here does not pretend to be exhaustive of all the measures implemented by Member States.

[6] At this moment no voluntary agreements are in force. The one for cold appliances ended in 2010 and the one for washing machines in 2008.

Fig. 32: Energy efficiency classes of white appliances sales in the EU, 2011 (source GfK)

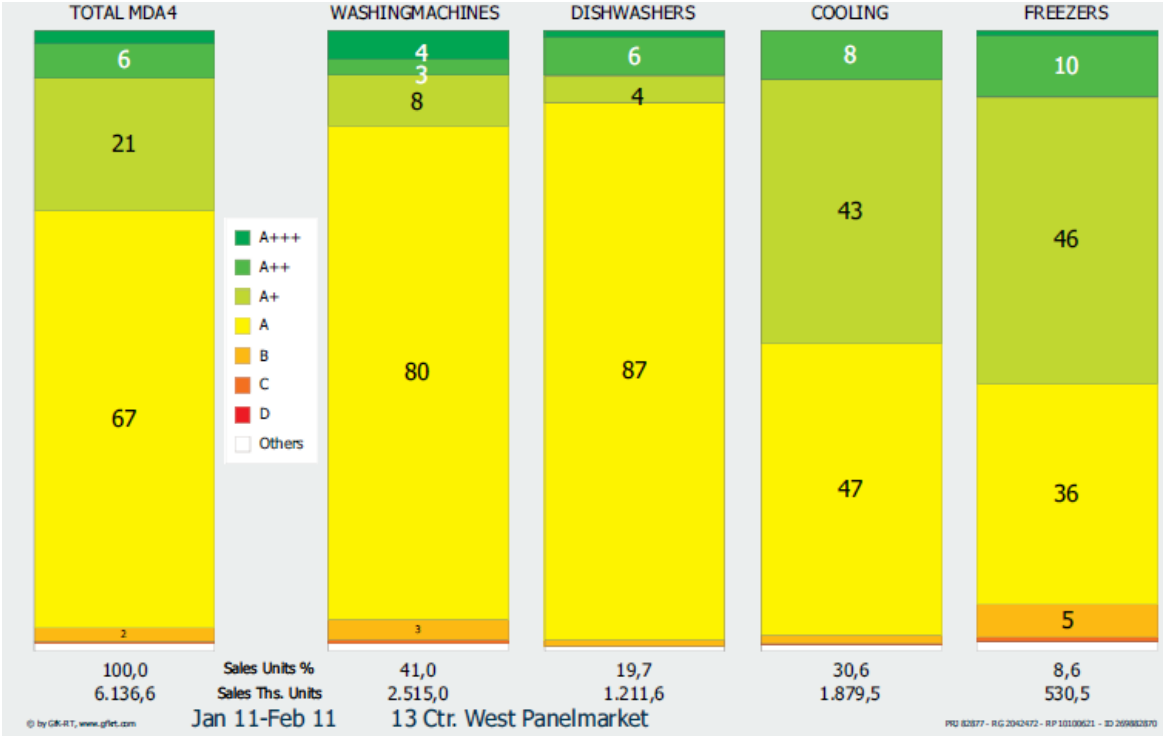


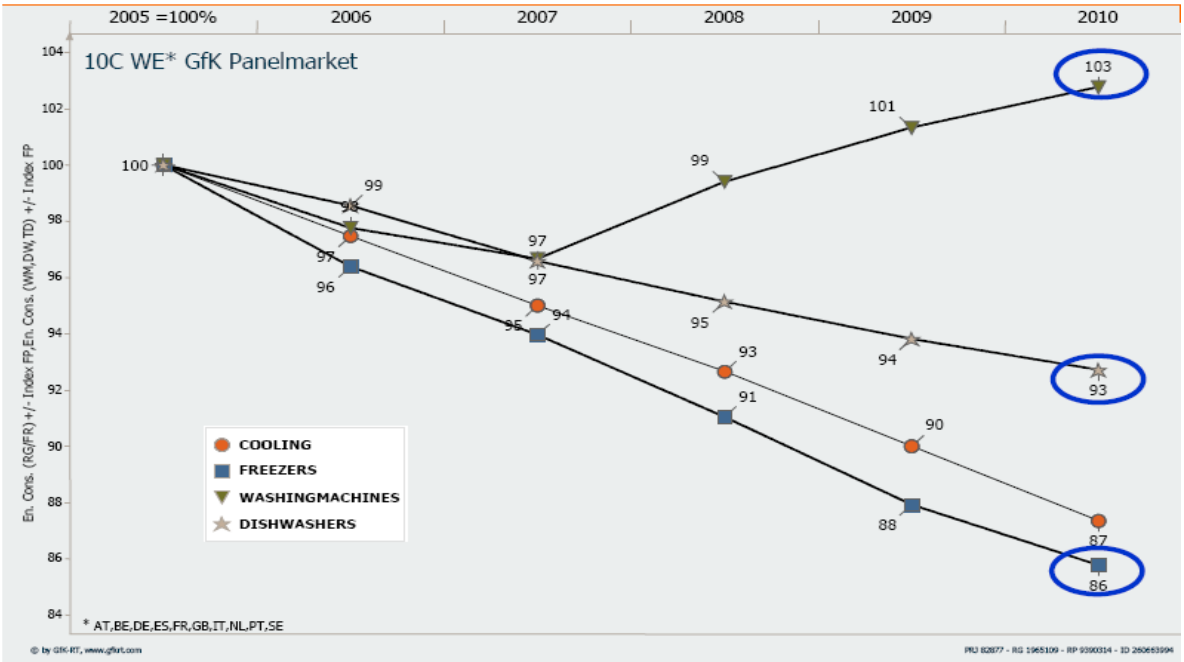
Fig. 33: Sales-weighted average annual energy consumption of MDA 4[7] in major EU markets (source GfK)

Fig.33 shows the sales-weighted average annual energy consumption of new household appliances (washing machines, dishwashers, cooling, and freezers). In 2010, the average annual consumption per appliance of these 4 product groups in the 23 EU countries listed in Fig. 33 was 246 kWh, in 2005 it was 265, implying a consumption decrease of 7 %. The consumption decrease in Spain was -18%, the one in Austria -12% and in Italy it was -11% [ECK2011].

Germany had the lowest average consumption levels of new appliances in the year 2005 (237 kWh) as well as in the year 2010 (215 kWh) (with a decrease of -9%) whereas Spain still has the highest average consumption of 268 kWh in the year 2010 despite the -18% decrease. The average consumption level in the UK did not change during the five year period and is above the EU-23 average in the year 2010 whereas it was exactly average in the year 2005. New appliances became hence significantly more efficient during the last years. The average energy consumption of new products in Western EU (see Fig.34) was cut down by 7-14% depending on the category since 2005. The exception is washing machines due to higher loading capacities, as better illustrated in section 3.3.2.

[7] Washing machines, Dishwashers, Cooling, Freezers.

Fig. 34: Average energy consumption trends of new products in Western EU (source GfK)



3.3.1. Cold appliances (refrigerators and freezers)

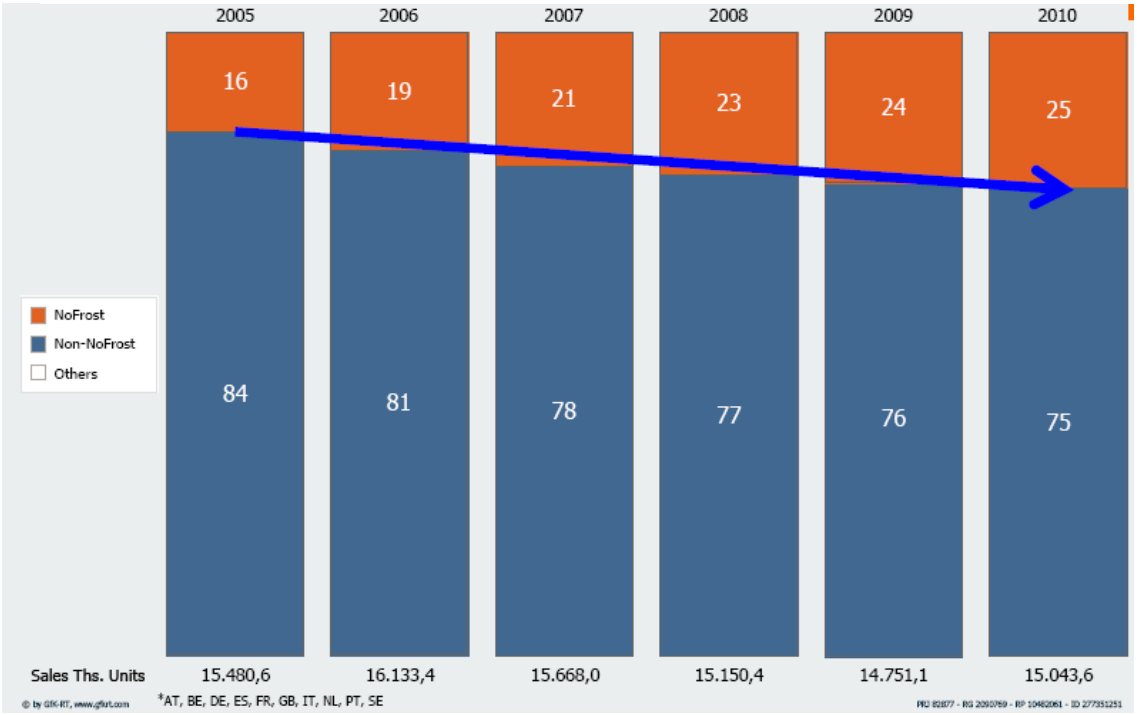
The market of cold appliances is characterised by a high level of substitution of old appliances rather than an increase of the existing stock. New cold appliances on the market became a lot more efficient in terms of energy consumption during the last years due to increasing awareness about energy consumption and the energy labelling scheme of the EU. These factors resulted in a real market transformation of the market across Europe [BER2009]. The recently introduced ecodesign requirements and the new energy label for cold appliances will enhance this trend even further.

Over the last years, the refrigerator stock reached the saturation level with penetration rates of around 100% in almost all EU-27 countries. At the same time, the freezer market registered a significant decreasing tendency, due to the increased use of combined refrigerators/freezers [BER2009]. In 2005, the preparatory study estimated the residential refrigerator stock in the EU-27 to be around 190,577 million units and the freezer stock to be around 54,292 units [PRE2008].

The energy consumption of the cold appliance stock was estimated to be around 82 TWh/year for refrigerators and 40 TWh/year for freezers in 2005 [PRE2008]. Since then, cold appliances have become substantially more efficient. This fact together with the market saturation leads to a decrease in electricity consumption of cold appliances. Its share in total residential electricity consumption has slightly decreased during the last years reaching 14.5%.

Combined refrigerator /freezer appliances account for the greatest share (60% in EU-15 and 80% in the NMS-12 market) of cold appliance sales during the last years [BER2009].

Fig. 35: Sales shares of Cold appliances with NoFrost technology in 10 Western EU countries 2005-2010 (source GfK)



In the last five years cold appliances with NoFrost technology reached 25% of overall sales. Appliances with NoFrost Technology are more practical for the consumer but also have higher energy consumption than cooling appliances without NoFrost technology. The trend shows that the NoFrost technology will continue to grow in the future.

A recent Gfk Panel Survey of Western Europe shows that energy efficiency appliances on the cold appliances market became less expensive over the last 10 years (Fig.36). In the last 5 years (2005-2010) A++ appliances became 25% less expensive (from 969 EUR to 728 EUR) and in the last five years (2005-2010) A+ appliances became 14% less expensive. The price premium of an A++ appliance compared to an A+ appliance in 2005 was 236 EUR. The price premium of an A++ appliance compared to an A+ appliance in 2010 is only 100 EUR. Overall, the price premium that consumers have to pay for higher efficiency classes decreased significantly over the past five years. There is, however, still a substantial price difference between an A-class appliance and an A++-class appliance. In February 2011, the average price of an A+++ appliance (the most energy efficient class) was 1186 EUR, whereas the average price for an A appliance was 459 EUR [ECK2011].

Fig. 36: Average prices of energy classes of cold appliances and price premium in ten EU countries (source GfK)

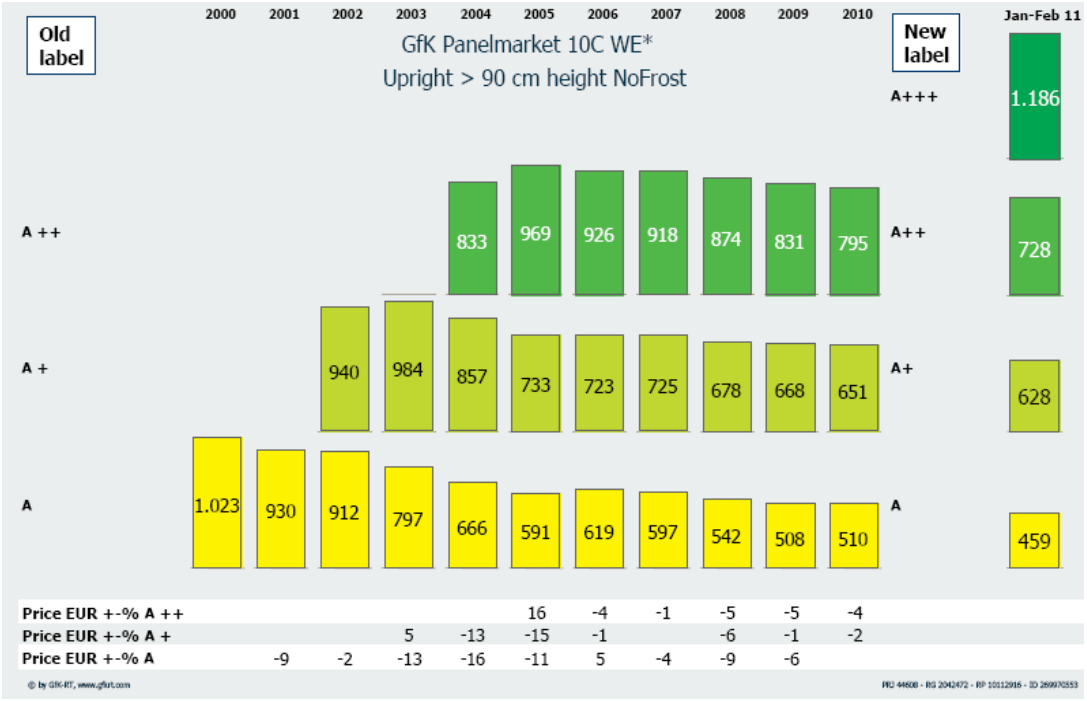
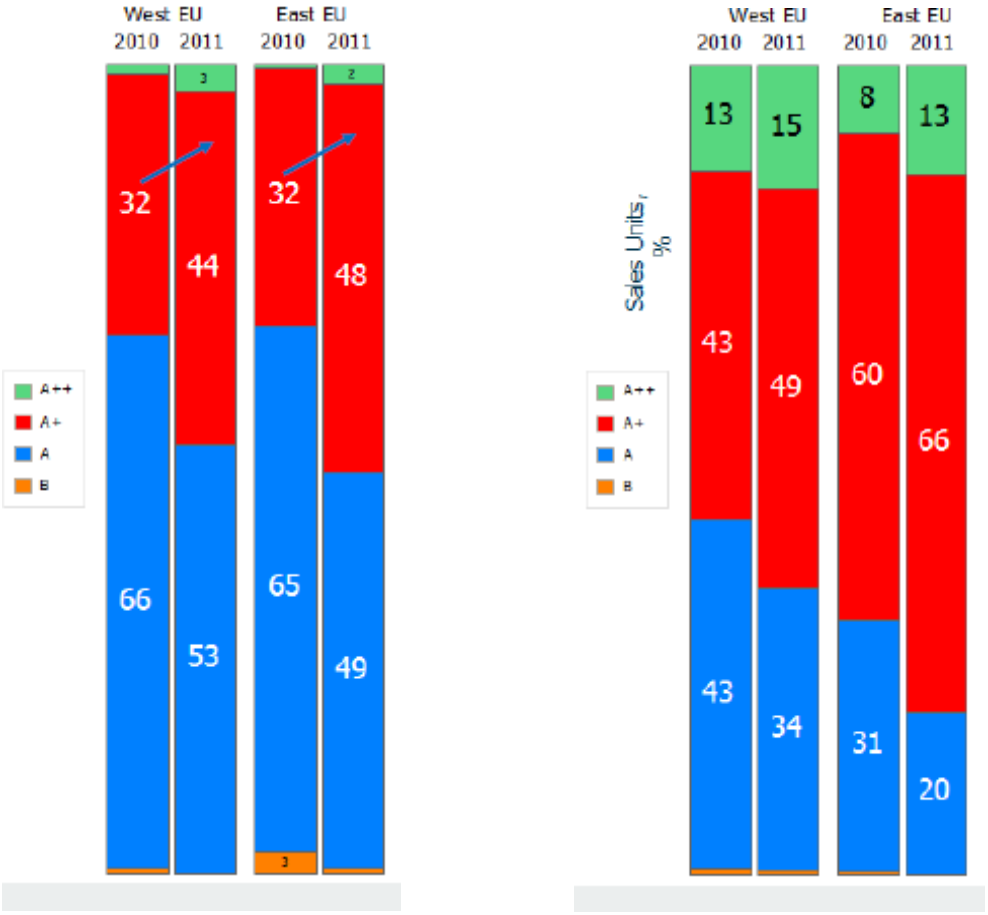


Fig. 37: Refrigerators' sales (seasonally adjusted) - 2 Door Freezer with (left) and without (right) NoFrost system (source GfK)



Commission Regulation (EC) No 643/2009 implemented the Eco-design Directive 2005/32/EC introducing new minimum energy performance standards for household refrigerating appliances. Minimum efficiency requirements for cold appliances have been in force since 1996.[8] These minimum efficiency requirements had long been exceeded and the industry (CECED) had implemented a self-commitment banning the least efficient appliances from the market. The industry decided not to introduce a new voluntary agreement after that.

Using the Energy Efficiency Index (EEI) the following new minimum requirements regarding energy efficiency were implemented:

For compression-type refrigerating appliances

From 1 July 2010: EEI < 55

From 1 July 2012: EEI < 44

From 1 July 2014: EEI < 42

[8] Directive 96/57/EC of the European Parliament and of the Council of 3 September 1996 on energy efficiency requirements for household electric refrigerators, freezers and combinations thereof

For absorption-type and other-type refrigerating appliances

From 1 July 2010: EEI < 150

From 1 July 2012: EEI < 125

From1 July 2015: EEI < 110

Directive 2003/66/EC implements energy labelling Directive 92/75/EC for household electric refrigerators, freezers and their combinations. Directive 92/75/EC is replaced by Directive 2010/30/EU which became effective in July 2011. An updated version of the energy label for cold appliances based on Directive 2010/30/EU was implemented by the Commission Delegated Regulation (EU) No 1060/2010. The regulation introduced a new energy efficiency class (A+++) and defined different EEI threshold values for A and A+ classes for the period December 2011 - 30 June 2014 and the period from 1 July 2014 onwards as summarized in Tab. 8 and Tab.9 reported below. Given the EEI threshold values reported in these tables and eco-design requirements above mentioned it can be inferred that class A becomes the minimum energy performance standard for compression-type appliances from 1 July 2010 onwards, whereas A+ becomes the new minimum energy performance standard from 1 July 2012 on class. The ecodesign requirements limit sales of compression-type[9] refrigerating appliances to classes A, A+, A++ and A+++ from July 2010 and to classes A+, A++ and A+++ from July 2012 on.

Tab. 8: New EU energy efficiency classes for household refrigerating appliances from December 2011 to 30 June 2014 (source EC)

A+++	A++	A+	A	B	C	D	E	F	G
EEI<22	22≤ EEI <33	33 ≤ EEI < **44**	**44** ≤ EEI < 55	55 ≤ EEI < 75	75 ≤ EEI < 95	95 ≤ EEI < 110	110 ≤ EEI < 125	125 ≤ EEI < 150	EEI ≥ 150

Tab. 9: New EU energy efficiency classes for household refrigerating appliances from 1 July 2014 (source EC)

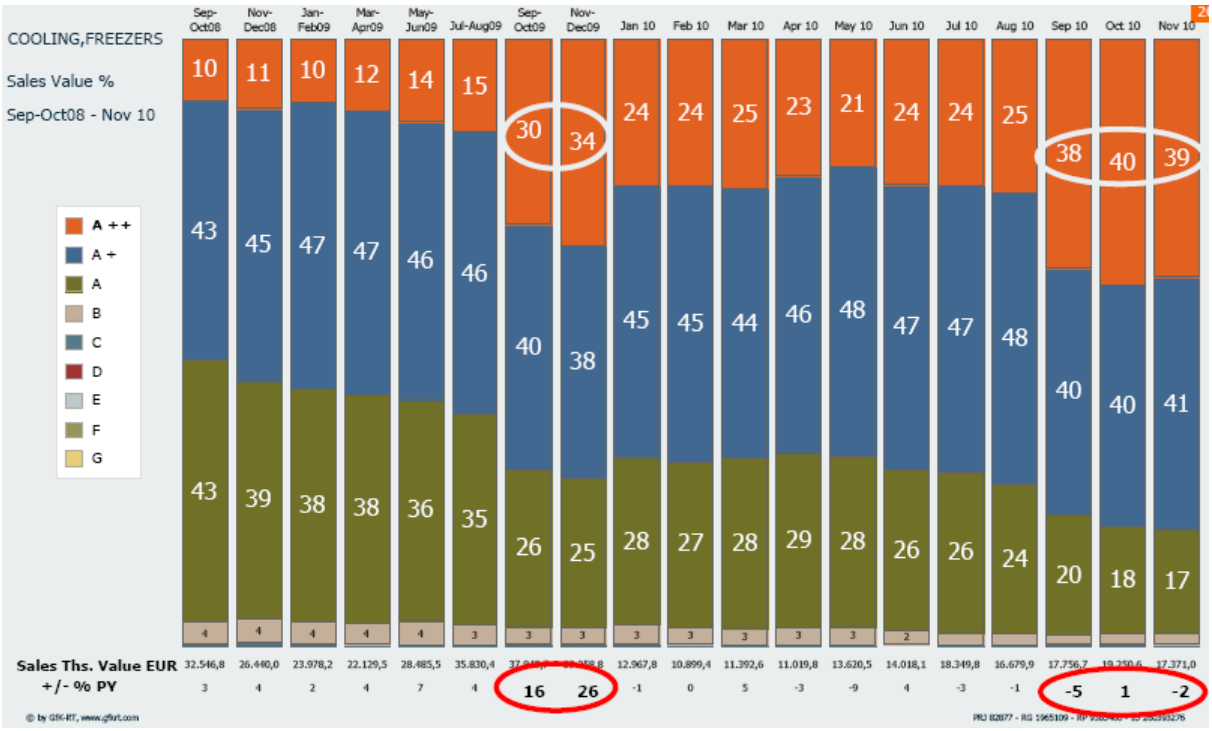
A+++	A++	A+	A	B	C	D	E	F	G
EEI<22	22≤ EEI <33	33 ≤ EEI < **42**	**42** ≤ EEI < 55	55 ≤ EEI < 75	75 ≤ EEI < 95	95 ≤ EEI < 110	110 ≤ EEI < 125	125 ≤ EEI < 150	EEI ≥ 150

Apart from the Ecodesign Directive and the Energy Label, national programmes and schemes also contribute to the promotion of energy efficiency. Two examples of successful

[9] Which account for over 90% of the market share of refrigerating appliances.

programmes in two Member States on the cold appliances market are a tax deduction programme in Italy and a scrapping-bonus programme in Austria.

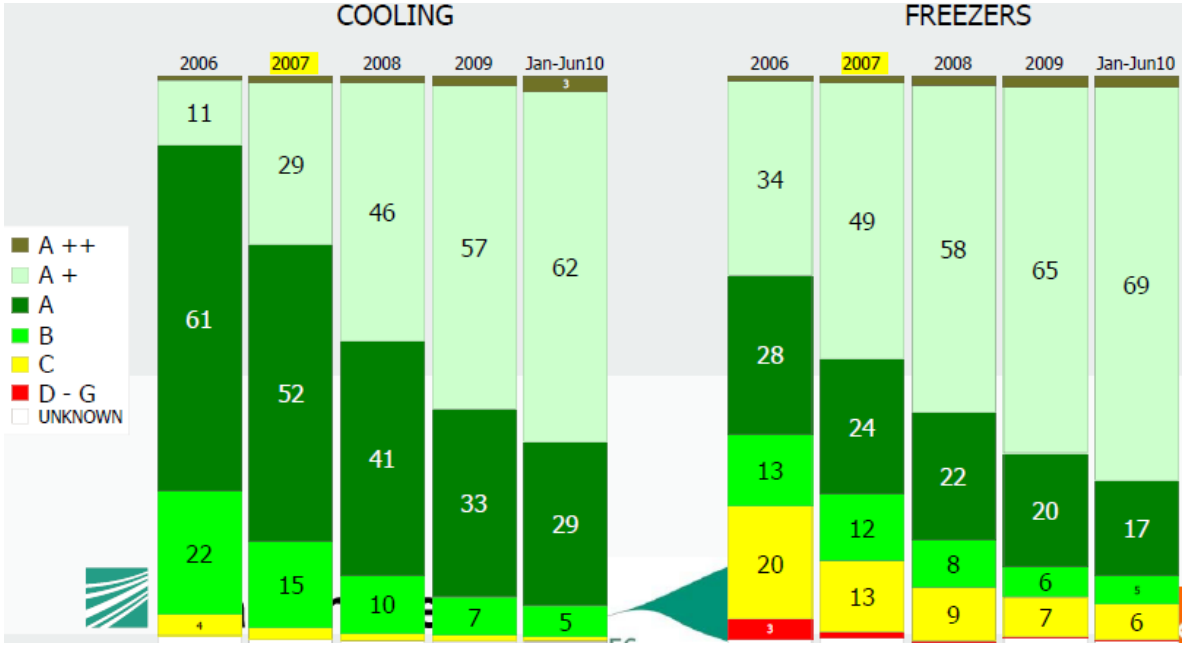
Fig. 38: Sales shares (value based) of A++ Cold appliances in Austria 2008-2010 (source GfK)



The scrapping bonus programme in Austria was running for two periods: 1st period September to December 2009, 2nd period September to mid of November 2010. Consumers could apply for a reimbursement of up to 100€ for the replacement of an old appliance by a new A++ appliance. During the two periods where the scrapping bonus was active the sales of A++ appliances increased significantly. In July / August 2009 the share of A++ appliances was 15%, whereas it increased to 30 and 34% during the scrapping bonus period. After the scrapping bonus the average market share of A++ appliances was lower than with the bonus but still significantly higher than before the bonus (24% in January 2010). In the second period of the bonus system, market shares rose to 40% in October 2010 [ECK2011].

The tax deduction programme in Italy was introduced in January 2007 in order to promote the sales of highly efficient cold appliances. Consumers buying an A+/A++ refrigerator or freezer could deduct 20% of the appliance cost (up to 200 EUR) from their income tax. The market response was a growth in the sales of A+ class appliances by a factor of 2.5 in 2007 compared to the previous year. The share of A+ appliances in sales reached 45.5% in 2008. In the first half of the year 2010, the sales' share of A+ appliances reached 62% for cooling and 69% for freezers [ECK2001,BER2009].

Fig. 39: Italian tax deduction programme for highly efficient cold appliances (source GfK)



3.3.2. Washing machines

The washing machines market has reached the saturation level with penetration rates of up to 100% in all EU-27 countries. As in the case with refrigerators, the washing machine market is hence characterised by a high level of substitution of old appliances, rather than increasing the overall stock. The efficiency improvement continues mainly due to the increase in awareness about energy consumption, the energy label and minimum efficiency requirements resulting in a real market transformation across EU-27 countries.

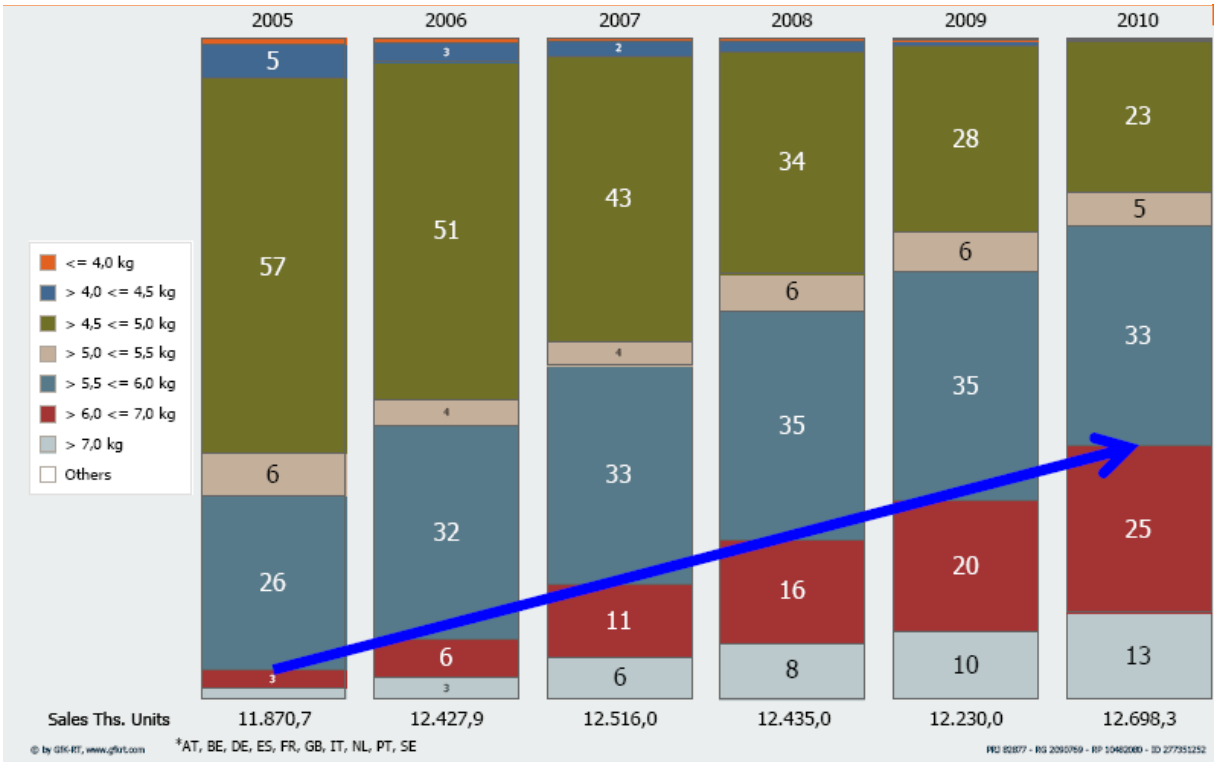
The EU-27 washing machine stock in the residential sector was estimated to be around 167 million units in 2005 [EC2010b]. The Eco-design preparatory study estimated the energy consumption of the washing machine stock in 2005 at around 51 TWh/year, with an average yearly consumption per appliance of 295 kWh in the EU-27 households [BER2009]. Energy consumption of washing machine stock has slightly increased between 2005 and 2009 mainly because of a continuous increase in the number of washing machines installed [EC2010b] and partly because of an increase in the number of washing cycles and in the load capacity of the new appliances bought. The following developments on the market are influencing their electricity consumption:

- The average efficiency of washing machines sold increased during the last five years

- The average load capacity also increased

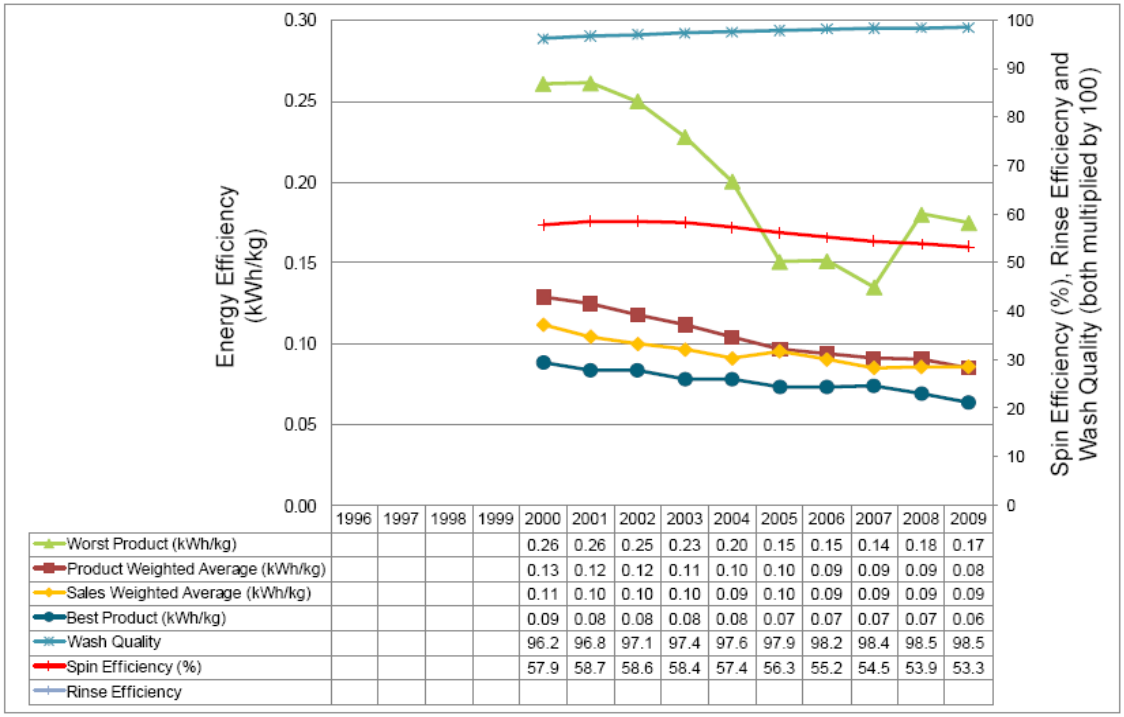
This analysis is confirmed by looking at market data. The sales weighted energy consumption of new washing machines remained constant during the last 5 years, however the loading capacity increased and with it the average energy efficiency did as well.

Fig. 40: Average load capacity trends of household washing machines in 10 EU countries (source GfK)



During the last years, the trend on the washing machine market is a significant increase in loading capacities. This trend results in higher energy consumption per washing load but not in an increase of overall consumption. In 2005, most washing machines (57%) had a loading capacity between 4.5 and 5kg. In 2010, 33% of washing machines have a loading capacity between 5.5. and 6kg and 25% have a loading capacity between 6 and 7kg; only 23% have a loading capacity between 4 and 4.5kg.There is a significant increase of very high loading capacities (over 7kg): 13% of sales in 2010, almost 0% in 2005.

Fig. 41: Energy efficiency of new washing machines in the EU (source 4E Mapping & Benchmarking[10])



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Worst Product (kWh/kg)					0.26	0.26	0.25	0.23	0.20	0.15	0.15	0.14	0.18	0.17
Product Weighted Average (kWh/kg)					0.13	0.12	0.12	0.11	0.10	0.10	0.09	0.09	0.09	0.08
Sales Weighted Average (kWh/kg)					0.11	0.10	0.10	0.10	0.09	0.10	0.09	0.09	0.09	0.09
Best Product (kWh/kg)					0.09	0.08	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.06
Wash Quality					96.2	96.8	97.1	97.4	97.6	97.9	98.2	98.4	98.5	98.5
Spin Efficiency (%)					57.9	58.7	58.6	58.4	57.4	56.3	55.2	54.5	53.9	53.3
Rinse Efficiency														

Between the years 2000 and 2009 the energy efficiency of the average washing machine on the market increased by 38% (see data related to energy efficiency of product weighted average measured as kWh/kg in Fig. 41 above). The efficiency of the best product on the market increased by 33%.The energy efficiency of the least efficient product on the market increased by 35%.

During the last ten years the least efficient products on the market and the most efficient ones came closer together. In the year 2000 the worst product on the market consumed 1.31 kWh per standard washing, whereas the best product only consumed 0.31 kWh. In the year 2009 the worst product consumed 0.92 kWh whereas the best product consumed 0.28 kWh [4E Mapping & Benchmarking].

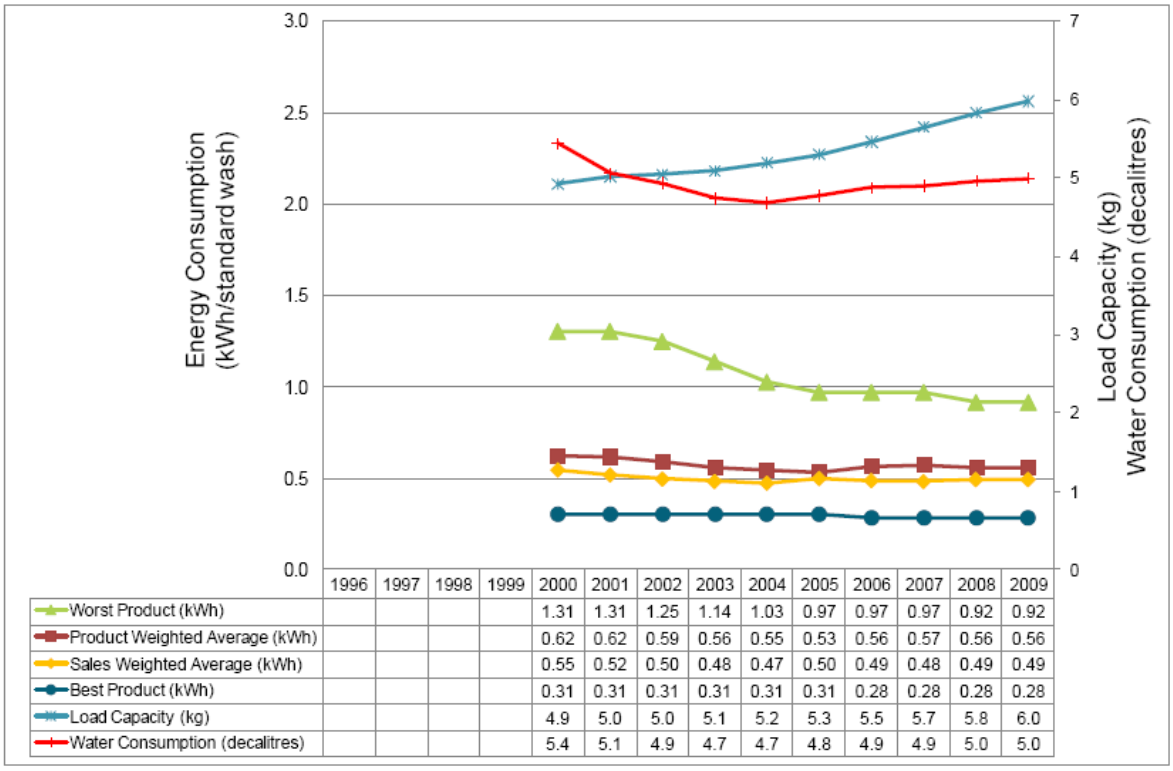
Topten[11] identifies the ten most energy efficient products on the market every year. The most energy efficient washing machine with loading capacity smaller than 8kg[12] has an energy consumption of 158 kWh/year and 0.9 kWh/ 60°washing cycle.

The differences in consumption between the best and the worst product are still significant these days but they are decreasing. The new implementing measure of the Eco-design Directive described below will contribute to further increase the average energy efficiency of

[10] More information on the project can be found under: http://mappingandbenchmarking.iea-4e.org/
[11] www.topten.eu
[12] The washing machine mentioned has a loading capacity of 7kg.

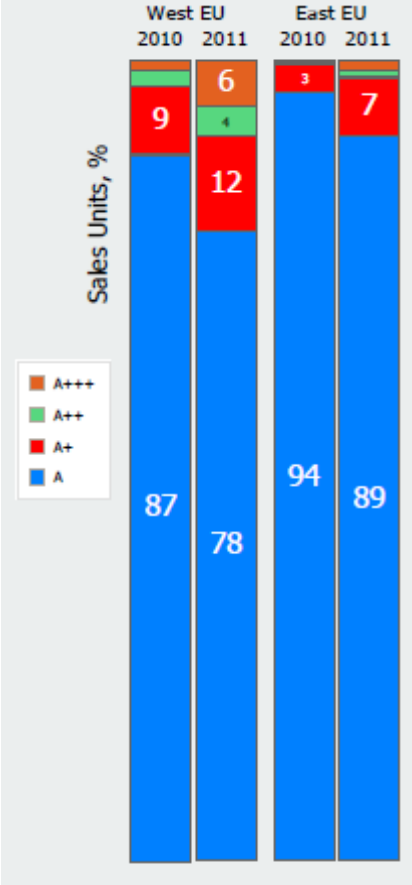
new household washing machines in the coming years. It may be worth mentioning that, without any measure taken, electricity consumption due to household washing machines would have increased by 8% in 2020 compared to 2005 (COM2010g).

Fig. 42: Energy consumption of new washing machines in the EU (source 4E Mapping and Benchmarking)



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Worst Product (kWh)					1.31	1.31	1.25	1.14	1.03	0.97	0.97	0.97	0.92	0.92
Product Weighted Average (kWh)					0.62	0.62	0.59	0.56	0.55	0.53	0.56	0.57	0.56	0.56
Sales Weighted Average (kWh)					0.55	0.52	0.50	0.48	0.47	0.50	0.49	0.48	0.49	0.49
Best Product (kWh)					0.31	0.31	0.31	0.31	0.31	0.31	0.28	0.28	0.28	0.28
Load Capacity (kg)					4.9	5.0	5.0	5.1	5.2	5.3	5.5	5.7	5.8	6.0
Water Consumption (decalitres)					5.4	5.1	4.9	4.7	4.7	4.8	4.9	4.9	5.0	5.0

Fig. 43: Seasonally adjusted washing machine sales (front load) 2010/2011 (source GfK)



Eco-design requirements for household washing machines have been set by Commission Regulation (EU) No 1015/2010 which does not apply to household combined wash-driers. It is indeed planned to address the Ecodesign requirements for this specific product category in a separate implementing measure of Directive 2009/125/EC (COM2010g).

Although this regulation addresses water and electricity consumption as the two most important environmental impacts of household washing machines, only Ecodesign requirements regarding energy consumption, in this case electricity consumption, are considered here.

These Ecodesign requirements are in force from December 2011 and consists of the followings:

From December 2011: the EEI for all household washing machines shall be less than 68

From December 2013 the EEI for household washing machines with a rated capacity equal to or higher than 4kg shall be less than 59

The lower Energy Efficiency Index of 59 from December 2013 on applies to almost all the household washing machines in the market since almost 100% of the washing machines sold in 2010 had a load capacity higher than 4kg [ECK2011].

Household washing machines were required to have the EU Energy Label since 1996. Commission Delegated Regulation (EU) no 1061/2010 supplementing Directive 2010/30/EU implements the new energy labelling of household washing machines introducing the new energy classes A+, A++ and A+++. The energy classes are based on the Energy Efficiency Index (EEI)[13] mentioned above. The new energy labelling applies from 20 December 2011. Given the above mentioned Ecodesign requirements energy class A results to be the minimum energy efficiency allowed and classes B, C and D result to be banned from the market as of December 2011. From December 2013, class A+ will be the new minimum Ecodesign requirement for almost 100% of the washing machine market (COM2009c).

Tab. 10: New energy efficiency classes for washing machines in the EU (source EC)

A+++	A++	A+	A	B	C	D
EEI<46	46≤ EEI <52	52 ≤ EEI < **59**	**59** ≤ EEI < 68	68 ≤ EEI < 77	77 ≤ EEI < 87	EEI < 87

The new energy labelling of household washing machines is following the trend of increasing energy efficiency on the market introduced by the washing machine industry through voluntary industry commitments. By 1999, the industry agreed to remove products of energy classes G, F and E from the market. In 2003, energy class D was also removed and the new energy class A+ was introduced. In addition to that, an industry movement to replace old appliances by new and more efficient ones is in place since 2007.

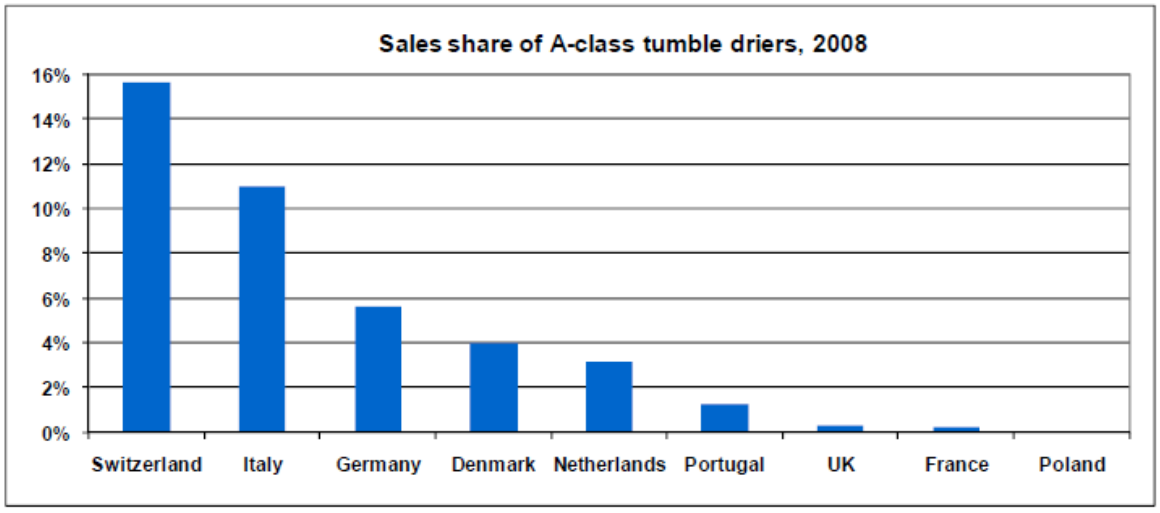
3.3.3. Tumble driers

The market of tumble driers did not transform as fast as for example the cold appliance market. Household tumble driers account for a significant part of total residential energy consumption. There is great potential to further reduce the energy consumption of household tumble driers. Many tumble driers sold in the EU are still less efficient compared to other appliances sold. Nevertheless, a development leading to a more energy efficient market can be observed. In 2005, 90% of appliances sold in the EU-25 were class C appliances. Two years later in 2007, the share of class C appliances dropped to 75% of all driers sold in the

[13] The EEI is the ratio between the estimated annual energy consumption and the standard annual energy consumption of a washing machine with the same capacity. It is expressed in kWh per kg of washing load.

EU-20[14], 16.7% of appliances sold were class B. The share of class A appliances was still very small with 1% (BER2009). In 2008, sales share of A-class driers were already significant in some EU Member States, for example in Italy the share was over 10%.

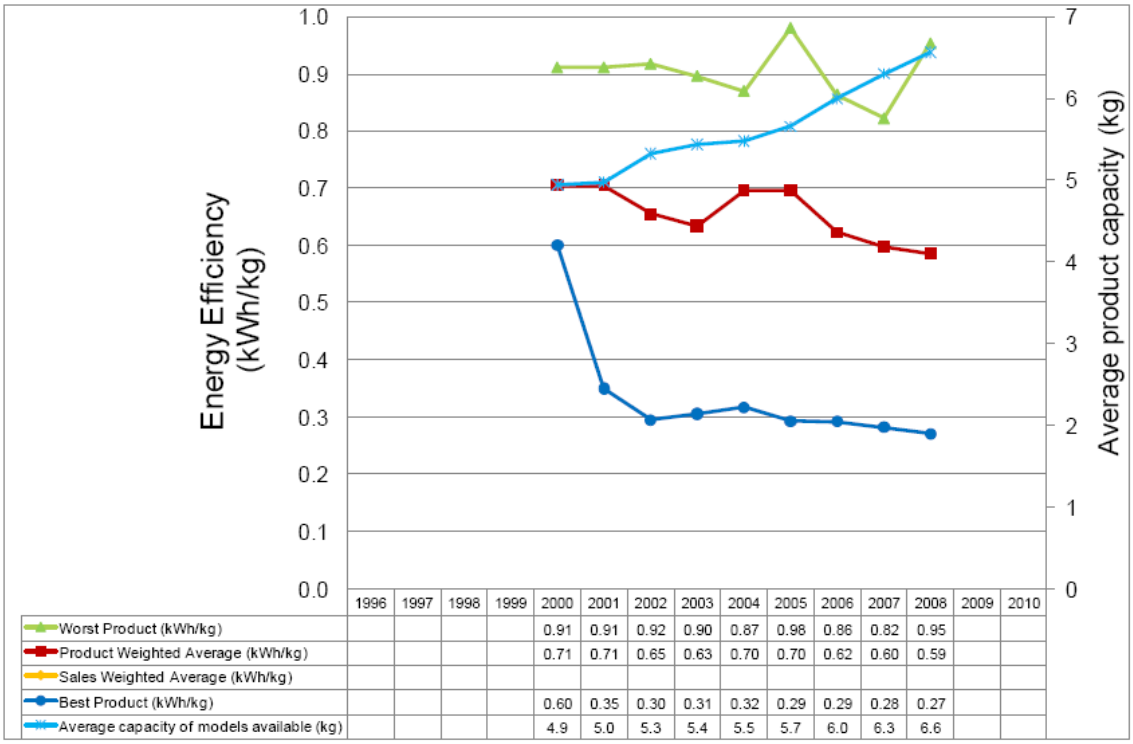
Fig. 44: Sales share of A-class laundry driers, 2008 (source www.topten.eu,[MIC2011])



As for washing machines, the average loading capacity of tumble driers has been increasing as well. In the year 2000, the average capacity of models available was 4.9 kg. In 2008, eight years later, the average capacity was 6.6 kg. Tumble driers became more efficient during this period: the product weighted energy efficiency ratio fell from 0.71 kWh/kg to 0.59 kWh/kg.[15] The relatively high share of A-class appliances in Switzerland showed by Fig. 44 above can be explained by a subsidy programme and minimum energy performance standards.

[14] Incl. AT, BE, BG, CZ, DE, DK, ES, FI, FR, GB, GR, HU, IT, NL, PL, PT, RO, SE,SI,SK.
[15] This decrease might be due to the higher capacity.

Fig. 45: Energy efficiency of new laundry driers in Europe (source 4E Mapping & Benchmarking)



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Worst Product (kWh/kg)					0.91	0.91	0.92	0.90	0.87	0.98	0.86	0.82	0.95		
Product Weighted Average (kWh/kg)					0.71	0.71	0.65	0.63	0.70	0.70	0.62	0.60	0.59		
Sales Weighted Average (kWh/kg)															
Best Product (kWh/kg)					0.60	0.35	0.30	0.31	0.32	0.29	0.29	0.28	0.27		
Average capacity of models available (kg)					4.9	5.0	5.3	5.4	5.5	5.7	6.0	6.3	6.6		

There are significant differences in energy efficiency between the best product and the worst product on the market. In 2008 the worst product had an efficiency of 0.95 kWh/kg whereas the best product was 0.27 kWh/kg. The best product on the market identified by Topten Best Products in 2011 with a load capacity of 6kg consumes 0.26 kWh/kg laundry.[16]

Eco-design requirements for electric mains-operated and gas-fired household tumble driers and built-in household tumble driers (including those sold for non-household use) have been established by the regulation 932/2012 of 3 October 2012. This regulation includes generic eco-design requirements that shall apply from 1 November 2014 and specific requirements that must be fulfilled from 1 November 2013 and 1 November 2015. Generic eco-design requirements relate to information that shall be mandatorily reported in the manufacturers' booklet of instructions and to the "standard cotton programme"[17] defined in the regulation. The regulation establishes indeed that this programme shall be clearly identifiable on tumble driers programme selection devices and be set as default cycle for appliances with automatic programme selection. Specific requirements establish instead a maximum energy efficiency index (EEI) for household tumble driers and a minimum weighted condensation efficiency

[16] www.topten.eu

[17] 'standard cotton programme' means the cycle which dries cotton laundry with an initial moisture content of the load of 60 % up to a remaining moisture content of the load of 0 %.

(Ct) for condenser household tumble driers placed on market from 1 November 2013 and from 1 November 2015[18].

An energy label for household tumble driers was first implemented in 1995 with Commission Directive 95/13/EC implementing the Labelling Directive 92/75/EEC with regard to energy labelling of household electric tumble driers. An energy label with energy classes ranging from A (most efficient) to G (least efficient) was introduced.

Since the introduction of the old energy label household tumble driers have improved their energy efficiency by some 12%; the EU energy label is believed to have been one of the most important market drivers for this improvement in efficiency [COM2012].

The Commission delegated regulation n. 392/2012 of 1 March 2012 implemented a new energy label replacing the old one introduced by Directive 95/13/EC. This regulation covers the same product types covered by the above mentioned eco-design regulation 932/2012. It shall apply from 29 May 2013 and establishes the energy efficiency classes reported in Tab. 11 below.

Tab. 11: New EU energy label classes for tumble driers

A+++	A++	A+	A	B	C	D
EEI< 24	24≤ EEI <32	32≤ EEI < 42	42≤ EEI < 65	65≤ EEI < 76	76 ≤ EEI < 85	85≤ EEI

New technologies that were not considered or not available at the time of the adoption of the old label, would allow to place tumble driers which consume up to 50% less than the limit for the current class A on the market. In the absence of classes above class A manufacturers appear unwilling to invest further in the development of new energy-efficient technologies. Consequently, highly efficiency appliances like heat-pump tumble driers fail to gain market share so that their production costs remain high.

The new label shall add three new energy classes A+, A++ and A+++, the least efficient energy classes E, F and G shall be removed from the label. Together with Ecodesign measurers, a cost-effective reduction in energy consumption during use will be achieved,

[18] The EEI of tumble driers shall be less than 85 for all household tumble driers placed on the market from 1 November 2013 (i.e. energy efficiency class D, E, F and G household tumble driers will be phase out) and less than 76 for condenser household tumble driers only (i.e. energy efficiency class C condenser household tumble driers will be phased out) from 1 November 2015. The minimum C_t values for condenser household tumble driers shall instead be 60% (phase out of condensation efficiency class F and G appliances) from 1 November 2013 and 70% (phase out of condensation efficiency class E appliances) from 1 November 2015.

with a savings potential of some 3.5 TWh in 2020 compared to the business-as-usual scenario, increasing to around 9 TWh of savings in 2030.

3.3.4. Dishwashers

In the EU-27 dishwashers have a lower saturation level than other major appliances (refrigerators and washing machines). Penetration differs from country to country and is around 50-60% [PRE2007]. The EU-27 dishwasher stock in the residential sector was estimated at around 69.307 million units in 2007 [BER2009].

The European Commission's impact assessment of the Ecodesign measures for household dishwashers estimates electricity consumption of household dishwashers to be of around 26.7 TWh in 2010 and 25.9 TWh in 2005. The most energy efficient product on the market with a place setting of 13 consumes 205 kWh/year and falls into the highest energy efficiency class of A+++ (source: Website Topten International Group 2011)[19].

Between 2001 and 2005 there was only a relatively small efficiency progress in the dishwasher market. The efficiency improvements started to be visible after the year 2005. Compared to other white appliances like fridges and freezers the market for dishwashers has not reached the transformation phase yet. In 2007, 92.9% of sales in a panel of 18 EU Member States[20] were class A appliances and 6.8% were class B or C appliances. In the beginning of 2011 (January and February 2011) the percentage of appliances of class A or better was 97%. The share of class B appliances was around 1% and there were no class C appliances sold. In January and February 2011, 6% of appliances sold were class A++ and 4% where class A+.

Commission Regulation (EU) No 1016/2010 implementing the Ecodesign Directive 2009/125/EC introduced minimum eco-design requirements for household dishwashers. The Ecodesign measure has been implemented in December 2011. In this report only the eco-design requirements regarding energy usage (here electricity consumption) are considered. The Ecodesign requirements are calculated in accordance with the number of place settings of the household dishwashers (the most common model being the one with 12 place settings). These requirements are introduced gradually over a period of five years (2011-2016) as follows:

[19] More information can be found under: http://www.topten.eu/

[20] 18 MS included: AT, BE, CZ, DE, DK, ES, FI, FR, GB, GR, HU, IT, NL, PL, PT, SE, SI, SK.

From 1 December 2011:

- The EEI[21] shall be less than 71 (class A) except for models with a rated capacity of 10 place settings and a width equal to or less than 45cm for which the EEI shall be less than 80 (class B)

From December 2013:

- The EEI shall be less than 63 (class A+) for household dishwashers with a rated capacity equal to or higher than 11 place settings and for models with a rated capacity of 10 place setting and a width bigger than 45 cm
- The EEI shall be less than 71 (class A) for household dishwashers with a rated capacity of 10 place settings and a width equal to or less than 45cm

From December 2016:

- The EEI shall be less than 63 (class A+) for household dishwashers with a rated capacity of 8 and 9 place settings and for household dishwashers with a rated capacity of 10 place settings and a width equal to or less than 45 cm

In addition to minimum energy efficiency standards producers of household dishwashers have to provide information regarding the power consumption of the off-mode and of the left-on mode, the most energy efficient washing programmes and indicative information about energy and water consumption of the main washing programmes.

Energy labelling for household dishwashers was introduced by Council Directive 92/75/EC and implemented by Commission Directive 97/17/EC. The Directive implemented an energy label with energy classes from A to G (A being the most efficient). Directive 97/17/EC was replaced by Commission Delegated regulation (EU) No 1059/2010 supplementing Directive 2010/30/EU with regard to energy labelling of household dishwashers. The new regulation measure introduces three new energy classes A+, A++ and A+++ mandatory for products placed on the marked from 20 December 2011.

Tab. 12: New energy efficiency classes for household dishwashers in the EU (source EC)

A+++	A++	A+	A	B	C	D
EEI<50	50≤ EEI <56	56 ≤ EEI < **63**	**63** ≤ EEI < 71	71 ≤ EEI < 80	80 ≤ EEI < 90	EEI <

3.3.5. Cooking appliances

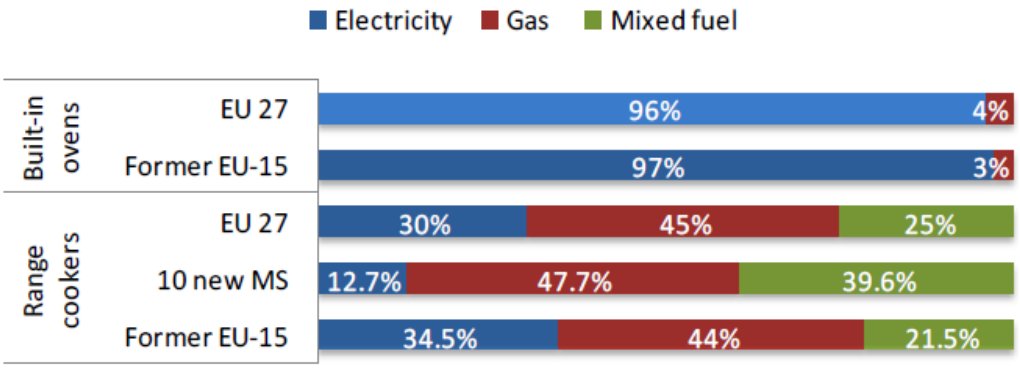
[21] The EEI (Energy Efficiency Index) of a household dishwasher is the ratio of its annual energy consumption and the annual energy consumption of a standard equivalent fmodel with same rated capacity.

For cooking appliances, there is still a significant potential for energy savings. The total electricity consumption for electric cooking was estimated to be around 60TWh (electric hobs and grills together) in 2007 [BER2009]. The JRC estimates the consumption in 2009 to be slightly higher than in 2007.

Five years after the introduction of the energy label for electric ovens, in the year 2007, more than 50% of new sales were A class appliances. The impact of the energy labelling is hence already visible on the market [BER2009].

For built-in ovens, 96% are running with electricity and 4% with gas. For range cookers the share of electricity is 30% whereas 45% is running with gas and 25% with mixed fuel. Electricity consumption of cooking appliances is therefore a substantial portion of total residential electricity consumption.

Fig. 46: Electric ovens and cookers in the EU-27 (source Bio Intelligence Service)



Eco-design requirements for cooking appliances are being defined by the European Commission. A Commission working document from June 2012 proposes energy efficiency performance limits for domestic ovens (including when incorporated in cookers), domestic hobs and electric mains-operated domestic range hoods also when used for non-domestic purposes.

Concerning energy labelling, Directive 2002/40/EC implementing Council Directive 92/75/EEC introduced energy labelling of household electric ovens. This Directive introduced different energy classes depending on the volume cavities of the electric ovens (small, medium or large):

Small: 12 l ≤ volume < 35 l

Medium: 35 l ≤ volume < 65 l

Large: 65 l ≤ volume.

The energy efficiency classes are based on the energy consumption (E in kWh) with a standard load and are defined as illustrated in Tab. 13 below.

Tab. 13: Energy efficiency classes for electric ovens with different volumes (small, medium and large) in the EU (source EC)

Small:

A	B	C	D	E	F	G
E<0.60	0.60≤ E <0.80	0.80≤ E < 1.00	1.00≤ E < 1.20	1.20≤ E < 1.40	1.40 ≤ E < 1.60	1.60≤E

Medium:

A	B	C	D	E	F	G
E<0.80	0.80≤ E <1.00	1.00 ≤ E< 1.20	1.20≤ E < 1.40	1.40≤ E < 1.60	1.60 ≤ E<1.80	1.80≤E

Large:

A	B	C	D	E	F	G
E<1.00	1.00≤ E <1.20	1.20 ≤ E < 1.40	1.40≤ E < 1.60	1.60≤ E < 1.80	1.80 ≤ E <2.00	2.00≤E

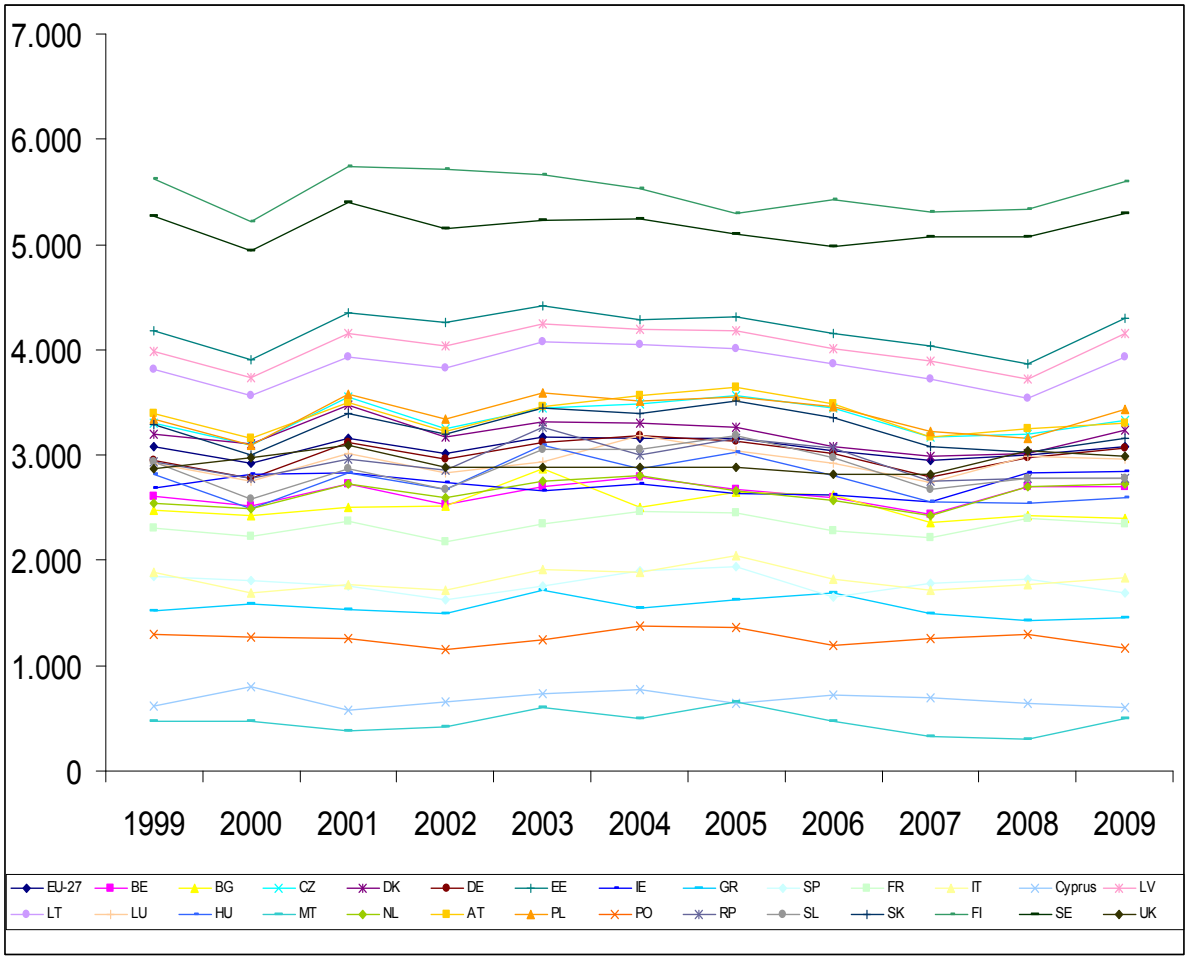
However Directive 2002/40/EC is being revised following the outcomes of the eco-design preparatory studies completed in 2011. These studies highlighted a significant energy saving potential for domestic ovens and domestic range hoods. A Commission working document on possible energy labeling requirements for domestic electric and gas ovens (including when incorporated into cookers) and electric mains-operated domestic range hoods (also when used for non- domestic purposes) has been hence produced in June 2012 and a consultation with the main stakeholders concerned has been launched on July 2012. This working document proposes new energy efficiency classes (from A+++ to D) for electric and gas ovens calculated based on a same energy efficiency index. In case of range hoods, besides energy efficiency classes (from A to G), fluid dynamics efficiency classes, lighting efficiency classes and grease filtering efficiency classes are proposed to be reported on the energy label.

3.4. Heating and cooling appliances

Space heating represents the single largest electricity end-use for consumers in the residential sector, comprising the electricity consumption of electric boilers, heat pumps, radiators and other electric heating appliances. The market for cooling (air-conditioning) is still relatively small in the EU but is growing. Energy consumption for heating and cooling

appliances strongly depends on climatic and weather conditions which can be monitored via heating degree days as illustrated below.[22]

Fig. 47: Actual heating degree days in the EU-27 (source Eurostat)



3.4.1. Space heating and boilers

Space heating equipment is the single largest electricity end-user in the residential sector at 150 TWh/year in 2007, including electrical equipment (electric boilers and radiators) and monitoring and control equipment of other heating equipment fuelled by gas or oil [BER2009].

Due to the strong competition from gas boilers and heat pumps and due the fact that water boilers and space heating equipment is becoming more efficient over the years, energy consumption is reduced. However, there are also other factors that increase consumption. During the last years, households have become smaller (less persons per household) and at

[22] This dependence is smaller for highly isolated buildings.

the same time the average size in square meter per person has increased. The JRC estimates the residential electricity consumption of space heating and boilers in 2009 to be almost the same as in 2007.

The central heating stock in the EU reached 80% of all installed heating systems including oil and gas boilers [KEM2007].

Until today no Ecodesign requirements for space and water heaters have been implemented in the European Union. Future requirements concerning the Ecodesign for space heaters, combination heaters, water heaters and hot water storage tanks are currently under discussion. The Ecodesign measures also include gas and oil boilers which consumer more than electric heating equipment. The preparatory study for boilers and combi-boilers (Lot 1) for implementing the Ecodesign Directive has been finalized and a draft Commission regulation has been proposed and will be soon discussed by the Regulatory Committee [EC2012b]. Currently the specifics of the regulation are being discussed. In the draft working document requirements are being suggested. The planned regulation will apply to space heaters and combination heaters with a rated heat output <= 400 kW, and cogeneration space heaters with an electrical capacity of < 50 kW. Excluded from the regulation are boilers exclusively designed for using biomass fuels and boilers using solid fuels. The regulation is introduced over two periods. Requirements for seasonal space heating energy efficiency indicated in the draft regulation produced are summarized in the tables below:

Tab. 14 Eco-design requirements proposed for space and combi heaters - first implementation phase (source EC)

Fuel boiler space heaters with rated heat output ≤ 70 kW and fuel boiler combination heaters with rated heat output ≤ 70 kW, with the exception of type B11 boilers with rated heat output ≤ 10 kW and type B11 combination boilers with rated heat output ≤ 30 kW:
The seasonal space heating energy efficiency shall not fall below 86%.
Type B11 boilers with rated heat output ≤ 10 kW and type B11 combination boilers with rated heat output ≤ 30 kW:
The seasonal space heating energy efficiency shall not fall below 75%.
Fuel boiler space heaters with rated heat output > 70 kW and ≤ 400 kW and fuel boiler combination heaters with rated heat output > 70 kW and ≤ 400 kW:
The useful efficiency at 100% of the rated heat output shall not fall below 86%, and the useful efficiency at 30% of the rated heat output shall not fall below 94%.
Electric boiler space heaters and electric boiler combination heaters:
The seasonal space heating energy efficiency shall not fall below 30%.
Cogeneration space heaters:
The seasonal space heating energy efficiency shall not fall below 86%.
Heat pump space heaters and heat pump combination heaters, with the exception of low-temperature heat pumps:
The seasonal space heating energy efficiency shall not fall below 100%.
Low-temperature heat pumps:
The seasonal space heating energy efficiency shall not fall below 115%.

Tab. 15 Eco-design requirements proposed for space and combi heaters - second implementation phase (source EC)

Electric boiler space heaters and electric boiler combination heaters:
The seasonal space heating energy efficiency shall not fall below 36%.
Cogeneration space heaters:
The seasonal space heating energy efficiency shall not fall below 100%.
Heat pump space heaters and heat pump combination heaters, with the exception of low-temperature heat pumps:
The seasonal space heating energy efficiency shall not fall below 110%.
Low-temperature heat pumps:
The seasonal space heating energy efficiency shall not fall below 125%.

Energy labelling requirements are instead established in a draft Commission delegated regulation for space heaters and combination heaters with rated heat output <= 70 kW, packages of space heater <= 70 kW, temperature control and solar device and packages of

combination heater <= 70 kW, temperature control and solar devices [EC2012c]. The energy efficiency ranking of heaters indicated in the draft regulation is based on the scheme laid down in Directive 2010/30/EU and has a single seasonal space heating energy efficiency scale for boilers, cogeneration, heat pumps and their packages with further products. Two years after the entry into force of the Delegated Regulation, a scale from G to A for conventional heaters (G-D for electric boilers, C-B for non-condensing boilers in collective buildings, B-A for condensing boilers) with higher classes A+ for cogeneration and A++ for heat pumps are supposed be introduced according to this draft regulation. Four years after the entry into force of the Delegated Regulation, a further class A+++ will be added on top of the labelling scale, while classes G to E will be abolished due to more ambitious ecodesign requirements. However it might happen that the submission to the Regulatory Committee will produce some changes in the implementation details..

Another product category for which the implementation of eco-design requirements by a separate regulation is being considered is that of local room heating products (the related ecodesign preparatory study has been finalized on June 2012 and a consultation forum with the main stakeholders involved has been organized on September 2012). Local room heating products can be defined as appliances that provide heat to indoor spaces by generating heat at the same location as needed. They are self-contained heating units that are typically portable, wall-mounted or chimney bound [MUD2011a]. The most common types of local room heating products (excluding solid fuel appliances) are electric heaters, but liquid and gaseous fuel heaters are also popular in many EU Member States [MUD2011a].

Concerning market share of the various space heating products installed in the residential sector, in the last years gas condensing boilers have gained substantial market share in Europe. Gas condensing boilers are much more efficient than traditional oil and gas boilers reaching efficiency levels of up to 98%[23] [BDH2011]. In the UK, the market share is now 100%, in Germany condensing boilers have reached a market share of approx. 55% and the first place in sales' statistics with 335,000 natural gas condensing boilers sold in 2010 [BDH2011].

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3.4.2. Residential room air conditioners

The European market for air-conditioning is still relatively young and still growing substantially. The stock is far from reaching saturation levels. Based on JRC estimates and

[23] Referring to the degree of utilisation based on the higher heating value of condensing boilers.

the data from the preparatory study, the existing stock of air-conditioning systems has reached of over 25 million units[24] [BER2009, RIV2008, JRC].

The air-conditioning market is growing fast worldwide. In Europe, the last two years (2008/2009) had registered significantly lower sales volumes than in the years before due to particular weather conditions. The summer periods of 2008 and 2009 were short and not as warm as in other years. Only during 2010 the European air-conditioners' market recovered: +23% (January to December 2010 vs. January to December 2009), this trend was mainly due to a warmer summer period in all Europe, predominantly due to July hot weather conditions. Summer periods represent more than 80% of the total yearly market volume for most of the regions [FRA2011].

In 2007 the overall electricity consumption of the EU-27 air-conditioning stock was around 17 TWh for both the residential and the tertiary sector [RIV2008]. Due to the low growth rates during the years 2008 and 2009 the air-conditioning stock and the overall electricity consumption is estimated to have remained almost constant until 2009.

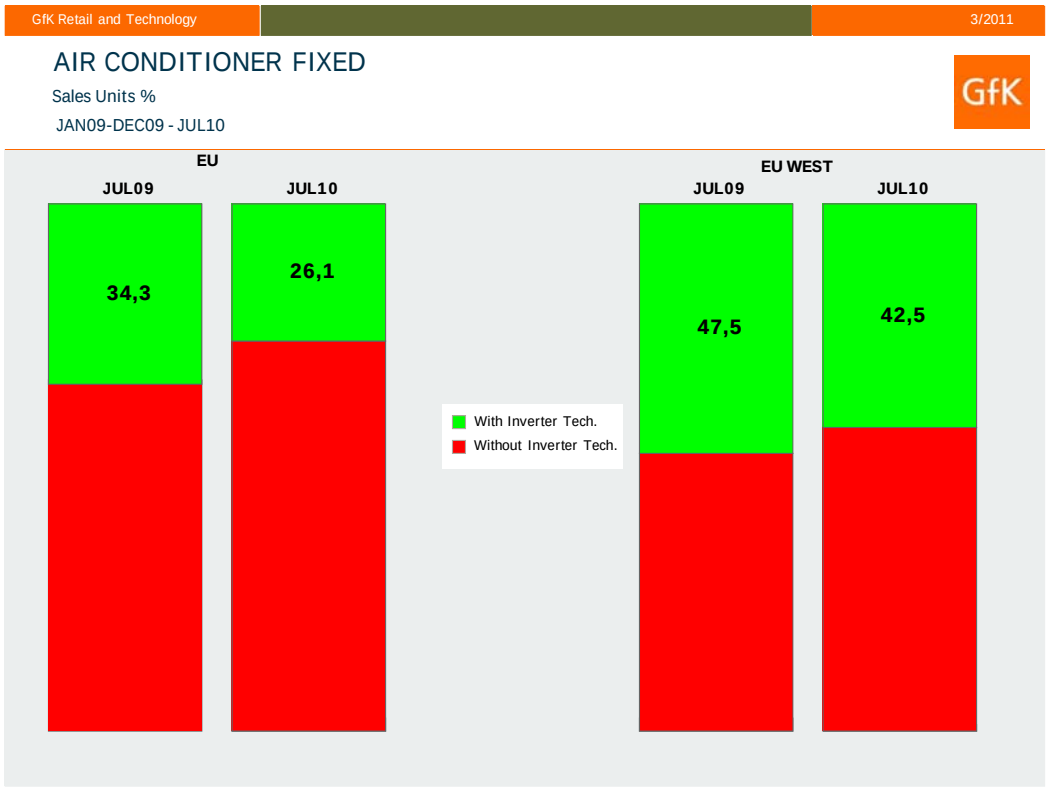
The biggest EU markets are Italy, Greece, Spain, and Southern France. Spain represents 37% of the EU-27 market, followed by Italy with 20%, Greece with 15% and France with 11%, cumulating more than three quarters of total EU sales for residential use in 2005 (cooling capacity) [RIV2008, BER2009].

The market of air-conditioning is characterized by an "impulse buying". This behaviour has an influence on the energy efficiency of the appliances sold. Together with a preference for low prices consumers tend to buy lower technology appliances characterized by low energy efficiency and no inverter technology allowing to continuously regulate temperature by controlling the compressor motor speed[25] [FRA2011].

[24] This is only the residential market which accounts for about 37% of the total market.

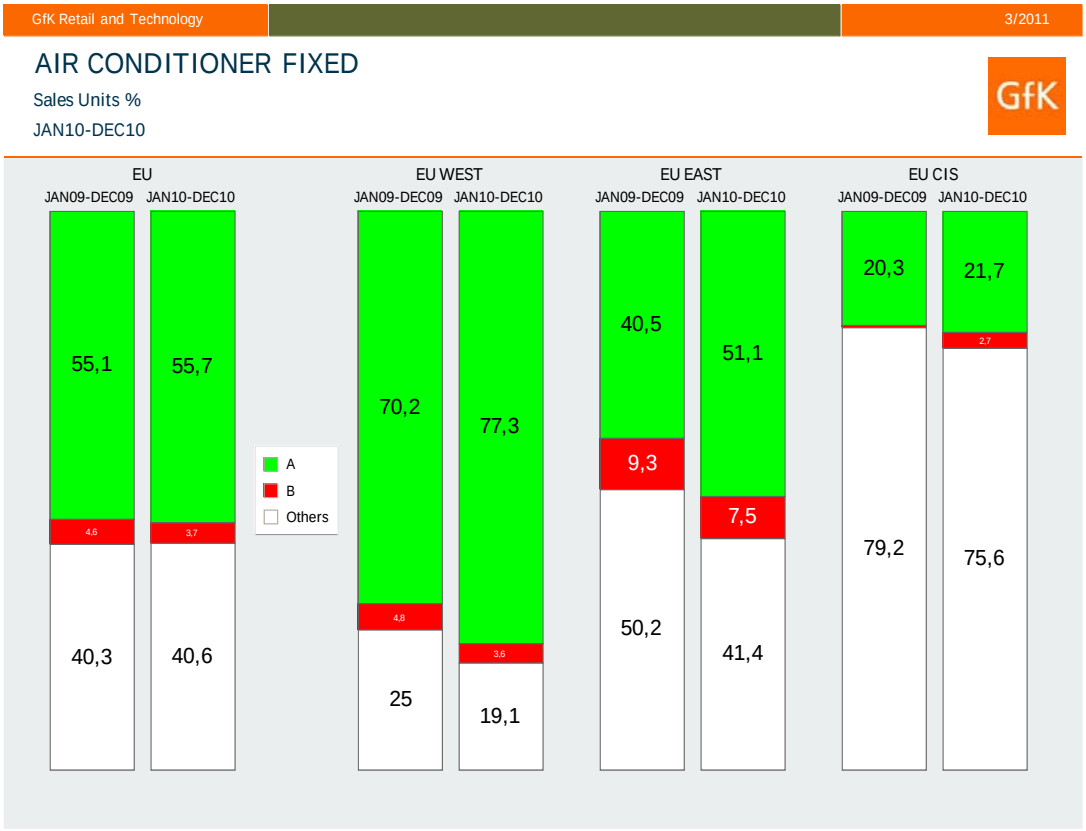
[25] Air conditioners without inverter technology regulate the temperature by using a compressor that is periodically either working at maximum capacity or switched off entirely.

Fig. 48: Importance of inverter technology of fixed air conditioners in 10 EU countries (source GfK)



The result of the ad-hoc buying behaviour of consumers during very warm periods can be illustrated by the sales in July 2010: in the relatively warm July 2010 26.1% of fixed air-conditioners sold were with inverter technology whereas this share was 34.4% in July 2009.

Fig. 49: Energy efficiency classes of fixed air-conditioners across the EU[26] (source GfK)



The air-conditioning market in the EU has seen a positive transformation into a more efficient one with the introduction of the energy label. The current label still leaves room for important improvements in energy efficiency. The recent introduction of Ecodesign requirements will enhance this trend even further. A recent GfK market survey shows that between January 2010 and December 2010 55.7% (55.1% in 2009) of all fixed air-conditioner units sold were A class appliances. In Western Europe this trend was even more profound with 77.3% in the same period and 70.2% in 2009.

This is a continuation of the market development between 2005 and 2008. In this period class A sales grew by 36.1% in major European markets[27]. At the same time, the sales for air-conditioning systems below or equal to class C decreased more than 50%, from 78.4% to 33% and the not labelled systems sales decreased by some 40% [BER2009, STO2009].

GfK data shows that the share of class A appliances on the market of residential room air-conditioners increased from 41% in 2007 to 57% in 2010 across Europe. In the Western European countries the share was 74% in 2010 (49% in 2007) and in Eastern European countries it was 63% in 2010 (35% in 2007).

[26] EU East: BG, CZ, HR, PL, RO, SK,SL; EU West: BE,FR, DE, GB, GR, IT,NL, PT, ES, SE ; CIS: RU, UA, KZ

[27] Here these markets are Spain and Italy.

Fig. 50: Importance of energy efficiency calls "A" in the EU during the last 4 years (source GfK)

YEAR	TOTAL EUROPE	WEST EUROPE	EAST EUROPE	CIS
2007	41%	49%	35%	23%
2008	51%	60%	58%	28%
2009	52%	68%	46%	20%
2010	57%	74%	63%	26%

Fig. 51: Energy efficiency ratio of new unitary air conditioners in the EU-10 (source 4E Mapping & Benchmarking)

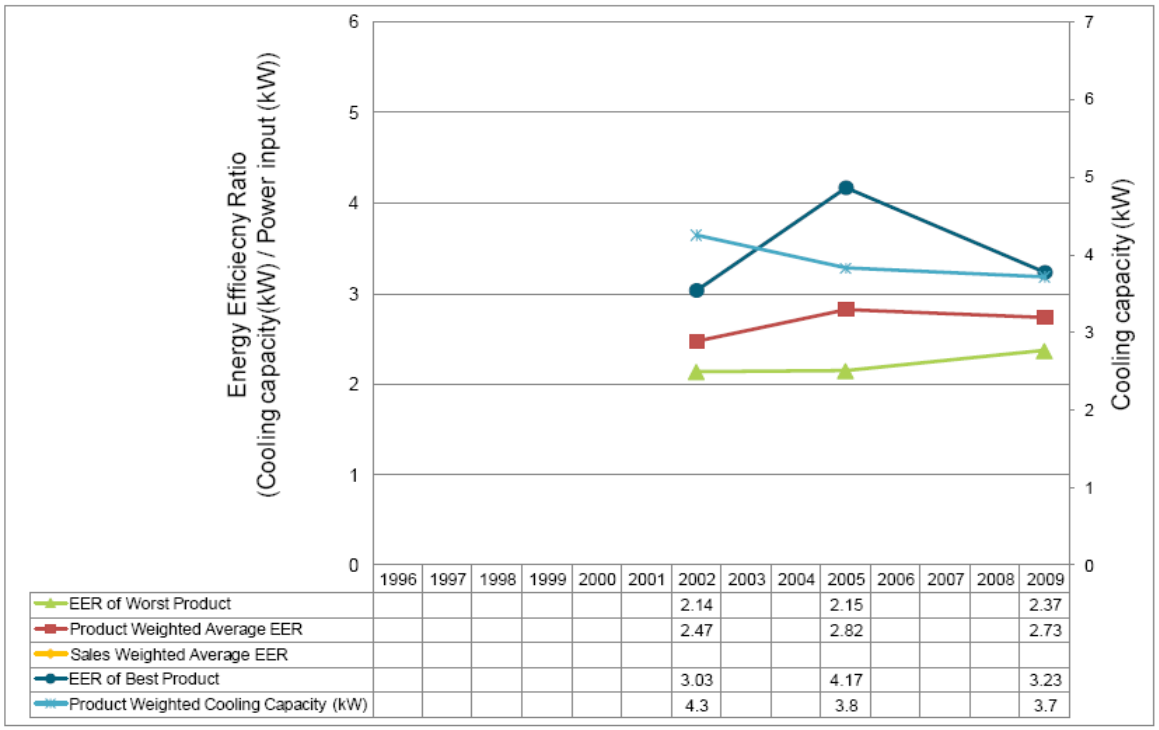
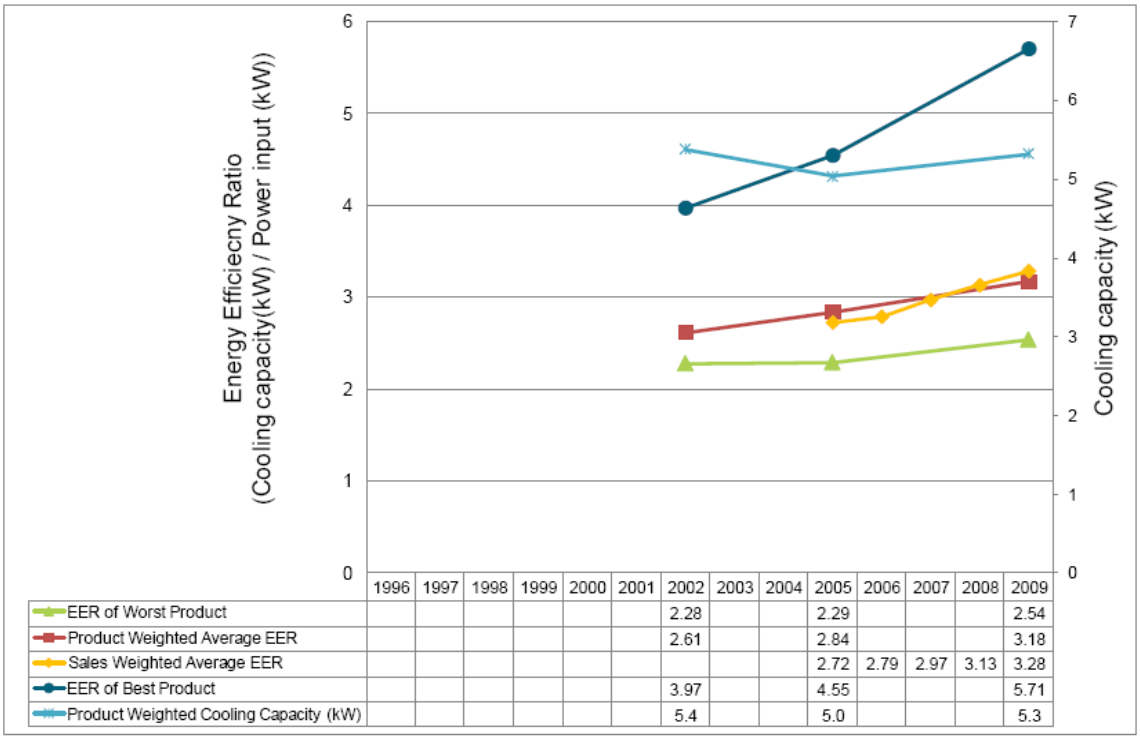


Fig. 52: Energy efficiency ratio of new split air conditioners in the EU-10 (source 4E Mapping & Benchmarking)



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
EER of Worst Product							2.28			2.29				2.54
Product Weighted Average EER							2.61			2.84				3.18
Sales Weighted Average EER										2.72	2.79	2.97	3.13	3.28
EER of Best Product							3.97			4.55				5.71
Product Weighted Cooling Capacity (kW)							5.4			5.0				5.3

Ecodesign requirements for residential room air conditioners have been introduced by Commission Regulation n. 206/2012 of 6 March 2012 [EC2012d].

Commission Delegated Regulation (EU) No 626/2011 of 4 May 2011 replaced instead Directive 2002/31/EC of 22 March 2002 implementing Council Directive 92/75/EEC with regard to energy labelling of household air-conditioners.

The old label consisted of seven energy classes, from class A (most efficient) to class G (least efficient). The energy classes were calculated in accordance with the product type. Two different product types were identified: air-cooled air conditioners and water-cooled air-conditioners. Different efficiency classes were defined for split and multi-split appliances, packaged appliances and single-duct or double-duct appliances. In addition to that, energy efficiency classes for the heating modes of both types were defined. The energy efficiency classes were defined based on the energy efficiency ratio (EER)[28] for the cooling mode and on the coefficient of performance (COP) for the heating mode.

The new regulation applies to electric mains-operated air conditioners with a rated capacity of ≤ 12 kW for cooling, or heating, if the product has no cooling function. It introduces two energy efficiency scales based on the primary function and on specific aspects important to

[28] EER= Energy Efficiency Ratio. This is the ratio between the output cooling (thermal) power and the input electrical power in the cooling mode.

consumers. Today's appliances, excluding single and double duct air conditioners, that achieve the highest efficiency levels have largely surpassed the A efficiency levels of the old energy label for air conditioners. The new efficiency calculation method with an Ecodesign implementing measure setting minimum energy efficiency requirements higher than the current A level, leads to a reclassification of these appliances. Consequently, split, window and wall air conditioners have a new A-G energy efficiency class scale with A+ added on top of the scale every two years (starting from 1 January 2013) until the A+++ class has been reached. For double duct and single duct air conditioners, steady-state energy efficiency performance indicators continue to be applied, as there are currently no inverter units on the market. As no reclassification of these appliances is appropriate, single and double duct air conditioners have an A+++ to D scale. While these, inherently less efficient than split appliances, can go only up to an A+ energy efficiency class in a scale of A+++ to D, the more efficient split appliances can reach up to the A+++ energy efficiency class. Whereas energy efficiency classes of single and double duct air conditioners have been defined based on the above mentioned indexes EER and COP, the energy efficiency classes of other air-conditioners, for which inverter technology is available, have been defined based on the seasonal energy efficiency ratio (SEER)[29] and the seasonal coefficient of performance (SCOP)[30] [COM2011a].

The above mentioned Commission Regulation n. 206/2012 introduces eco-design requirements for the placing on the market of electric mains-operated air conditioners with a rated capacity of ≤ 12 kW for cooling, or heating if the product has no cooling function, and comfort fans with an electric fan power input ≤ 125W. This regulation establishes minimum efficiency requirements based on the above energy efficiency indexes and the global warming potential (GWP) of the refrigerant used and sets a maximum power consumption allowed in off-mode and stand-by mode[31]. Requirements set for energy efficiency will determine the banning of least efficient products as summarized in Tab. 16 below.

[29] The seasonal energy efficiency ratio (SEER) is the overall energy efficiency ratio of the unit, representative for the whole cooling season, calculated as the reference annual cooling demand divided by the annual electricity consumption for cooling.

[30] The seasonal coefficient of performance (SCOP) is the overall coefficient of performance of the unit, representative for the whole designated heating season (the value of SCOP pertains indeed to a designated heating season), calculated as the reference annual heating demand divided by the annual electricity consumption for heating.

[31] From 1 January 2013 off-mode power consumption shall not exceed 1.00 W, whereas stand-by power consumption shall not exceed 1.00 or 2.00 W depending on whether equipment providing information or status display is installed or not. From 1 January 2014 these limits on maximum power consumption will be decreased to 0.50 W (for off-modes) and to 0.50 and 1.00 W (for standby modes of products respectively without or with equipment providing information or status display). These requirements will apply only to single or double duct air conditioners and comfort fans,

Tab. 16 Energy efficiency classes banned by ecodesign requirements for air-conditioners (elaboration of data available in [EC2012d]).

From 1 January 2013						
	All other air conditioners		**Double duct air conditioners**		**Single duct air conditioners**	
	Cooling	**Heating**	**Cooling**	**Heating**	**Cooling**	**Heating**
If GWP of refrig. > 150	E, F, G	B, C, D, E, F, G	C, D, E, F, G	D(only if COP<2.36), E, F, G	C, D, E, F, G	D, E, F, G
If GWP of refrig. ≤ 150	E(only if SEER<3.24), F, G	C(only if SCOP<3.06), D, E, F, G	C(only if EER<2.16), D, E, F, G	D(only if COP<2.12), E, F, G	C(only if EER<2.16), D, E, F, G	D(only if COP<1.62), E, F, G
From 1 January 2014						
If GWP of refrig. > 150 for < 6 kW	C, D	A(only if SCOP<3.80)	B	C, D	B	B(only if COP<2.04), C
If GWP of refrig. ≤ 150 for < 6 kW	C(only if SEER<4.14), D, E	A(only if SCOP<3.42), B, C	C(only if EER<2.34)	D(only if COP<2.34)	C(only if EER<2.34),	C(only if COP<1.84), D
If GWP of refrig. > 150 for 6-12 kW	C(only if SEER<4.30), D	A(only if SCOP<3.80)	B	C, D	B	B(only if COP<2.04), C
If GWP of refrig. ≤ 150 for 6-12 kW	D(only if SEER<3.87), E	A(only if SCOP<3.42), B, C	C(only if EER<2.34),	D(only if COP<2.34)	C(only if EER<2.34)	C(only if COP<1.84), D

The combined effect of energy labelling and Ecodesign requirements for air conditioners is expected to result in annual electricity savings of 11 TWh by 2020, compared to the situation without measures [COM2011a].

3.4.3. Electric water heaters

A water heater is defined as a product connected to an external supply of drinking or sanitary water to generate and transfer heat to deliver drinking or sanitary hot water at given temperature levels. The hot water is typically used for cooking, cleaning, and bathing.

Electric water heaters account for 8.7% of total electricity consumption at 73 TWh in 2009. The JRC estimates show that in 2007 the installed stock of electric water heaters in the EU-27 was around 119 million units (out of a total of 267 million units' domestic water heaters) of which 29 million units were electric instantaneous and 90 million of units were electric water heaters with storage. For the same year, estimates show around 2 million solar water heater units installed. In 2007, around 31.7% of the EU-27 households owned a secondary water heater, usually a small one for the kitchen or bathroom tap [BER2009].

In the last two years, the solar thermal heating systems had an impressive development on the EU-27 market. While much of the market is in one and two family houses, demand by housing companies, office building operators and other commercial users is increasing significantly. The solar thermal market in the EU-27 showed a strong performance in 2008, growing by 60% to 3.27 GWth of new capacity. The biggest yearly growth came from the German market, which from 2007 increased by 123%, but demand for solar thermal technology grew strongly also in smaller markets. The overall installed capacity in EU-27 was around 18.97 GWth in 2008 [BER2009, EST2008]. In 2011, the solar thermal market experienced an overall decrease in Europe but with a total of 2,586 MWth of newly installed capacity it still remained above its 2007 level. The German market while still the largest in Europe has dropped by almost 29% in 2010. This decrease combined with the 23% downturn in 2009, brings the market almost back to its 2007 level, with 805 MWth of newly installed capacity [EST2011].
Between 2009 and 2010, the market in Europe decreased by -13%. In 2010, the cumulative installed capacity in operation reached 24.11 GWth in the EU-27 and Switzerland [EST2011].

Fig. 53: Solar thermal market in EU-27 and Switzerland (source EST2011)

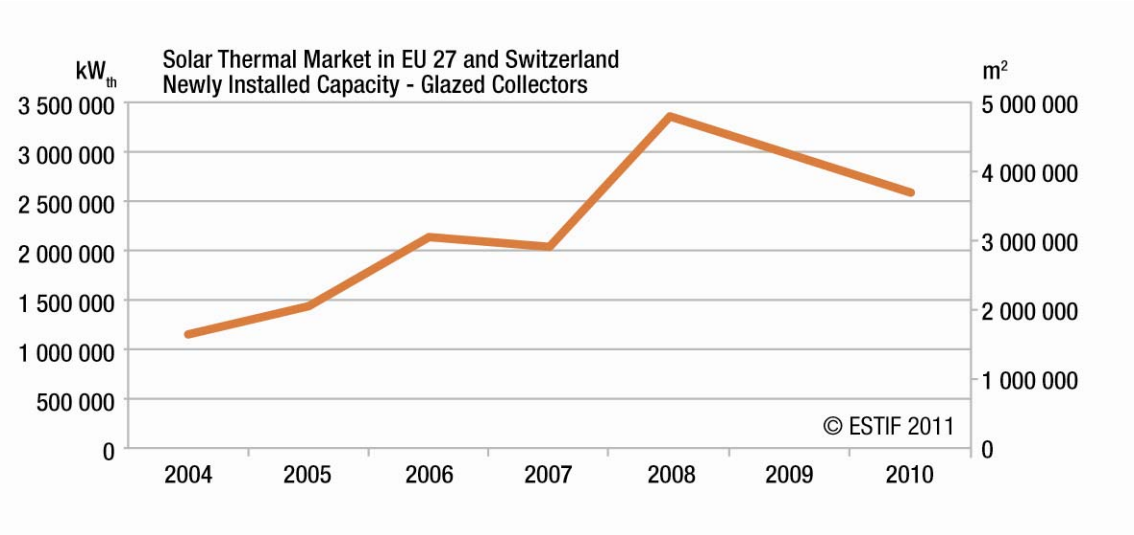
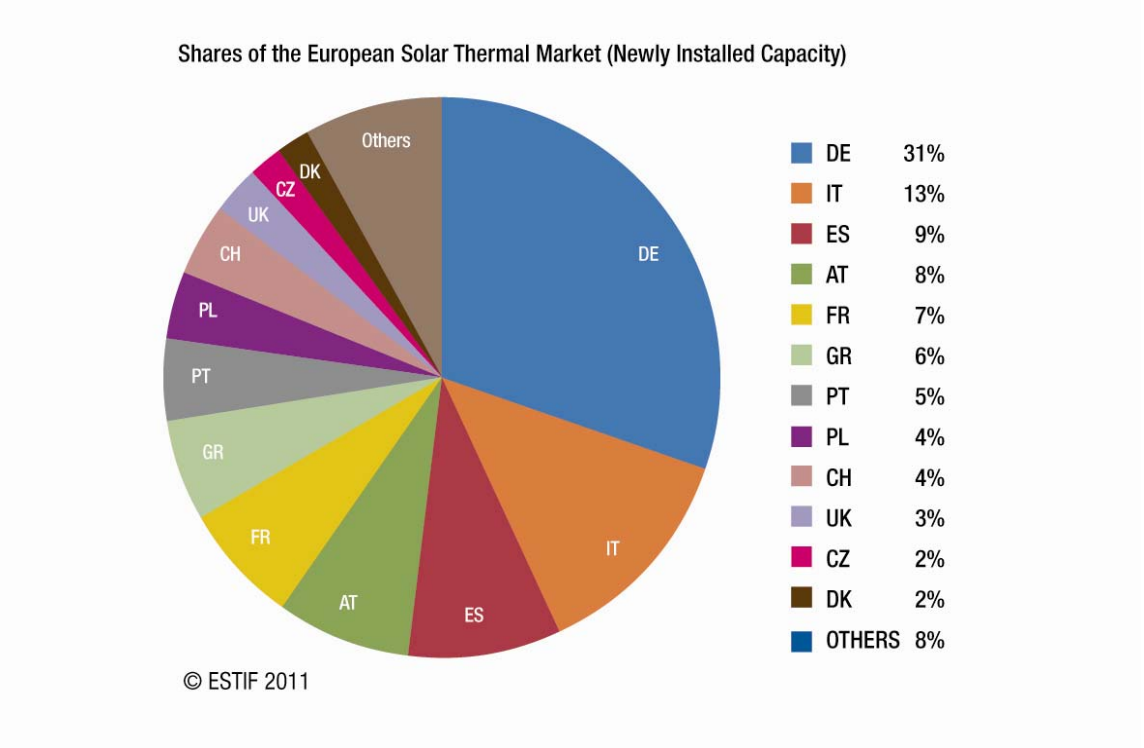


Fig. 54: Shares of the European solar thermal market (aource EST2011)



A new Commission Delegated Regulation implementing energy labelling of water heaters with a rated heat output <= 70 kW, hot water storage tanks with a storage volume <= 500 litres and packages of water heater <= 70 kW and solar device has been recently submitted to the Regulatory Committee [EC2012e]. The proposal introduces the widely known A-G scale covering the various types of conventional water heaters and hot water storage tanks. Additionally, the dynamic top classes A+, A++ and A+++ will promote the use of renewable energy sources and superinsulated tanks. Two years after entry into force of the delegated

Regulation, a scale from G to A for conventional water heaters is applied (for small load profiles, G-A for electric water heaters; for medium to large load profiles, G-C for electric water heaters, C-A for gas water heaters), whereas actual solar water heaters and heat pump water heaters are not sufficiently efficient yet to reach classes beyond A. Four years after the entry into force of the Regulation, a further class A+ will be added on top of the labelling scale to encourage development of more efficient solar water heaters and heat pump water heaters. Classes A++ and A+++ can only be reached by packages with large solar-only systems. It is expected that this fact will ensure a dynamic market transformation toward high efficient heaters using new renewable technologies [EC2012e].
For hot water storage tanks an efficiency scale G-A is applied from two years after entry into force of the Regulation. Three years after the entry into force, a further class A+ will be added on top of the labelling scale to encourage the development of superinsulated storage tanks [EC2012e].

Until today, no Ecodesign requirements have been implemented for household water heaters. Ecodesign requirements for water heaters with a rated heat output up to 400 kW and hot water storage tanks with a storage volume up to 2 000 litres has been recently submitted to the Regulatory Committee [EC2012f].
The following minimum Ecodesign requirements are suggested in the Regulation being discussed:

First phase (two years after regulation comes into force):

- Minimum performance of 22% for 3XS loads
- Minimum performance of 23% for XXS loads
- Minimum performance of 26% for XS and S loads
- Minimum performance of 30% for M, L and XL loads
- Minimum performance of 32% for XXL, 3XL and 4XL loads

Second phase (four years after regulation comes into force):

- Minimum performance of 32% level for 3XS, XXS, XS and S loads (with some exceptions for replacements)
- Minimum performance of 36% (M loads), 37% (L loads), 38% (XL loads) and 40% (XXL, 3XL, 4XL loads)

Third phase (five years after regulation comes into force):

- Minimum performance of 60% for XXL loads and 64% for 3XL and 4XL loads

Lower minimum energy efficiency requirements are set for the water heaters with smart controls for the first and second implementation phase in the text of the Regulation under discussion.

3.5. Lighting

Lighting represents around 10% of the residential electricity consumption, being the third main consumer after electricity for heating and cold appliances. Electricity consumption of household lighting was estimated to be around 84 TWh in 2007. Since then consumption decreased substantially compared to other appliance groups by around 5% resulting in an estimated electricity consumption of around 79.8 TWh in 2009. This trend is expected to continue in the coming years.

Household lamp technologies include LED, incandescent lamps (GLS), halogen lamps, self-ballasted compact fluorescent lamps, and to some extent, also single and double capped fluorescent lamps without integrated ballast and high density discharge lamps. These technologies also include control gear and luminaires designed for these lamps [BER2009].

Compact fluorescent lamps (CFLs) represent one of the most efficient solutions available today for improving energy efficiency in residential lighting. The recent drop in price, together with several information and promotion campaigns, had a positive impact on sales. In particular, two different types of CFLs are marketed: the short life (average life around 6000 hours) and the professional models (up to an average life of around 12000 hours). The first type is mainly marketed for the residential sector [BER2009]. Further price reduction has been triggered by the ban on incandescent completed in Sept 2012. LED lighting starts to penetrate the market for replacement lamps, and special purpose lighting. The market price for LEDs was still very high in 2011.

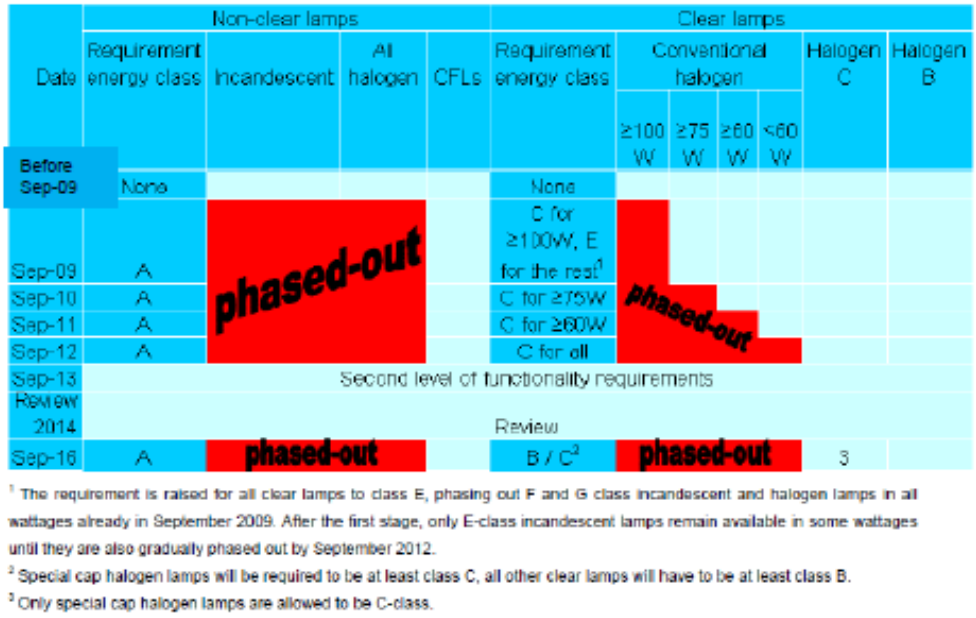
New sales' estimates of the 4E Mapping & Benchmarking Project show that about 1747 million incandescent lamps were sold in the EU-27 (plus Norway and Switzerland) in 2006 whereas this number decreased to 1108 million lamps in 2010. For CFLs, the trend is the contrary: 426 million CFLs were sold (self-ballasted and pin based CFLs) in 2006. It has been estimated that in 2010 this number increased to 607 million lamps meaning an increase of 45% during this period[32].

[32] Estimates concerning sales values performed in the framework of the 4E Mapping & Benchmanrking Project for the period 2008-2010 are based on percentage growth from 2007 of individual product groups. Growth values are average aggregated values from industry and other sources.

These estimates are coherent with the estimations of the Ecodesign preparatory study [TIC2008]. In the study the growth of CFLs between 2003 and 2007 is estimated as 340% (from 145 million in 2003 to 628 million lamps in 2007). The estimates include both domestic and non-domestic sales. For domestic sales alone the estimated number for 2007 is 488 million units [BER2009, TIC2008].
This increase in CFL penetration (more than 300 million CFLs have been distributed) was strongly stimulated in many Member States with special national policies and measures like the White Certificates schemes in Italy and energy suppliers obligations in the United Kingdom.

Commission Regulation (EC) No 244/2009 of 18 March 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council introduced Ecodesign requirements for non-directional household lamps. The Ecodesign directive stipulated the progressive phasing out of incandescent bulbs started in 2009 and finished in the end of September 2012.
The regulation applies to non-directional lamps. Ecodesign measures for directional (reflector) lamps, such as spot and LEDs have been adopted by the Regulatory Committee on July 2012 (see more information further in this section).
In September 2009, the phasing out of all inefficient non-clear lamps (non-transparent lamps) started. Non-clear lamps were required to be A-class (or slightly less efficient for certain lamps such as those with external envelope). In practice, considering the available technologies, this means that non-clear lamps have to be CFLs which save about 80% energy compared to incandescent lamps. Consumers who prefer another lamp technology, (for various reasons such as aesthetics, size, shapes etc.) can buy clear (transparent) lamps [BER2009, COM2009a].
The less efficient clear lamps have been also phased out progressively, starting with the highest wattage (100W incandescent bulbs and above, and equivalent lamps) in 2009. Since September 2009, lamps equivalent in light output to 100W transparent conventional incandescent bulbs and above have to be at least class C (achieved by improved incandescent bulbs with halogen technology and not by conventional incandescent ones). All lower wattage clear lamps of the D, E, F and G classes have been progressively phased out, so that only C-class have remained from end of September 2012. This has left on the market the most efficient clear halogen lamps, with savings of 25-50% compared to the old equivalent incandescent lamps.

Fig. 55: Phasing-out of incadescent lightbulbs in the EU (source EC)



[1] The requirement is raised for all clear lamps to class E, phasing out F and G class incandescent and halogen lamps in all wattages already in September 2009. After the first stage, only E-class incandescent lamps remain available in some wattages until they are also gradually phased out by September 2012.

[2] Special cap halogen lamps will be required to be at least class C, all other clear lamps will have to be at least class B.

[3] Only special cap halogen lamps are allowed to be C-class.

Halogen clear lamps (xenon-filled) from energy class C will remain on the market until 2016. Unless new technologies emerge, from 2016 the dominant clear lamps will be the class B low voltage halogen lamps, with integrated or non-integrated transformer.

LEDs are an even more promising emerging technology than CFLs and fall under the energy efficiency class A [BER2009].

In addition to the minimum efficiency requirements, the Ecodesign Regulation also contains requirements concerning lamp functionality and product information.

Commission Directive 98/11/EC of 27 January 1998 implementing Council Directive 92/75/EEC introduced energy labelling for household lamps. The label introduced had seven energy classes from class A (most efficient) to class G (least efficient). An update of this energy label for household lamps has been performed by a new Commission Delegated Regulation adopted in July 2012. This Regulation redistributes the energy efficiency classes after the phasing out of classes D, E, F, and G and integrates low voltage lamps, reflector lamps, and LEDs, which were not covered by the old label [EC2012].

Fig. 56: Energy savings and old energy efficiency classes of lamps vs. incandescent lamps (source EC)

Lamp technology	Energy savings	Energy class
I. Incandescent lamps	-	E, F, G
II.1 Conventional halogens (mains voltage 220 V)	0 – 15 %	D, E, F
II.1 Conventional halogens (low voltage 12 V)	25%	C
II.2 Halogens with xenon gas filling (mains voltage 220 V)	25%	C
II.3 Halogens with infrared coating	45%	B (lower end)
III. CFLs with bulb-shaped cover and low light output	65%	B (higher end)
III. CFLs with bare tubes or high light output	80%	A

Apart from the EcoDesign measures and the energy labelling, a voluntary programme, the European Quality Charter for LED[33] has been implemented. The European Quality Charter for LED was developed in 2010 on the initiative of the European Commission DG JRC to support the European initiatives for the promotion of efficient lighting in the residential sector [EC2011a].

The scope of the present version of the LED Quality Charter is limited to LED lamps intended primarily for use in the residential sector. At this stage the European Quality Charter for LED does not include LED modules, luminaries and lamps specific for use in the commercial sector. This limitation is due to the urgent need to support customers replacing banned incandescent lamps (GLS and some halogen lamps), and other promotion programmes at national or local level (e.g. White Certificates) [EC2011a].

The aim of the European LED Quality Charter is to offer a high quality voluntary standard to be used by European utilities, industries and other bodies for:

- manufacturing, marketing and/or sales of high quality LED lamps in the European Union.
- raising consumer awareness and confidence in LED technology by assuring an acceptable quality and a good performance level are reached.
- supporting promotion and procurement campaigns providing quality, comfort, energy and money saving and decreasing the carbon dioxide (CO2) emission.

The final goal of the European LED Quality Charter is thus to further increase the penetration of high quality and efficient LEDs across the EU and thus contribute to the goals of the EU energy and environmental policies [EC2011a].

[33] More information on the LED Quality Charter can be found at: http://re.jrc.ec.europa.eu/energyefficiency/LED_Quality_Charter/index.htm

Tab. 17: The EU LED Quality Charter requirements (including ballast) (source EC)

	CRI	Min efficacy	2011	2012	2013	2014	2015
NDLS	>80	lm/W	61	65	70	75	80
	>90	lm/W	52	55	60	65	70
DLS	>80	lm/W	50	55	60	65	70
	>90	lm/W	40	45	50	55	60

A Commission Regulation on Ecodesign requirements for directional lamps has been adopted by the Regulatory Committee on July 2012 [EC2012a]. The new Regulation establishes Ecodesign requirements for the placing on the market of the following general lighting electric products, including when they are marketed for non-general lighting use or when they are integrated in other products:

- directional lamps[34];
- light emitting diode (LED) lamps;
- equipment designed for installation between the mains and the lamps, including lamp control gear and luminaires (other than ballast and luminaires for fluorescent and high-intensity discharge lamps).

The Ecodesign measures will be introduced in three stages: 1) 1 September 2013, 2) 1 September 2014, and 3) 1 September 2016.

The Ecodesign measures are based on the Energy Efficiency Index (EEI) which is calculated as the ratio of the rated power measured at nominal input voltage corrected by certain correction factors as specified in the regulation divided by a reference rated power at nominal input voltage.

[34] Directional lamps are defined as lamps having at least 80% light output with a solid angle of π sr (corresponding to a cone with angle of 120°).

Tab. 18: Maximum Energy Efficiency Index (EEI) for directional lamps set in the Ecodesign Regulation ([EC2012a])

Application date	Maximum energy efficiency index (EEI)			
	Mains-voltage filament lamps	Other filament lamps	High-intensity discharge lamps	Other lamps
Stage 1	If Φ_{use} > 450 lm : 1.75	If $\Phi_{use} \leq$ 450 lm : 1.20 If Φ_{use} > 450 lm : 0.95	0.50	0.50
Stage 2	1.75	0.95	0.50	0.50
Stage 3	0.95	0.95	0.36	0.20

Minimum energy efficiency requirements will also be introduced for lamp control gear. From Stage 2, the no-load mode input power of lamp control gear intended for use between the mains and the switch for turning the lamp load on/off shall not exceed 1.0 W. From Stage 3, the limit shall be 0.5 W. For lamp control gear with output power (P) over 250W, the no-load power limits shall be multiplied by P/250W. From Stage 3, the standby power of a lamp control gear shall not exceed 0.50 W. From Stage 2, the efficiency of halogen lamp control gear shall be at least 0.91 at 100% load [EC2012a].

Apart from energy efficiency requirements, functionality requirements for directional lamps (excluding compact fluorescent lamps and high-intensity discharge lamps), non-directional and directional LEDs and equipments designed for installation between the mains and the lamps are introduced.

In addition to Ecodesign measures for directional lamps, a Commission Delegated Regulation introducing an energy label for electrical lamps and luminaires has been adopted on July 2012 [EC2012].

The measure sets out new and revised mandatory energy labelling requirements for suppliers placing general lighting lamps on the market, and for dealers offering these appliances at the point of sale or by distant selling such as vie catalogues or the internet. The pre-existing lamp energy label has been extended to directional lamps and professional lamps, and new classes are introduced above A to allow a better distinction among the higher-end technologies, in particular singling out efficient LEDs as better performers than compact fluorescent lamps that have been on top of the scale until now [ECO2012].

In addition to the existing energy classes, A+ and A++ have been introduced for both directional and non-directional lamps. The following table gives an overview of the new energy efficiency classes under the revised label:

Tab. 19: Energy efficiency classes for lamps under the new label (source [EC2012])

Energy efficiency class	Energy efficiency index (EEI) for non-directional lamps	Energy efficiency index (EEI) for directional lamps
A++ (most efficient)	EEI ≤ 0.11	EEI ≤ 0.13
A+	0.11 < EEI ≤ 0.17	0.13 < EEI ≤ 0.18
A	0.17 < EEI ≤ 0.24	0.18 < EEI ≤ 0.40
B	0.24 < EEI ≤ 0.60	0.40 < EEI ≤ 0.95
C	0.60 < EEI ≤ 0.80	0.95 < EEI ≤ 1.20
D	0.80 < EEI ≤ 0.95	1.20 < EEI ≤ 1.75
E (least efficient)	EEI >0.95	EEI > 1.75

3.6. Information and Communication Technologies

Information and communication technologies (ICTs) are among the fastest growing electricity end-use in the residential and tertiary sector. In 2009, the ICT market in Europe reached the size of 849 billion EUR, in 2010 it grew to 854 billion EUR [IDA2010]. Worldwide, the ICT market reached 2,629 billion EUR in 2009 and 2,658 billion EUR in 2010, the European market accounts for 32% of the world ICT market [IDA2010]. The market is expected to continue growing substantially reaching a worldwide market volume of 3,050 billion EUR in 2,013 and 933 billion EUR in Europe in 2013 [IDA2010].

The size of the digital technology sector in Europe represents 4.5 % of EU aggregate GDP and even more if value added of digital technologies in other sectors is also accounted for [DIG2009]. In 2011, global IT revenues grew by 4.4% to 1.1 billion euros [EITO2011]. The growth rate in the EU was almost 3% with Germany leading with 4% growth before France (3%) and the UK (2%) [EITO2011].

In the first quarter of 2010, consumers in Western Europe spent € 46.5 billion on technical consumer goods, meaning an increase of 2.7% in total compared to the same quarter in 2009 [GfK2010]. The information technology market, the second biggest market after consumer electronics, was worth € 11.5 billion in the first quarter of 2010 [GfK2010].

The following products are being covered in this section: televisions (analogue and digital services), set-top boxes, broadband communication equipment, personal computers, computer monitors, imaging equipment, and external power supplies/ battery chargers.

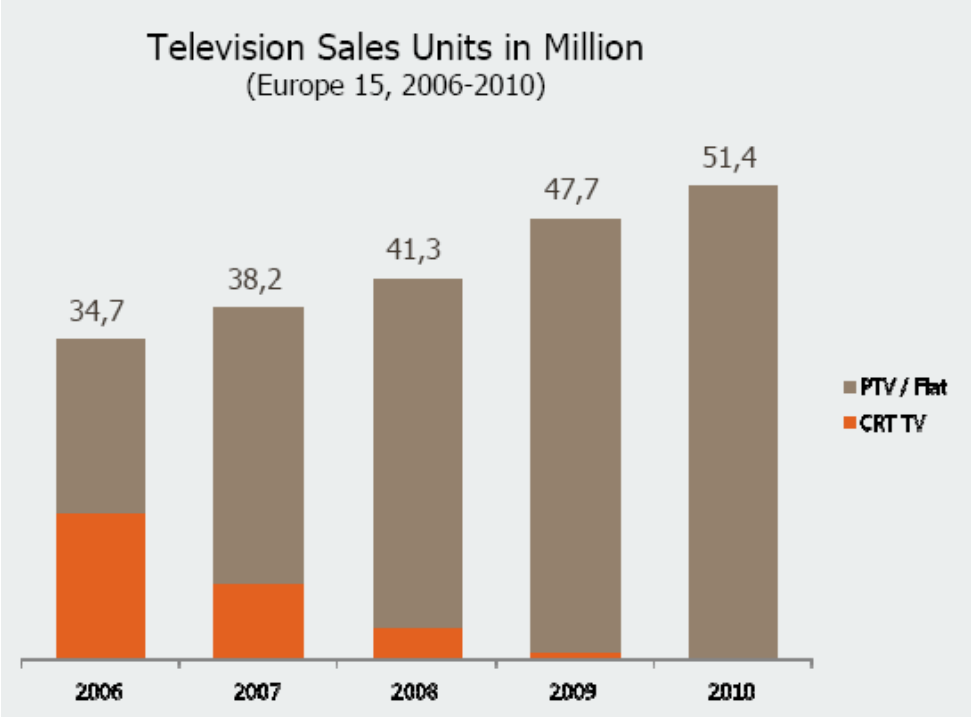
3.6.1. Television – analogue and digital services

The market for television is growing and changing rapidly. The most important trends are: bigger screen sizes, flat panel displays, digital television broadcasting and high-resolution television (HD).

Television sales have been increasing substantially during the last years. GfK data from 2011 show that in the EU-15 a total of 34.7 million TV units were sold in the year 2006. In 2010 the sales were already 51.4 million units. In 2006 flat screens already made more than 50% of total sales in the EU-15. Only a few years later, in 2010, this share was 100%.

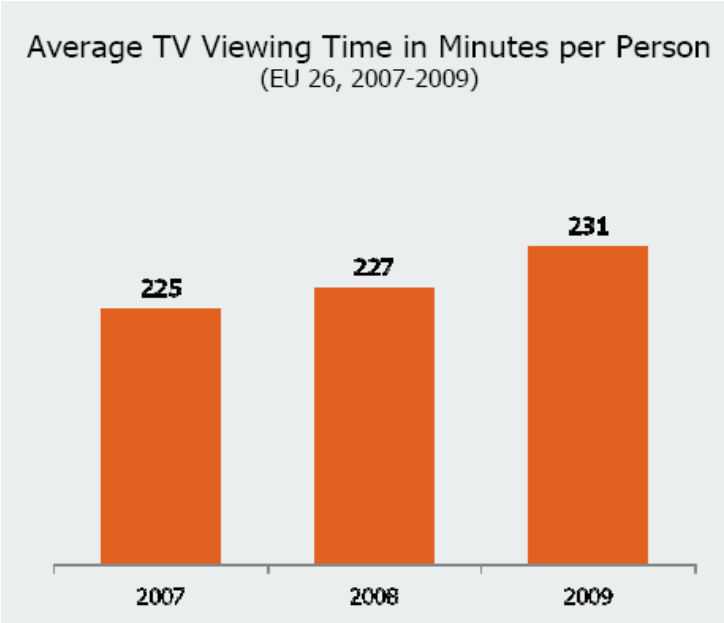
In 2007, estimated electricity consumption was around 54 TWh. Despite an increase in energy efficiency total consumption of TV sets has been increasing over the last years. Between 2007 and 2009 the increase in consumption is estimated at around 2-3% reaching 56 TWh in 2009.

Fig. 57: Television Sales (million) in the EU-15 (source GfK)



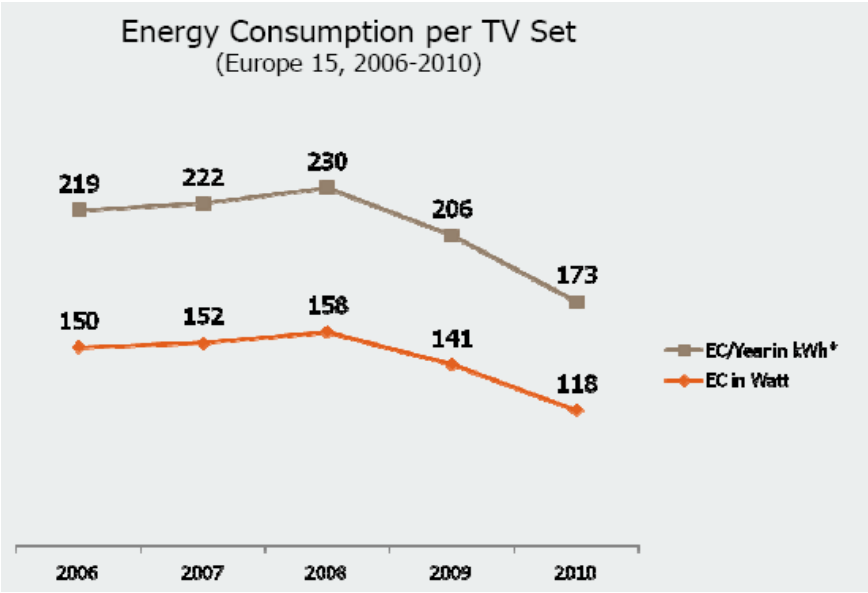
With the increase in sales of TVs the viewing time per person in the EU is also increasing significantly. In 2007 people in the EU were watching 225 minutes of television per day. Two years later the average viewing time per person reached 231 minutes (see Fig. 58 below) [HEY2011].

Fig. 58: Average TV viewing time in minutes per person in the EU (source GfK)



Another important trend on the television market is the increase of energy efficient appliances. Between 2006 and 2010 the average energy consumption per TV Set (EC/year) has been decreasing by -21% from 219 kWh/yr in 2006 to 173kWh/year in 2010.

Fig. 59: Average energy consumption per TV set in the EU-15 (source GfK)

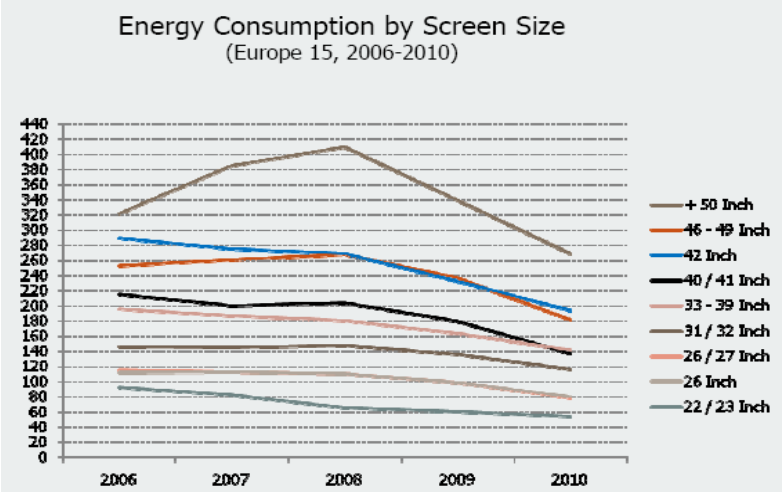


2007 electricity consumption of TVs in the EU-27 is estimated at 60 TWh, of which 54 TWh in on-mode power consumption and 6 TWh in stand-by/off-mode power consumption. These figures are expected to remain almost constant in 2009. The increase in the number of appliances installed per household, the fact that the old TV set is often kept in the household, and the increase in viewing-time are working against the efficiency improvements.

Following the findings of the preparatory study for the Ecodesign Directive, JRC estimates indicate that the installed stock of TVs in the EU—27 residential sector is over 310 million units with a penetration rate of around 150% [BER2009, FRA2007]. With energy labelling and performance requirements for television reaching full impact, estimated savings of around 43 TWh/year are expected by 2020 [BER2009, FRA2007].

The energy consumption of TV sets depends to a large extent on the screen size. The bigger the screen size the bigger is the energy consumption. In the last five years (2006 – 2010) the average energy consumption per TV set decreased for all screen sizes. However, there are still large differences in consumption between the different sizes.

Fig. 60: Average energy consumption by screen size in the EU-15 (source GfK)



Digital TV, in the form of digital cable, satellite, digital terrestrial (DTT), and IPTV (Internet Protocol Television), is fast replacing the analogue technologies. The adoption of digital television in Europe should grow strongly over the next years, providing enhanced image quality and advanced features (greater breadth of content and bundled communications). Apart from enhancement, the switch-off analogue transmission is a further key driver for the transition to digital TV in these regions. The EU is leading in switching from analogue to digital television [BER2009].

Commission Regulation (EC) No 624/2009 of 22 July 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council introduces Ecodesign requirements for televisions. The Ecodesign requirements for televisions entered into force on 20 August 2010. The directive lays out different Ecodesign requirements for on-mode, off-mode and home-use power modes. The Ecodesign requirements are introduced in stages to allow manufacturers to adapt to the new requirements.

Commission Delegated Regulation (EU) No 1062/2010 of 28 September 2010 supplementing Directive 2010/30/EU of the European Parliament implements energy

labelling of televisions. This is the first EU energy label for televisions. The energy classes are based on the EEI. The label is implemented in four phases. Phase one starting on 30 November 2011 introduces the energy classes from A (most efficient) to G (least efficient). On 1 January 2014, the new energy class A+ will be added to the label and class G will be removed. On 1 January 2017, the new energy class A++ will be added to the label and class F will be removed. From 1 January 2020, the new energy class A+++ will be added to the label and class E will be removed.

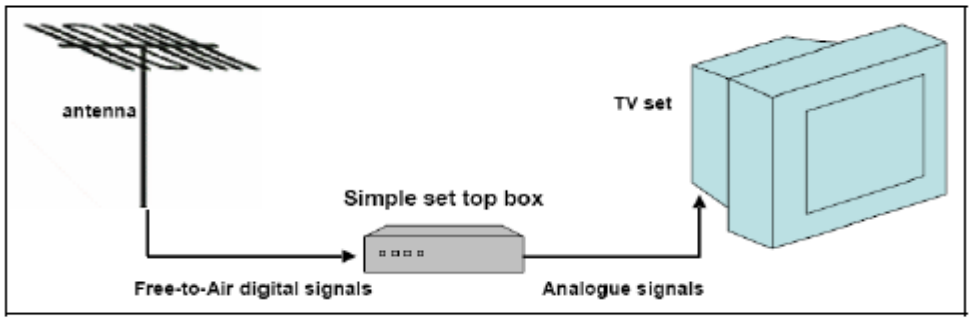
Tab. 20: New energy efficiency classes for televisions in the EU (source EC)

A+++	A++	A+	A	B	C	D	E	F	G
EEI<0.10	0.10≤ EEI <0.16	0.16 ≤ EEI < 0.230	0.23 ≤ EEI < 0.30	0.30 ≤ EEI < 0.42	0.42 ≤ EEI < 0.60	0.60≤ EEI < 0.80	0.80 ≤ EEI < 0.90	0.90 ≤ EEI < 1.00	1.00 ≤ EEI

3.6.2. Set-top boxes

Simple set-top boxes (SSTBs) have the primary function of converting digital input into analogue output signals. During the ongoing transition from analogue to digital broadcasting TV sets not adapted to receive digital signals will need to be accompanied by SSTBs. Taking into account the fast penetration of digital TV sets on the EU markets, it is expected that in the next years the SSTBs will lose importance in favour of the complex SSTBs [BER2009].

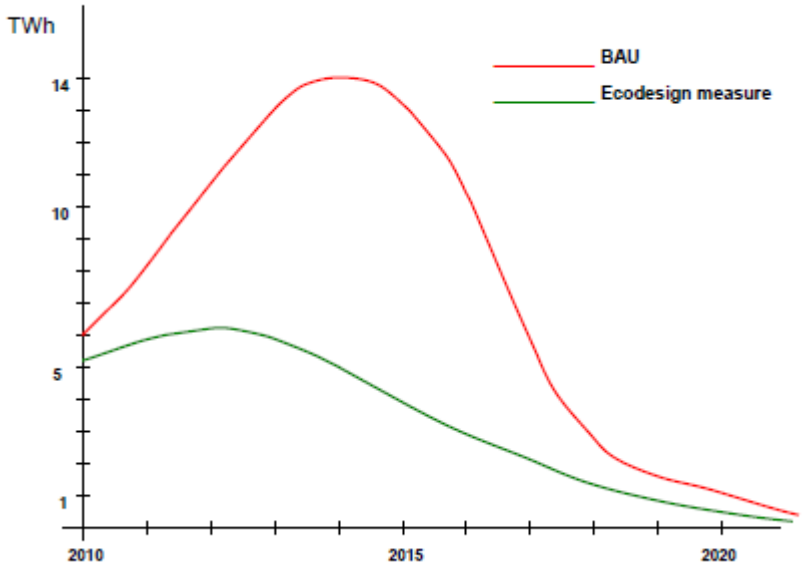
Fig. 61: Illustration of a simple set to box system (source EC)



In 2009 simple set-top boxes (SSTBs) reached a stock of 90 million units in the European Union [EC2009b]. This number is expected to grow to 177 million units in 2014. The annual energy consumption of SSTBs is estimated at 6 TWh in 2010 and 14 TWh in 2014 (without any minimum efficiency standards) [EC2009b]. The improvement potential when applying cost effective existing technology is estimated at 0.5 TWh in 2010 and 9 TWh in 2014. The improvement potential is due to the fact that existing cost-effective technical solutions allow significant reduction of the electricity consumption of these devices. The aggregated energy-

saving potential for the year 2010-2020 exceeds the annual residential electricity consumption of Sweden and is therefore considered to be significant. [EC2009b].

Fig. 62: Estimated energy consumption of STBs under Ecodesign measurers (source EC)



Commission Regulation (EC) No 107/2009 of 4 February 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to Ecodesign requirements for SSTBs. Ecodesign requirements concerning stand-by and active mode power consumption are implemented gradually in two steps.

1. One year after the regulation comes into force the maximum allowed power consumption is 5 W for on mode, and 1 W for stand-by and off-mode
2. Three years after the regulations has come into force, the limit is still 5 W for on-mode but 0.5 W for stand-by and off-mode

As stipulated in the Ecodesign regulation for SSTBs all new SSTBs on the market have now a stand-by mode option and automatic power-down function as default.

There is no energy label for STBs at the moment.

A voluntary programme, the European Code of Conduct for Digital TV Services[35], has been introduced to enhance energy efficiency of set-top boxes. The programme was developed by a working group of relevant stakeholders. The Code of Conduct sets out basic principles to be followed by all parties involved in digital TV services, operating in the European Commission in respect to energy efficiency equipment. At this point of time, the voluntary

[35] More information can be found at:
http://re.jrc.ec.europa.eu/energyefficiency/html/standby_initiative_digital%20tv%20services.htm

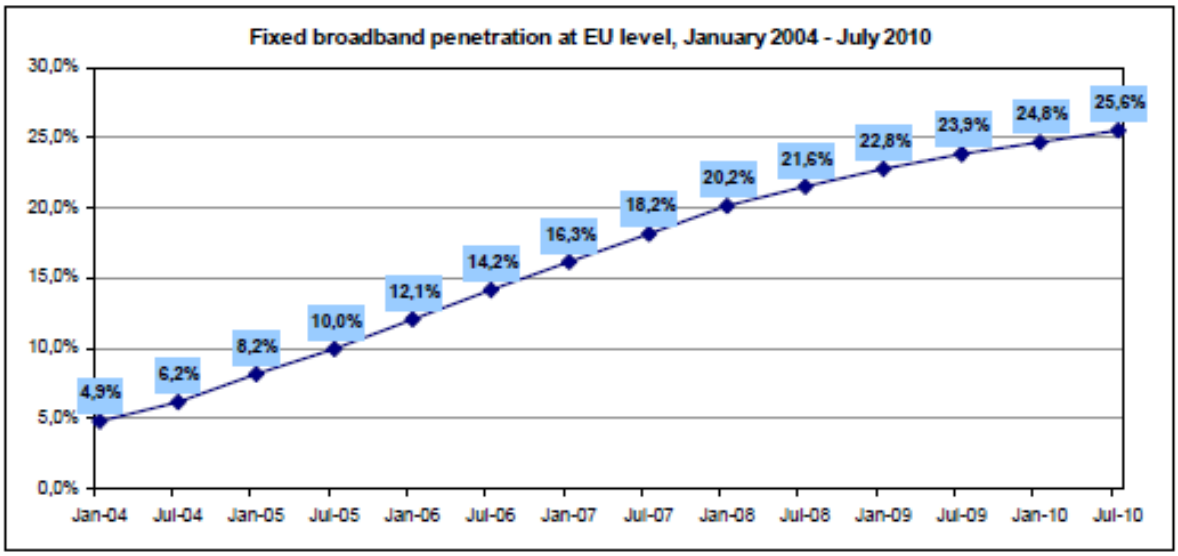
programme has reached 11 industry participants[36]. In addition, a new voluntary initiative by industry has been set up as an implementing measure under the Ecodesign Directive for complex set top boxes. Formal acknowledgement of the European Commission is expected in 2012.

3.6.3. Broadband communication equipment

Broadband penetration continues to grow in the EU. From 18.2% in 2007, 21.7% in 2008, 23.9% in 2009 up to 25.6% in 2010. Only six years earlier, in 2004, the penetration rate was 4.9%[EC2010].

As of mid 2010, the EU-27 registered 128 million fixed broadband lines in comparison to 108 million in 2008, growing by 18.5% during these two years [EC2010].

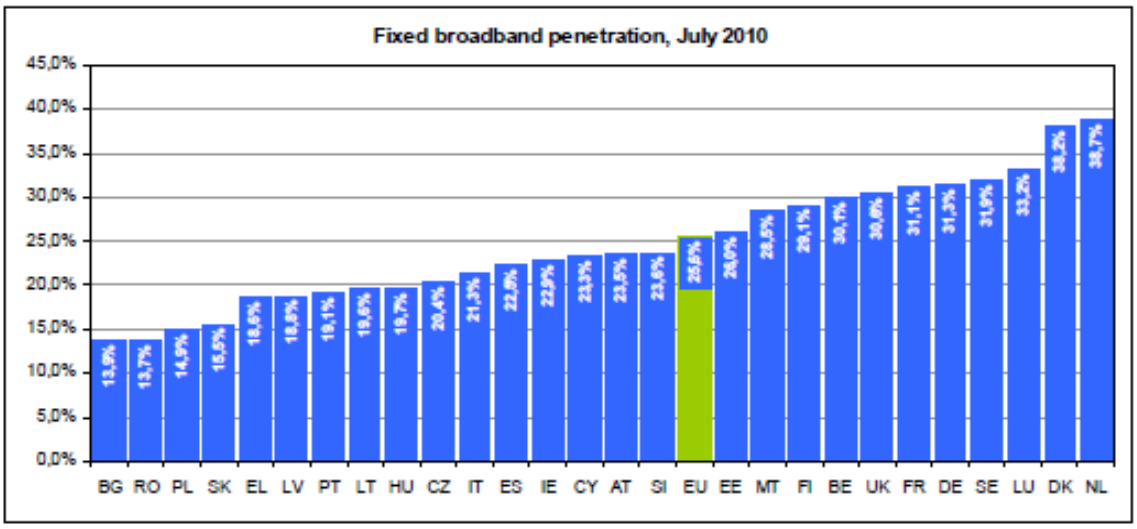
Fig. 63: Fixed broadband penetration at EU level (source EC)



DSL continues to be the main technology in the EU broadband market, although slightly decreasing (from 78.7% in 2009 to 77.9% in July 2010). The share of DSL in the new connections is decreasing slightly. In the first six months of 2010, around 60% of the new added lines were based on PSTN (65% in the same period one year before). Cable lines grew by 4.7% in the first six months of 2010 and now account for 20,040,087 lines (16% of total lines).

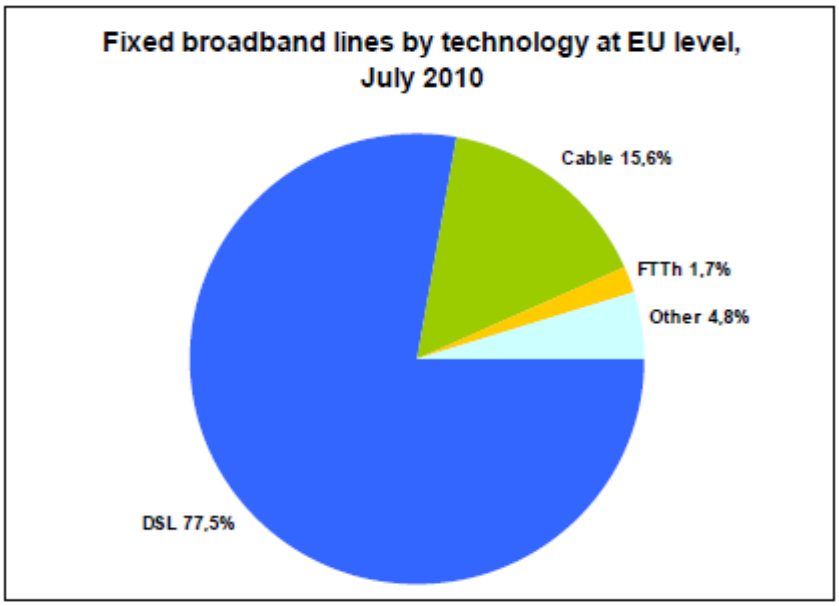
[36] Participants can be found here: http://re.jrc.ec.europa.eu/energyefficiency/html/s_b-Participants-STB-CoC.htm

Fig. 64: Fixed broadband lines by technology at EU level (source EC)



The strongest growth took place in Cyprus (+36% in this period) followed by Ireland (+15%). Cable is mostly present in Malta (46% of total lines), Belgium (44%), Hungary (43%), Portugal (37%) and the Netherlands (35%). FTTH lines grew by 5.6% in the same period in the EU and now account for a total of 2,206,468 lines (1.7% of total lines). The biggest growth took place in Portugal (+154%) and Latvia (+108%) [EC2010].

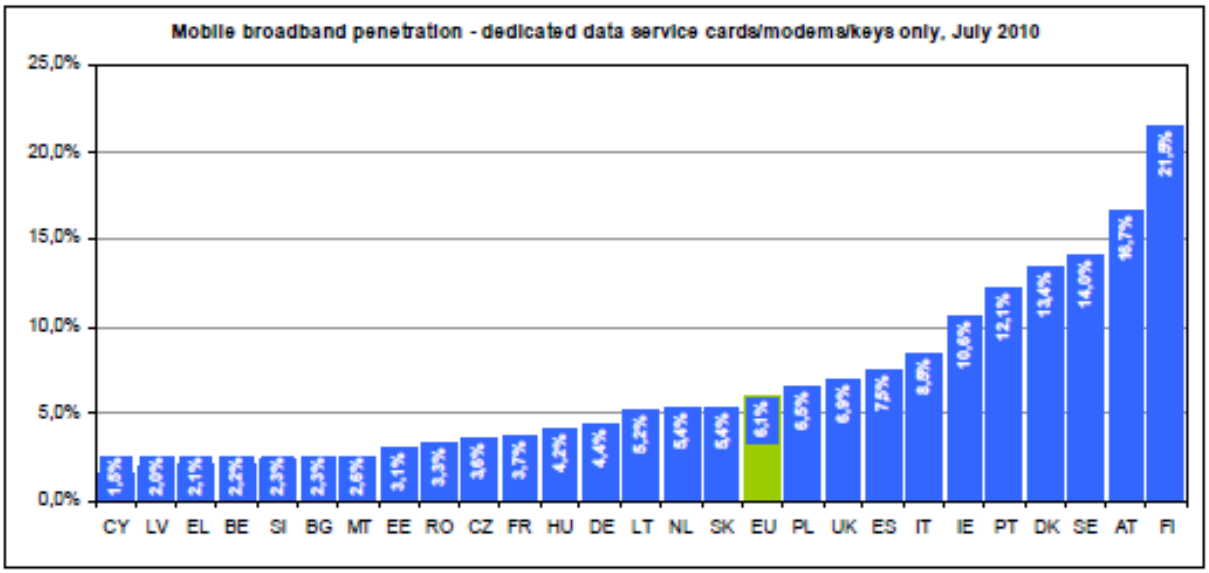
Fig. 65: Fixed broadband lines by technology at EU level, 2010 (source EC)



The highest growth took place again in the mobile broadband market. The penetration of mobile broadband as measured by dedicated data service cards/modems/keys was 6.1% in 2010 (from 5.2% in January 2010 and 4% in July 2009), growing at a slightly slower pace

than in the previous period. Take-up measured by dedicated data cards/modems/keys grew by 30% in the year between July 2009 and July 2010. However, growth in the first half of 2010 was 15% while in the second half of 2009 growth was 23%. Finland tops the league with a 21.5% penetration rate [EC2010].

Fig. 66: Mobile broadband penetration in the EU, 2010 (source EC)



Broadband equipment is becoming an important electricity end-user in the residential sector. It is estimated to consume up to 50 TWh/year by 2015 in the EU-27..

There exists currently no regulation concerning Ecodesign requirements or energy labelling for broadband communication equipment. A horizontal implementing measure under the Eco-design Directive for networked standby[37] is under discussion at the moment. Networked standby contributes significantly to the electricity consumption and is estimated to be 90 TWh per year whereas the potential for cost-effective improvements are of around 40 TWh [NUS2011]. The Networked standby implementing measure will be incorporated into the existing standby regulation 1275/2008 which implies that the horizontal approach will be maintained. The implementing measure addresses household and office equipment as defined in 1275/2008 (professional equipment is not included) and complex TVs [NUS2001]. The Ecodesign requirements address availability of modes, power management, power consumption limits, and information to be provided by the manufacturers. There will be two tiers of power consumption limits:

[37] Examples for networked standby are: Wake on LAN/WLAN, proxying, broadcasting signals, always online etc.

Tab. 21: Power consumption limits under the Ecodesign measure for broadband equipment (source EC)

	January 2014	January 2016
LoNA	4 Watt	2 Watt
HiNA	12 Watt	8 Watt

The power management shall be introduced with the first tier in 2014. Products shall, unless inappropriate for the intended use, offer a mode having network standby. Proposed default operation condition: LoNA[38] (HiNA[39] only if LoNA inappropriate for the intended use). Default delay time: after the shortest possible time appropriate for the intended use (into HiNA) and after 1 hour latest (into LoNA) [NUS2011].

On 10 February 2011 an updated version of the Code of Conduct on Energy Consumption of Broadband Equipment was published[40].The aim of the voluntary programme is to reduce energy consumption of broadband communication equipment without hampering the fast technological developments and the service provided. The programme covers customer premises equipment like home gateways, simple broadband access devices, home network infrastructure devices (e.g. Wi-Fi access points, powerline adapters) and other home network devices (e.g. VoIP telephone). The other product group covered is network equipment like DSL network equipment, wireless broadband network equipment etc.

The Code of Conduct covers the two sides of broadband communication: the customer (end-use equipment) and the network side (network equipment). With the general principles and actions resulting from the implementation of the programme the energy consumption of broadband equipment per year could be cut in half resulting in a consumption of 25TWh per year instead of the 50 TWh projected for the year 2015 [BER2009]. The network site (network equipment) is not part of the residential electricity consumption although it is included in the total energy consumption of broadband equipment as noted above.

[38] Low Network Availability
[39] High Network Availability
[40] http://re.jrc.ec.europa.eu/energyefficiency/pdf/CoC%20Brodband%20Equipment/Code%20of%20Conduct%20Broadband%20Equipment%20V4%20final%2010.2.2011.pdf

The Code of Conduct on Energy Consumption of Broadband Equipment counts 18 participants all over Europe by now.

3.6.4. Personal computers, computer monitors, and imaging equipment

In the last decade, computers have become ubiquitous and their role will continue to be more and more important due to their impacts on productivity, education, society, and personal lives. Consequently, the number of computers and information technologies is continuously growing, Europe is becoming more computerised, and internet access is spreading among households across the European Union.

Fig. 67: Percentage of householdws with computer (source ITU2011)

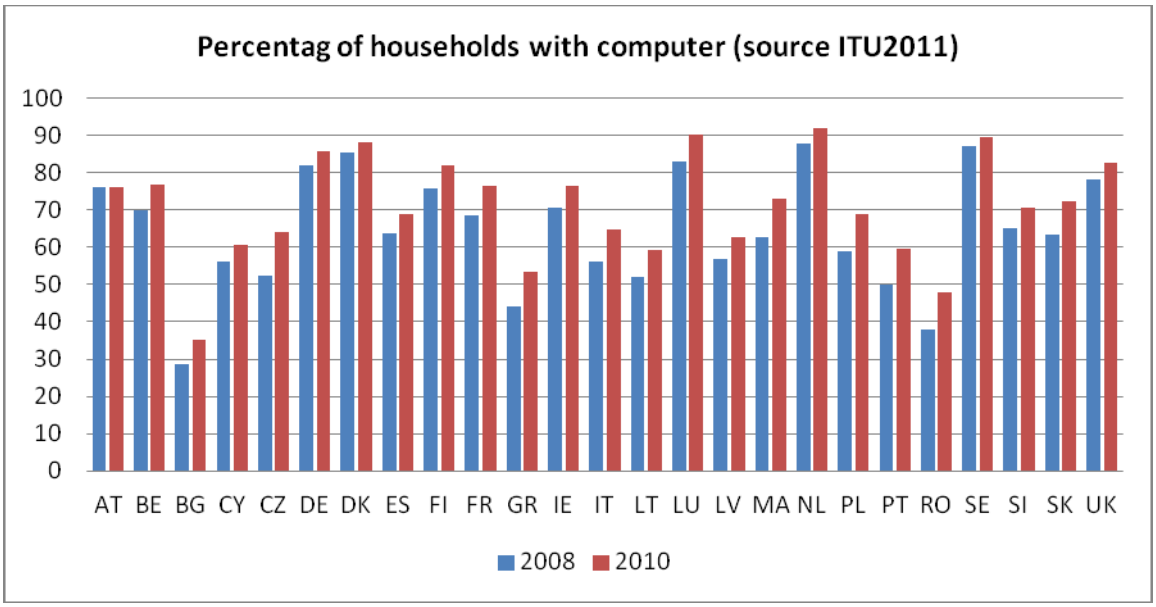
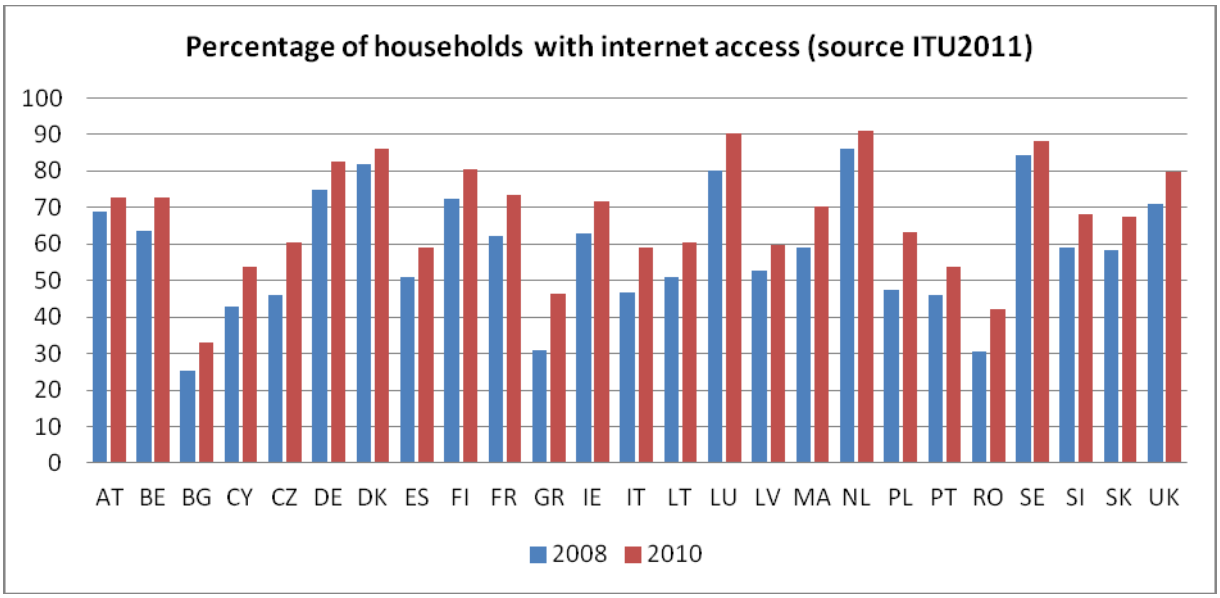
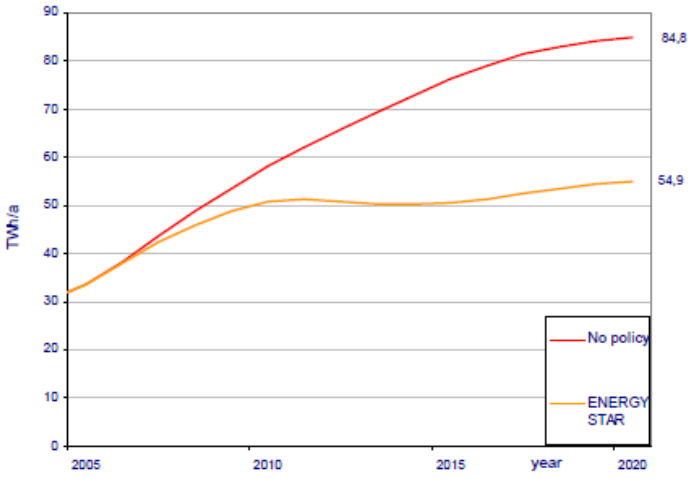


Fig. 68: Percentage of households with internet access (source ITU2011)



From the year 2006 on, the Energy Star Programme has been implemented in the European Union.[41] The ENERGY STAR is a voluntary appliance specific label, identifying to consumers appliances that meet certain standards regarding energy efficiency. The EU ENERGY STAR Programme follows an agreement between the United States of America's Government and the European Union on the co-ordination of voluntary energy labelling of office equipment, approved by the EU Council in April 2003. The number of manufacturers participating in the programme has increased significantly, from 16 companies in 2006 to 74 in 2010. The graph below depicts the impact of the ENERGY STAR Programme for computers and displays:

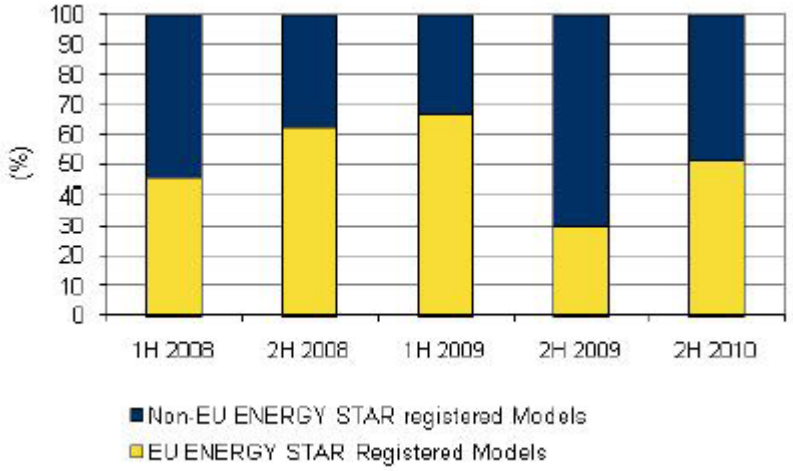
Fig. 69: The success of the energy star programme (source EC)



[41] More information can be found under: http://www.eu-energystar.org/en/index.html

It is estimated that without ENERGY STAR the electricity consumption of new office equipment sold in the EU in the last three years would have been approximately 67 TWh. ENERGY STAR succeeded in reducing this by around 11 TWh, i.e. by approximately 16 %. This translates into more than EUR 1.8 billion saved on energy bills and 3.7 million tons (Mt) of avoided CO2 emissions. It needs to be noted that these numbers represent do not take into account the current impact of earlier (pre-2008) specifications. If also earlier specifications are taken into account it is estimated that ENERGY STAR will succeed by 2020 in reducing the energy consumption of the installed base of computers, displays and imaging equipment in the EU by more than 30%. (Energy Star Programme in the EU 2006 - 2010, EC2011).

Fig. 70: Energy consumption of personal computers under the energy star measures in the EU (source EC)



Personal computers

Eco-design requirements for computers are currently being discussed. In the working document of implementation measures of the Ecodesign Directive for personal computers, the following equipment is covered in the document: Desktop computers, notebook computers, integrated desktop computers, workstations, and thin clients.

The timing for the introduction of requirements was chosen with the aim of taking off the market the least performing products and are based on the forecast of compliance rates with the ENERGY STAR Programme[42] (scenario without an Ecodesign measure) shown below:

[42] The revised Energy Star technical specifications Version 5.0 for computers became effective on 1 July 2009.

Fig. 71: Compliance of planned Ecodesign measures for personal computers with energy star measures (source [COM2011b])

	Tier I ENERGY STAR Computers v4.0	Tier II ENERGY STAR Computers v5.0
Computer Product	Jan-11	Jan-13
All Computers	89%	95%
Notebook All	74%	79%
Notebook Category A	95%	95%
Notebook Category B	66%	76%
Notebook Category C	66%	67%
Desktop All	95%	95%
Desktop Category A	89%	89%
Desktop Category B	95%	95%
Desktop Category C	95%	95%
Desktop Category D	89%	91%

The requirements are planned to be introduced gradually and separately for on-mode, idle state, sleep mode, and off-mode. The first stage of the power consumption requirements to be applicable 6 months after the entry into force of the Regulation is in line with ENERGY STAR Computers v4.0. Second stage requirements to be applicable by 31 January 2013 are in line with ENERGY STAR Computers v5.0. The revised Energy Star technical specifications Version 5.0 for computers became effective on 1 July 2009 [EC2011].

On 9 June 2011, the European Commission published the Commission Decision on establishing the ecological criteria for the award of the EU Ecolabel for personal computers [EC2011d]. Energy efficiency requirements are also set in this decision.

The energy efficiency performance of desktop and integrated desktop computers shall exceed the appropriate energy efficiency requirements set out in the Agreement as amended by Energy Star v5.0 by at least the following:

1. Category A: 40%
2. Category B: 25%
3. Category C: 25%
4. Category D: 30%

The energy efficiency performance of thin clients shall meet at least the energy efficiency requirements for thin clients set out by Energy Star v5.0.

Computer displays

Commission Decision of 26 October 2009 implements energy star requirements for displays (i.e. computer monitors). The regulation concerns displays up to 60 inches of size.

Minimum On Mode power consumption requirements for displays have to be fulfilled. The display must not exceed a maximum power consumption level for Sleep and Off Modes.[43] Displays capable of multiple Sleep Modes (i.e. Sleep and Deep Sleep) must meet Sleep Mode requirements in all sleep modes.

For computer displays, the energy efficiency performance in active mode shall exceed the energy efficiency requirements set out in Energy Star v5.0 by at least 30%. Computer display sleep power must not exceed 1 W, computer displays shall have an energy consumption in on-mode of ≤ 100 W measured when set to maximum brightness, and computer monitor off mode power shall not exceed 0.5 W.

In addition to these, some criteria for power management are set. The power management settings shall be:

1. 10 minutes to screen off (display sleep)
2. 30 minutes to computer sleep (system level S3, suspended to RAM

Concerning internal power supplies, these shall meet at least the energy efficiency requirements for internal power supplies set out by Energy Star v5.0 [EC2011].

Imaging equipment

Imaging equipment covers printers, copiers, faxes, and multifunctional devices.

Until today no Ecodesign requirements exist nor has an energy label been implemented for imaging equipment. A voluntary industry agreement has been introduced. The agreement is based on the Energy Star programme and encompasses the compliance with the Energy Star programme v 1.1. for an increasing percentage of aspects and products put on market. The following targets have been set so far:

Target for Tier I (by January 2011): 60% (BAU compliance was estimated at 50%).

Target for Tier II (by January 2012): 80% of new equipment on the market (compared to an estimated BAU compliance of 60%).

The establishment of further future compliance targets is currently being discussed. A consultation forum has been organized in this respect on October 2012.

[43] Tables with the specific values can be found in the energy start regulation (Commission Decision 2009/789/EC)

3.6.5. External power supplies/ battery chargers

The 2009 stock of the 2 billion units of external power supplies (EPS) implies an estimated 17 TWh/year of electricity consumption in the EU-27 in the use phase[44] [COM2009a]. Sales are estimated at around 611 million units per year. The share of total energy consumption, related to several primary load product categories by EPS is illustrated in figure 73 [BIO2007, BER2009].

The estimates done under the EPS Code of Conduct indicate an electricity consumption of around 14 TWh in 2006 (at business as usual scenario (BaU)). Based on these, the JRC estimates EPS electricity consumption of around 15.5 TWh/year in 2007 [BER2009]. Considering the annual sales of EPS, the increase in efficiency due to Ecodesign requirements and the Code of Conduct the JRC estimates an energy consumption of around 17 TWh in 2009 which is in line with the estimates in the Commission Regulation that are the basis of the Ecodesign requirements.

Commission Regulation (EC) No 278/2009 of 6 April 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council introduces Ecodesign requirements for no-load condition electric power consumption and average active efficiency of EPS. The requirements for external power supplies include most stand-alone AC/AC and AC/DC devices with rated power up to 205 Watts and has been introduced in two stages: from 2010 and from 2011. The requirements from 2011 are harmonised with the EU Code of Conduct for power supplies and the current US Energy Star requirements. In the first stage (from April 2010), the no-load consumption shall not exceed 0.50 W. In the second stage (April 2011), the no load-consumption for a nameplate output power (PO)[45] smaller or equal to 51.0 W shall not exceed 0.50 W for AC/AC EPS except low voltage external power supplies and 0.30 W for a AC/DC EPS and low voltage EPS. For a nameplate output power greater than 51.0 W the no-load consumption of AC/AC and AC/DC EPS shall not exceed 0.50 W [COM2009c].

Before the adoption of the eco-design requirements, the only energy efficiency measure in place for EPS was the European Code of Conduct on Energy Efficiency of External Power Supplies (EU CoC EPS)[46] . The Code was introduced in the year 2000 in order to reduce the no-load losses and for improving the on-mode efficiency. Before the introduction of the of the Code of Conduct, many EPS had no-load power consumption above 1 W, and low efficiency in operational modes, but by 2005 many of the external power supplies in the European

[44] Here electricity consumption means the sum of energy losses due to the conversation of electricity from the main power source (espresse as active efficciency), and of no load consumption. The energy consumption of the primary load product is not considered.

[45] Nameplate output power (PO) means the output power as specified by the manufacturer.

[46] http://re.jrc.ec.europa.eu/energyefficiency/html/standby_initiative.htm

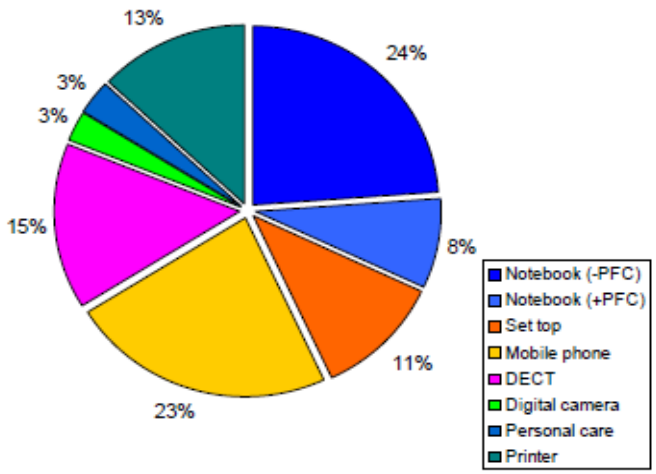
market had no-load losses below 1 W. With actions resulting from this Code of Conduct, the stand-by consumption of EPS and chargers can be reduced by 5 TWh/yr. The operation losses can also be reduced by increasing the power conversion efficiency, resulting in energy savings of the same order of magnitude (1 - 5 TWh) [BER2009].

Version 4 of the Code of Conduct has been in force since April 2009. It sets the current requirements for no-load consumption and the efficiency criteria for active mode.

Fig. 72: EU CoC EPS requirements for no-load consumption and the efficiency criteria for active mode (source EC Code of Conduct)

	Rated output power (Pno)	Entry in force date	No-load power consumption
All EPS, excluding external power supplies up to 8 W for mobile handheld battery driven applications	0.3 ≤ Pno < 50 W	from 1.01.2009	0,30 W
	50 ≤ Pno < 250 W	from 1.01.2009	0,50 W
For external power supplies up to 8 W for mobile handheld battery driven applications	0.3 ≤ Pno ≤ 8 W	from 1.01.2009	0,25 W
	0.3 ≤ Pno ≤ 8 W	from 1.01.2011	0,15 W
	Rated output power (Pno)	**Entry in force date**	**Minimum Four Point Average Efficiency in Active Mode (expressed as a decimal)**
All EPS, excluding external power supplies up to 8 W for mobile handheld battery driven applications	0 < Pno ≤ 1 W	from 1.01.2009	≥ 0,48 * Pno + 0,145
	1 < Pno ≤ 36 W	from 1.01.2009	≥ [0,06 * ln(Pno)] + 0,585
	36 < Pno ≤ 250 W	from 1.01.2009	≥ 0,870
For external power supplies up to 8 W for mobile handheld battery driven applications	0 < Pno ≤ 1 W	from 1.01.2009	≥ 0,50*Pno+0,029
	1 < Pno ≤ 8 W	from 1.01.2009	≥ [0,096*ln(Pno)]+0,529

Fig. 73: Shares of total energy consumption in primary load-product categories powered by the EPS in 2009 (source EC Code of Conduct)



Note: "+PFC"/"-PFC" means with/without power factor correction and "set top" means set top box and modems

3.7. Stand-by and off-mode losses

Standby functions and off-mode losses are a common feature of electrical and electronic household and office equipment (consumer electronics, information and communication technology equipment, personal care products etc.). The users are often not aware of the electricity consumption and costs for stand-by/off-mode (small for a single product) and low power consumption in stand-by/off-mode is not an important purchasing criterion. Taking into consideration that a typical household is in general equipped with dozens of products having stand-by/off-mode, the resulting electricity consumption and the related costs are significant. The technical solutions reducing energy consumption in stand-by/off-mode are frequently not applied , for example due to possible additional costs for the manufacturer, and also because it is not a market access requirement [FRA2007, BER2009].

Until December 2008 there was no regulation across the EU on stand-by/off-mode consumption, apart from some focused Codes of conduct implemented on voluntary basis and the EICTA voluntary agreement on TVs. In December 2008, the EU Commission adopted the Commission Regulation (EC) No 1275/2008 implementing the Ecodesign Directive with regard to requirements for stand-by and off-mode electric power consumption of electric and electronic household and office equipment [COM2008].

The Regulation focuses on an extensive list of equipment with stand-by/off-mode consumption, comprising four big categories of products:

1. household appliances,
2. information technology equipment intended for use in the domestic environment,
3. consumer equipment,

4. toys, leisure and sports equipment.

The regulation stipulates that from 7 January 2010 on, the following conditions must be fulfilled by the above-mentioned products on the EU-27 market:

1. Power consumption of equipment in any off-mode condition shall not exceed 1 W.
2. The power consumption of equipment in any condition providing only a reactivation function, or providing only a reactivation function and a mere indication of enabled reactivation function, shall not exceed 1 W.
3. The power consumption of equipment in any condition providing only information or status display, or providing only a combination of reactivation function and information or status display, shall not exceed 2W.
4. Equipment shall, except this is inappropriate for the intended use, provide off-mode and/or stand-by mode, and/or another condition, which does not exceed the applicable power consumption requirements for off-mode and/or stand-by mode when the equipment is connected to the mains power source.

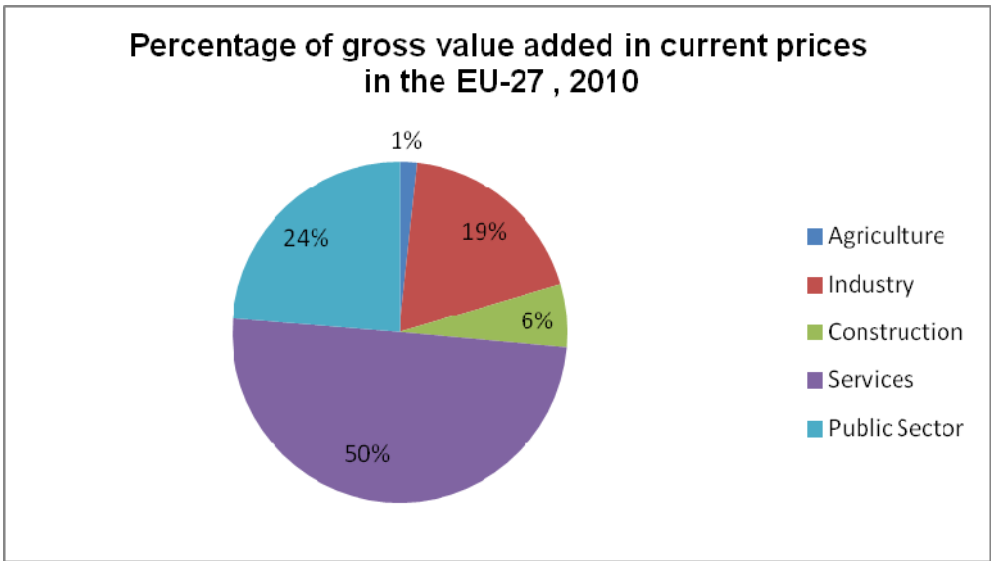
From January 2013 on, the conditions will become more restrictive in the following way:

1. Power consumption of equipment in any off-mode condition shall not exceed 0.5 W.
2. The power consumption of equipment in any condition providing only a reactivation function, or providing only a reactivation function and a mere indication of enabled reactivation function, shall not exceed 0.5 W.
3. The power consumption of equipment in any condition providing only information or status display, or providing only a combination of reactivation function and information or status displays shall not exceed 1 W.
4. Equipment shall, except where this is inappropriate for the intended use, provide off-mode and/or stand-by mode when the equipment is connected to the main power source.
5. When equipment is not providing the main function, or when other energy-using product(s) are not dependent on its functions, equipment shall unless inappropriate for the intended use, offer a power management function, or a similar function, that switches equipment after the shortest possible period of time appropriate for the intended use of the equipment, automatically into:
    a) Stand-by mode, or
    b) off-mode, or
    c) another condition which does not exceed the applicable power consumption requirements for the off-mode and/or stand-by mode when the equipment is connected to the mains power source. The power management function shall be activated before delivery.

4. The tertiary sector

In this report, the tertiary sector refers to the public sector, healthcare, services and commerce[47]. The tertiary sector accounts for a large share of GDP in the European Union. 50% of total value added is generated by the services sector. If the public sector is also included this share rises to 74%. The tertiary sector is also expected to further grow in importance during the next years.

Fig. 74: Gross value added to GDP of the tertiary sector, 2010 (source Eurostat)

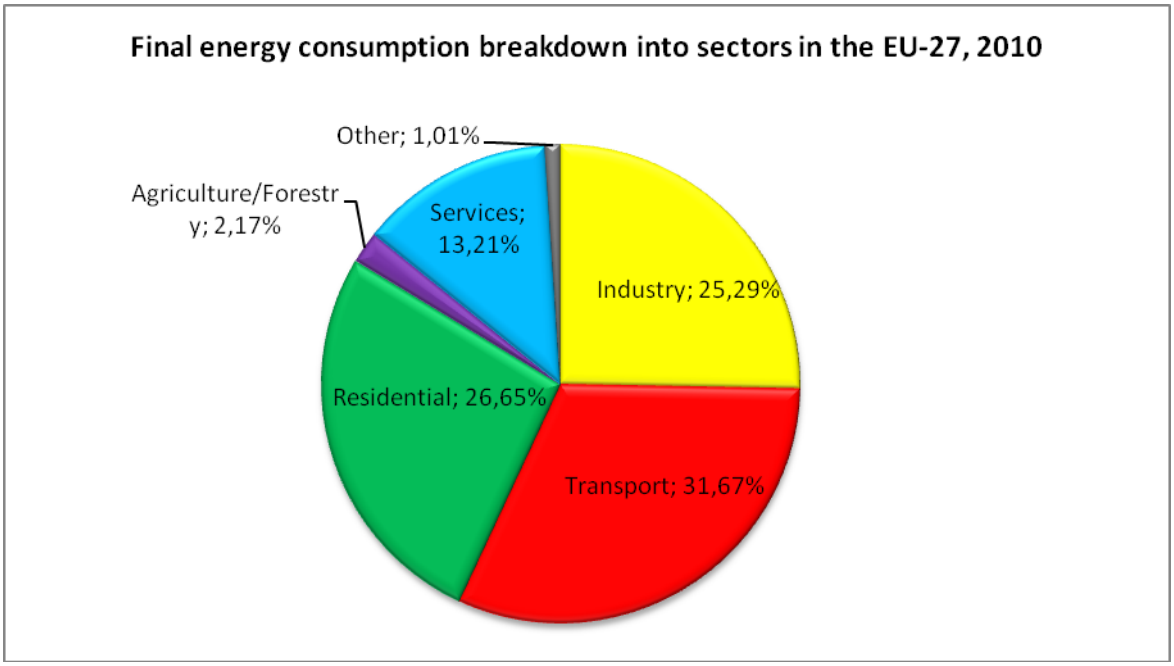


4.1. Energy consumption trends in the tertiary sector

The tertiary sector accounted for 13.21% of total final energy consumption in the year 2010. Considering its share in value added this is relatively low compared to the industry sector, for instance, that consumed 25.29% of total final energy but only contributed with 19% to the total value added in 2010.

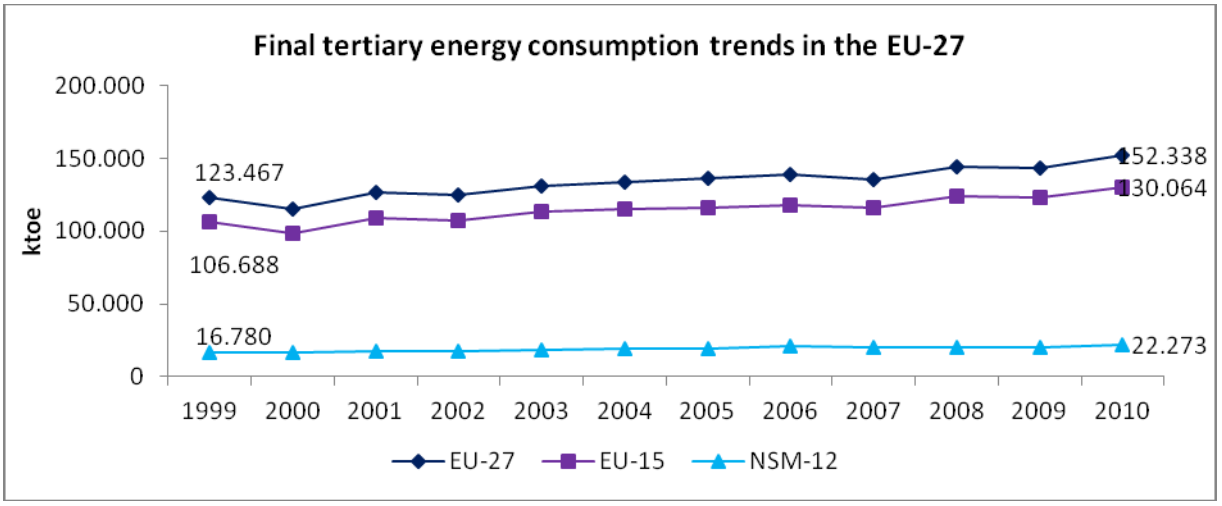
[47] This category is also known as the “commercial sector” and represents non-residential buildings in the services sector.

Fig. 75: Final energy consumption breakdown into sectors in the EU-27 (source Eurostat)



Final energy consumption in the tertiary sector has been growing during the last years. In 1999, total final energy consumption of the services sector in the EU-27 was 123,476 ktoe whereas in 2009 the sector consumed 143,295 ktoe and in 2010 this figure grew to 152,338 There is a large difference in consumption between the EU-15 (130,064 ktoe in 2010) and the NMS-12 (22,273 ktoe in 2010) (see Tab.22).

Fig. 76: Final tertiary energy consumption in the EU-27 (source Eurostaat)



Contrary to total final energy consumption or residential energy consumption there is not yet a decreasing trend in tertiary energy consumption. However between 2008 and 2009, energy consumption in the services sector fell from 144,074 ktoe in 2008 to 143,295 ktoe in 2009.

This decrease is very likely a result of the financial and economic crisis in 2009. GDP per capita increased between 2009 and 2010 and so did final energy consumption in the tertiary sector.

Between 1990 and 2010 total energy consumption in the tertiary sector in the EU-27 grew by 40.42%. Most of this growth took place in the EU-15 where consumption in the tertiary sector increased by 44.28% in this period whereas consumption in the NMS-12 only grew by 21.46%. The picture slightly changes when looking at the growth in consumption in the period 2000 to 2010. During this time, energy consumption in the tertiary sector in the EU-27 grew by 32.38%. In the EU-15 the growth in consumption was 31.79% whereas the growth in the NMS-12 was 35.94%. In the EU-27, the EU-15, and the NMS-12 energy consumption in the tertiary sector reached its highest level in 2010 with 152,338 ktoe, 130,064 ktoe, and 22,273 ktoe respectively.

In the last five years energy consumption in the tertiary sector continued to grow. In the EU-27 the growth rate between 2005 and 2010 was 12.12%, in the EU-15 it was 11.77%, and in the NMS-12 consumption increased by 14.20%.

Tab. 22: Final tertiary energy consumption in the EU-27 (source Eurostat)

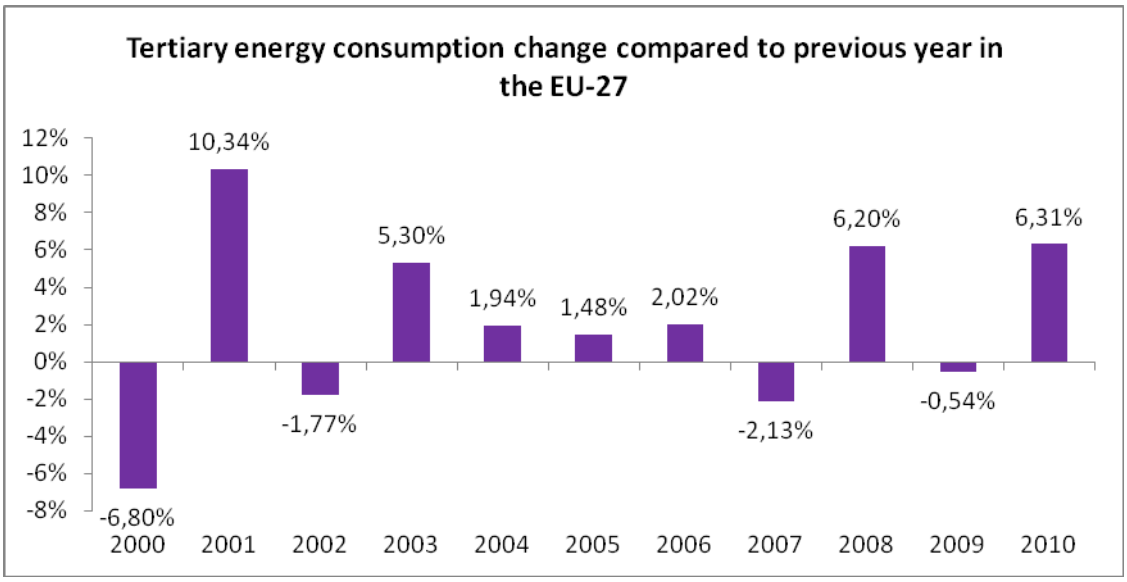
Consumption

			EU-27	EU-15	NMS-12
EU-27	2010	(ktoe)	152,338	130,064	22,273
	2009	(ktoe)	143,295	122,737	20,558
	2008	(ktoe)	144,074	123,786	20,288
	2007	(ktoe)	135,665	115,908	19,755
	2006	(ktoe)	138,615	117,918	20,697
	2005	(ktoe)	135,874	116,372	19,503
	2004	(ktoe)	133,889	114,900	18,989
	2003	(ktoe)	131,337	113,176	18,160
	2002	(ktoe)	124,723	107,552	17,171
	2001	(ktoe)	126,966	109,417	17,551
	2000	(ktoe)	115,073	98,688	16,384
	1999	(ktoe)	123,467	106,688	16,780
	1990	(ktoe)	108,488	90,150	18,338

Growth Rates

			EU-27	EU-15	NMS-12
EU-27	1990-2010	%	40.42%	44.28%	21.46%
	2000-2010	%	32.38%	31.79%	35.94%
	2005-2010	%	12.12%	11.77%	14.20%

Fig. 77: Growth rates (% change compared to previous year) of tertiary energy consumption in the EU-29 (source Eurostat, JRC)

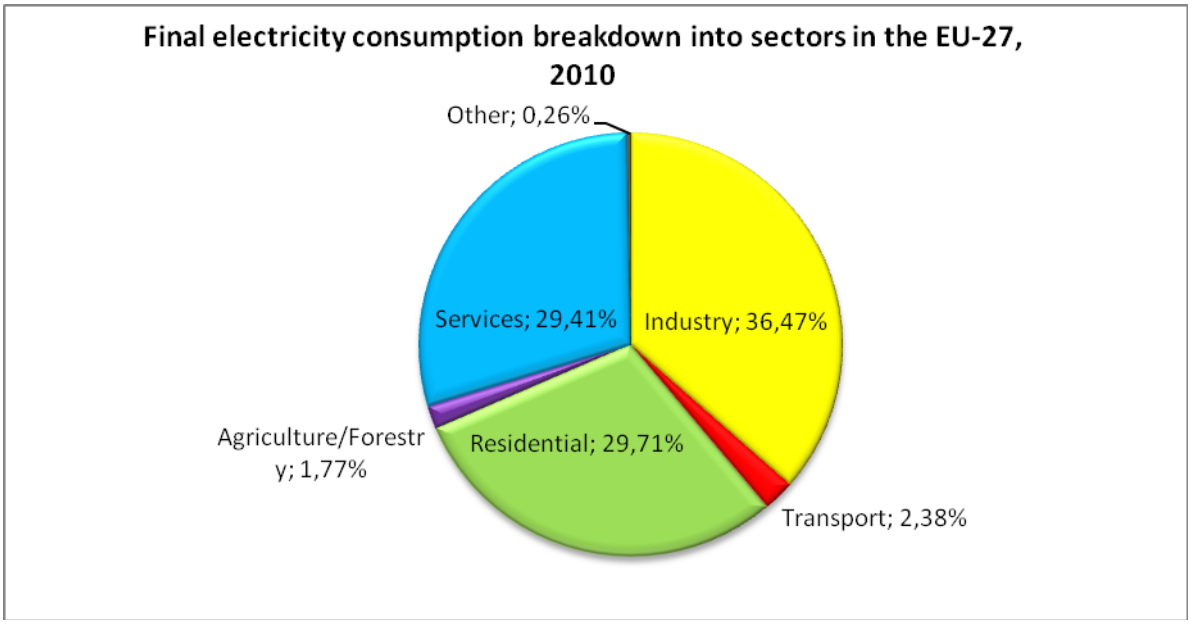


Between 2008 and 2009, final energy consumption in the tertiary sector fell by -0.54%; between 2009 and 2010 it grew by 6.31%. Annual growth rates of the last ten years (2000-2010) do not allow identifying a clear trend for tertiary energy consumption. Between 2003 an 2007 it looked like tertiary energy consumption growth rates were decreasing. The growth rates etween 2007 and 2008 and between 2009 and 2010 are, however, contrary to this trend.

4.2. Electricity consumption trends in the tertiary sector

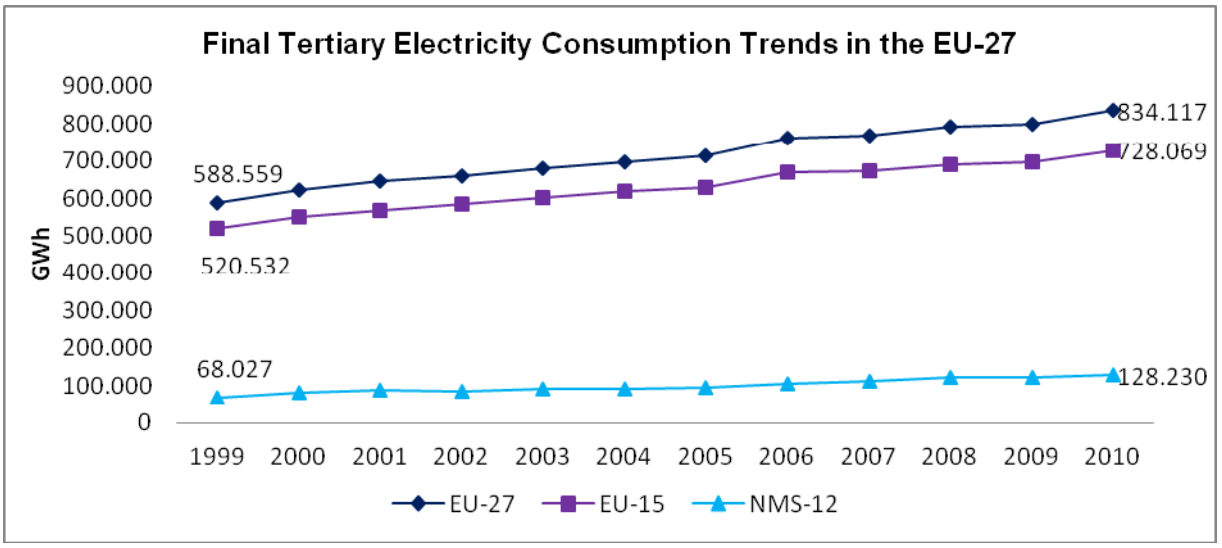
The tertiary sector had a share of 29.41% of total electricity consumption in the EU-27 in the year 2010. It was therefore the third biggest sector in electricity consumption after the industry sector with 36.47% and the residential sector with 29.71%. The share of the residential and the tertiary sectors were almost equal in 2010.

Fig. 78: Final elecricity consumption breakdown into sectors in the EU-27 (source Eurostat)



Electricity consumption in the tertiary sector is continuing to grow. Electricity consumption grew from 588,559 GWh in 1999 to 834,117 GWh in 2010 in the EU-27. In the EU-15 electricity consumption was 520,532 GWh in 1999 and 728,069 GWh in 2010, and in the NMS-12 consumption grew from 68,027 GWh in 1999 to 128,230 GWh in 2010.

Fig. 79: Final tertiary electricity consumption in the EU-27 (source Eurostat)



Between 1990 and 2010 electricity consumption in the tertiary sector has increased by 92.61% in the EU-27. In the NMS-12, the increase in consumption was 142% and in the EU-15 the increase was 58.57%. This increase can be attributed to above average growth rates in 2006 (6.56%) and 2010 (4.62%), Between 2000 and 2010 electricity consumption in the

tertiary sector in the EU-27 increased by 33.89% compared to 31.92% in the EU-15 and 53.88% in the NMS-12. Growth rates were below average in the years 2007 (0.98%) and 2009 (0.82%). The relatively small growth rate in 2007 can be attributed to a large extent to the warm weather in 2007 (and hence less heating) whereas the one in 2009 is likely related with the financial and economic crisis.

Tab. 23: Final tertiary electricity consumption in the EU-27 (source Eurostat)

		EU-27	EU-15	NMS-12
Consumption				
2010	(GWh)	834,117	728,069	128,230
2009	(GWh)	797,281	696,958	121,799
2008	(GWh)	790,805	689,994	121,641
2007	(GWh)	766,755	672,633	112,269
2006	(GWh)	759,341	668,993	107,496
2005	(GWh)	712,593	628,985	96,311
2004	(GWh)	698,000	617,662	92,266
2003	(GWh)	681,154	602,320	90,740
2002	(GWh)	658,364	583,324	86,898
2001	(GWh)	645,350	568,181	89,960
2000	(GWh)	622,980	551,886	83,330
1990	(GWh)	433,049	391,307	49,540

Growth rates		EU-27	EU-15	NMS-12
1990-2010	%	92.61%	86.06%	158.84%
2000-2010	%	33.89%	31.92%	53.88%
2005-2010	%	17.05%	15.75%	33.14%

Tab. 24: Final teritary electricity consumption in the EU-2 Member States in GWh (Source Eurostat)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
EU-27	622,663	645,254	658,364	681,154	698,000	712,593	759,341	766,755	790,805	797,281	834,117
BE	12,236	12,791	11,858	11,906	11,928	12,703	17,148	18,147	20,830	21,476	22,182
BG	5,062	5,144	5,641	5,989	5,768	6,143	6,887	6,993	7,479	7,433	8,101
CZ	11,559	11,849	11,379	12,592	12,213	12,530	12,980	13,253	13,938	13,651	13,988
DK	9,895	10,117	10,183	10,122	10,330	10,400	10,654	10,897	10,898	10,575	10,710
DE	117,945	117,902	127,238	128,218	126,975	123,868	130,302	119,800	118,726	129,827	136,165
EE	1,384	1,489	1,622	1,727	1,850	1,929	2,176	2,358	2,553	2,583	2,534
IE	5,590	5,905	6,748	8,163	8,167	8,465	8,133	8,710	9,556	7,940	9,176
GR	12,260	13,240	13,989	15,005	15,872	16,479	17,757	18,773	19,691	19,769	18,000
ES	50,023	51,266	53,227	57,232	60,671	63,823	76,202	77,430	84,032	85,482	88,047
FR	104,012	106,639	106,398	113,915	117,951	120,826	127,953	130,474	135,078	135,826	145,436
IT	56,595	59,236	62,830	67,426	69,955	73,875	78,057	79,865	82,773	84,300	85,619
CY	1,229	1,432	1,558	1,634	1,681	1,755	1,826	1,952	2,067	2,164	2,263

LV	1,546	1,466	1,727	1,865	1,988	2,142	2,331	2,704	2,628	2,335	2,420
LI	1,872	1,995	2,096	2,375	2,543	2,686	2,836	3,012	3,240	2,955	2,825
LU	1,647	1,968	1,560	1,692	1,581	2,014	1,777	2,126	2,081	1,962	1,956
HU	8,880	8,986	8,723	8,647	9,124	9,931	10,298	10,853	10,827	11,363	11,355
MA	504	546	577	621	624	563	664	663	650	627	626
NL	29,347	30,105	29,347	30,142	31,947	30,611	32,433	35,127	32,747	33,749	34,271
AT	11,586	11,626	11,327	11,672	10,687	10,989	12,657	13,267	13,318	10,469	12,324
PL	27,756	29,129	28,640	29,892	31,019	33,357	36,711	37,189	41,090	40,574	43,263
PT	11,288	12,013	12,363	13,185	13,705	14,407	15,240	15,606	15,775	15,973	16,397
RO	3,908	5,552	2,741	4,749	3,586	4,000	4,900	5,721	6,432	6,526	7,581
SI	2,126	2,327	2,986	2,272	2,589	2,421	2,472	2,580	3,117	3,033	3,087
SK	5,268	7,254	7,350	6,471	7,353	6,151	6,267	6,844	6,790	7,079	8,005
FI	13,277	14,124	14,634	14,657	15,158	15,512	15,923	16,190	16,532	17,238	17,829
SE	25,383	28,033	28,002	27,263	27,557	26,135	27,139	28,457	28,096	26,744	32,747
UK	90,485	93,120	93,620	91,722	95,178	98,878	97,618	97,764	99,861	95,628	97,210

Fig. 80: Growth rates (% change compared to previous year) of tertiary electricity consumption in the EU-27 (source Eurostat, JRC)

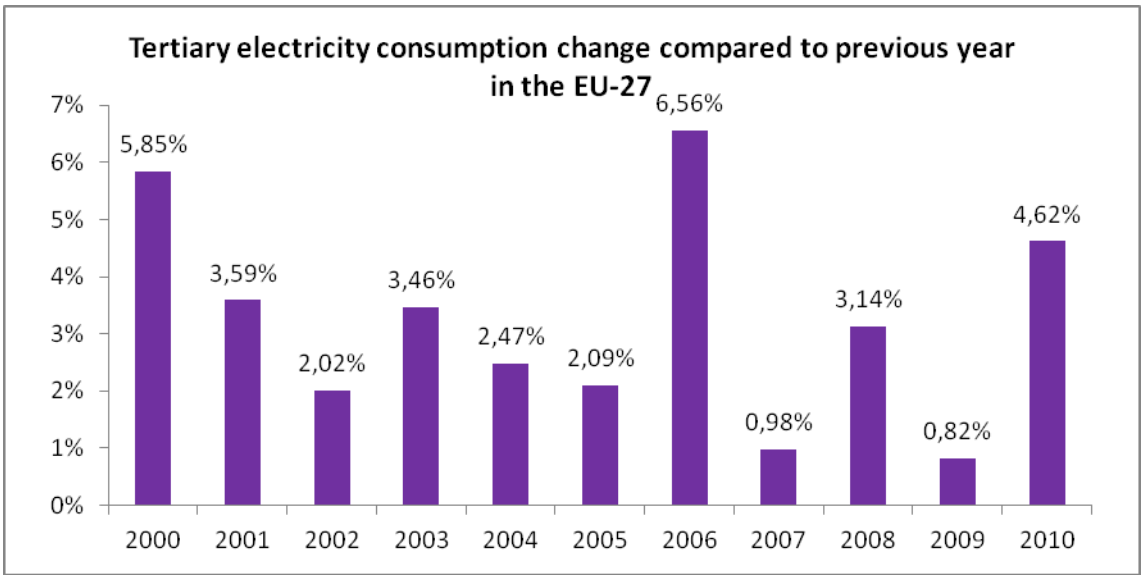
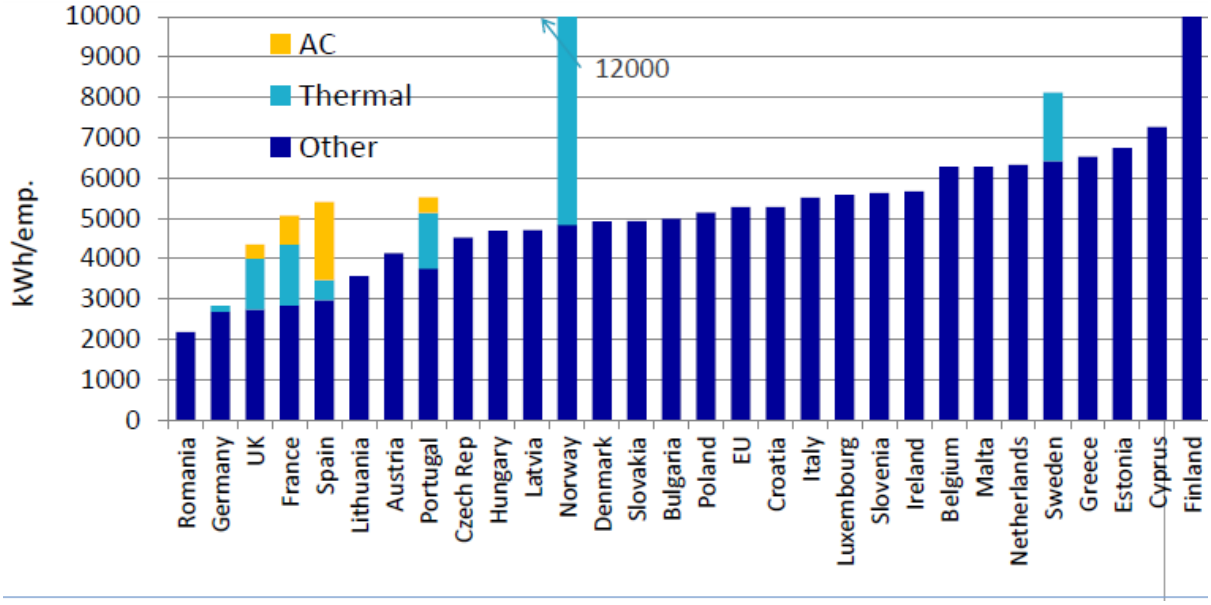


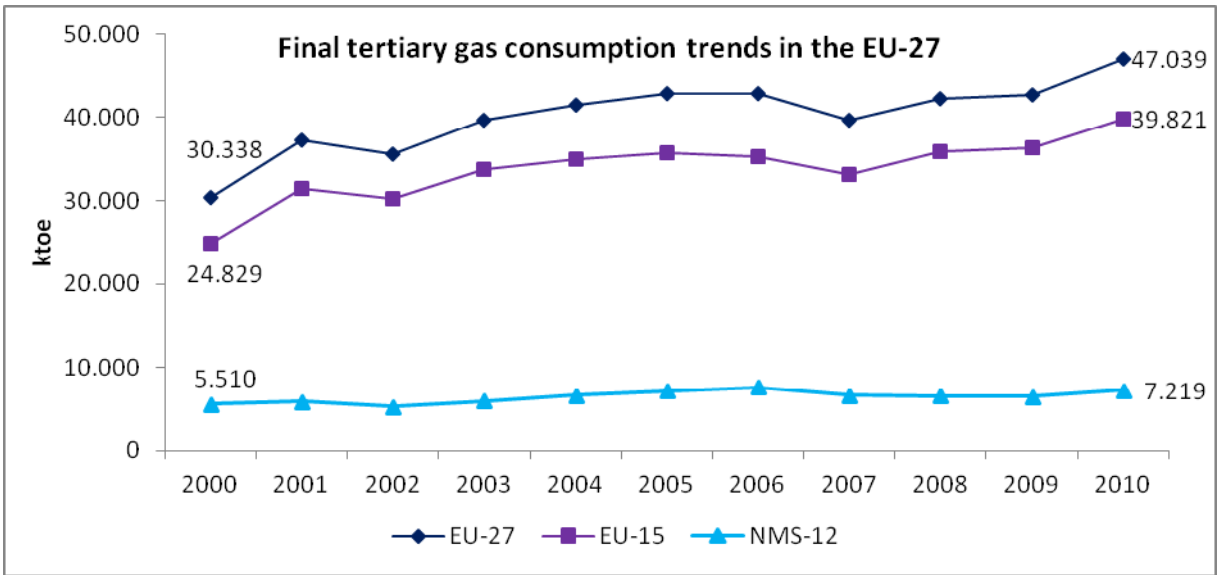
Fig. 81: Electricity consumption per employee in the tertiary sector in the EU-27 (source Enerdata, [LAP2011])



4.3. Gas consumption trends in the tertiary sector

Between 1990 and 2010 final tertiary gas consumption in the EU-27 grew by 71.41%. Between 2000 and 2010 tertiary consumption grew by 60.38%. During the last five years tertiary consumption grew by 9.60% (2005-2010) and only by 1.57% between 2004 and 2009. The high growth rates are to a large extent caused by a high growth in consumption between 2009 and 2010 (9.98%). There is a drop in consumption in the year 2007 which can be explained with warmer temperatures during this year (and hence less heating degree days and less gas consumption). If absolute consumption figures are considered it can be observed that total gas consumption in the EU-27 had a peak in the year 2004 with a total consumption of 285,560 ktoe. In the year 1990 total gas consumption was 229,009 ktoe and twenty years later in 2009 the consumption level was 252,577 ktoe. In the tertiary sector there was a peak in consumption in the year 2005 with a total consumption of 43,062 ktoe and consumption reached its highest point in 2010 with 47,039 ktoe. In 1990 tertiary gas consumption was 26,965 ktoe and the consumption level in 2009 was 42,262 ktoe. Since the year 2005/2006 a decreasing trend in gas consumption has been registered until the year 2007. Then gas consumption increased at least until 2010. The decrease observed can be attributed to a large extent to the success of the building performance policies in the European Union. The Energy Performance of Buildings Directive was adopted in May 2002 (and the recast in 2010) and calls for increased national regulation for energy efficiency in new and renovated buildings. The directive also sets the framework for national requirements for building systems, such as heating systems and larger ventilation systems. In July 2012, the new Directive shall be implemented.

Fig. 82: Final tertiary gas consumption trends in the EU-27 (source Eurostat)



Tab. 25: Tertiary gas consumption trends in the EU-27 (source Eurostat, JRC)

		EU-27	EU-15	NMS-12
Consumption				
2010	(ktoe)	47,039	39,821	7,219
2009	(ktoe)	42,771	36,351	6,421
2008	(ktoe)	42,308	35,808	6,500
2007	(ktoe)	39,693	33,072	6,622
2006	(ktoe)	42,875	35,296	7,579
2005	(ktoe)	42,917	35,786	7,133
2004	(ktoe)	41,596	35,001	6,595
2003	(ktoe)	39,728	33,784	5,943
2002	(ktoe)	35,522	30,291	5,232
2001	(ktoe)	37,195	31,380	5,816
2000	(ktoe)	30,338	24,829	5,510
1990	(ktoe)	26,965	23,231	3,733

Growth rates		EU-27	EU-15	NMS-12
1990-2010	%	74.44%	71.41%	93.38%
2000-2010	%	55.05%	60.38%	31.02%
2005-2010	%	9.60%	11.28%	1.21%

Tab. 26: Final tertiary gas consumption in the EU-27 Member States in ktoe (source Eurostat)

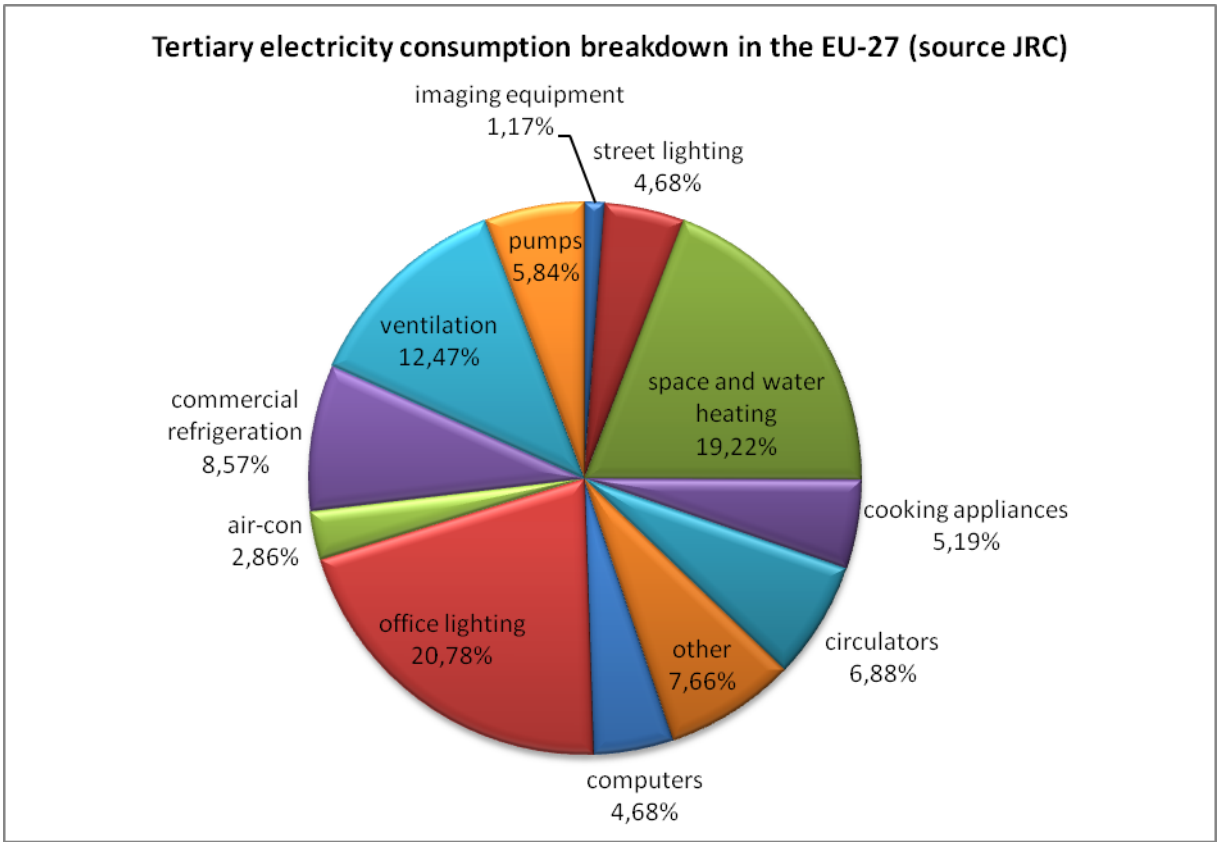
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
EU-27	30,393	37,087	35,504	39,728	41,596	42,917	42,875	39,693	42,308	42,771	47,039
BE	1,545	1,648	1,614	1,668	1,768	1,771	1,690	1,365	1,696	1,723	1,953
BG	12	18	20	28	31	44	65	70	81	66	80
CZ	1,104	1,297	1,206	1,264	1,242	1,274	1,221	1,212	1,329	1,252	1,378
DK	159	161	169	207	207	220	244	228	226	215	271
DE	5,806	6,021	6,021	7,289	7,526	7,311	7,311	6,665	6,665	7,524	8,742
EE	11	22	28	64	59	46	49	44	34	27	30
IE	293	313	291	303	293	314	305	353	383	427	439
GR	9	12	18	28	44	74	90	105	129	145	139
ES	632	739	795	178	320	706	868	784	852	914	1,015
FR	0	4,616	4,120	5,282	5,476	5,579	4,943	5,176	4,765	5,903	6,462
IT	5,572	5,861	5,467	6,230	6,206	7,434	7,563	7,071	8,623	8,610	8,614
CY	0	0	0	0	0	0	0	0	0	0	0
LV	44	48	70	75	90	94	102	114	115	112	116
LI	31	34	38	40	52	51	54	72	69	62	66
LU	170	128	135	172	136	123	149	136	154	150	159
HU	1,773	1,926	1,781	1,890	2,403	2,281	1,965	1,528	1,442	1,572	1,715
NL	3,720	4,352	4,556	4,850	4,827	4,371	4,844	4,347	5,418	4,948	5,674
AT	591	824	749	847	1,011	770	809	698	712	370	622
PL	921	1,194	1,457	1,602	1,662	1,634	1,517	1,565	1,702	1,810	2,031
PT	73	86	110	118	140	136	155	168	180	201	248
RO	235	518	92	462	675	782	1,596	1,081	808	929	936
SI	19	80	91	48	57	26	14	12	12	18	24
SK	1,360	679	449	470	324	901	996	924	908	573	843
FI	27	28	31	30	31	32	30	29	27	26	29
SE	36	34	66	90	90	95	97	99	103	57	26
UK	6,250	6,449	6,131	6,493	6,928	6,850	6,197	5,846	5,875	5,138	5,429

5. Electricity end-use in the tertiary sector

5.1. Electricity consumption breakdown

There is much less reliable data available for individual electricity end-uses in the tertiary sector than in the residential sector, and only a few sources attempted to divide total electricity consumption among different end-uses. The largest electricity consumers in the EU-27 tertiary sector are lighting in buildings (20.78% and 25.46% together with street lighting), electric space and water heating systems (19.22%), ventilation (12.47%) and commercial refrigeration (8.57%).

Fig. 83: Tertiary electricity consumption breakdown in the EU-27 (source JRC)



5.2. Overview of current energy efficiency regulation in the tertiary sector

EU product efficiency policy focuses on two main approaches: 1) labelling and standard product information and 2) minimum energy performance standards (ecodesign requirements). In the last two years two new important directives concerning product energy efficiency have been implemented: Directive 2010/30/EU on labelling *(Directive on the indication by labeling and standard product information of the consumption of energy and other resources by energy-related products*) and Directive 2009/125/EU on Ecodesign ((*directive establishing a framework for the setting of eco-design requirements for energy-related products*). Both directives are new versions of already existing directives (Directive 92/75/EEC for labeling and Directive 2005/32/EU for design of energy-using products.

The Eco-design Directive is a framework directive. This means that the directive does not set specific eco-design requirements for specific products but it sets a general framework for specific requirements. In the Eco-design Directive the conditions and criteria for the eco-design requirements through subsequent implementation measures are defined. The

directive also defines the product categories to which the eco-design requirements will be applied.

Tab. 27 Current situation of eco-design measures in the tertiary sector:

Product group	Eco-Design Measure
Space and Combination Heaters	not implemented yet
Water Heaters	not implemented yet
Circulators in buildings	implemented 07/2009
Commercial Refrigerators and Freezers	not implemented yet
Professional Refrigerators and Freezers	not implemented
Computers and Servers	not implemented yet
Electric motors	implemented 07/2009
External Power Supplies	implemented 04/2009
Imaging equipment	VA implemented 01/2011
Network standby losses	not implemented yet
Office and street lighting	implemented 03/2009
Ovens , hobs and grills	not implemented yet
Simple Set-Top Boxes	implemented 02/2009
Complex Set-Top Boxes	VA implemented 07/2010
Standby and off Mode	implemented 12/2008
Tertiary airconditioning	not implemented yet
Ventilation fans	implemented 03/2011

According to the new labelling directive, from December 2011 onwards new energy efficiency classes on the basis of the Energy Efficiency Index (EEI) are be added (e.g. A+, A++, etc.) and the coverage is extended to non residential equipment.

Apart from product policy, building performance standards have been implemented in the EU in order to promote energy efficiency. The Energy Performance of Building Directive (EPBD) was adopted in May 2002 (and the recast in 2010) and calls for increased national regulation for energy efficiency in new and renovated houses. The directive also sets the framework for national requirements for building systems, such as heating systems and larger ventilation systems. In January 2012, the Delegated Regulation No 244/2012 supplementing the recast EPBD (Directive 2010/31/EU) established a comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements.

5.3. Lighting

According to the Ecodesign preparatory studies [TIC2007] for office and public lighting, the EU-27 office lighting consumption is the biggest share of total electricity consumption in the tertiary sector with 21.57%, representing 164 TWh in 2007. The street outdoor lighting takes

a share of 4.73% of the overall tertiary sector electricity consumption, representing 36 TWh in 2007. These figures are estimated to remain almost constant in 2009 with a trend to decrease in the next years considering the Ecodesign measures, energy labelling and also voluntary programmes.

The preparatory study estimates the market share in 2004 of linear fluorescent lamps (LFLs) at 16% of total lamp sales and CFLs at 6%. The annual increase in 2004 was 4.2% for LFLs and 8.3% for CFLs [BER2009, TIC2007].

Existing data for the domestic sector show an increase in CFLs over the last years. Between 2006 and 2010 an increase of 45% in sales of CFLs in the domestic sector has been estimated[48]. Therefore, it can be assumed that CFL sales are also increasing substantially in the tertiary sector.

In recent years, there has been a new trend to promote more white light sources for outdoor lighting and the Solid State Lamps (SSL or LEDs) became a very promising efficient solution on the market. However, solid state lamps have been rarely used in street lighting because of the high price. With the time, technology is changing and the prices go down. Traffic lights are already using this technology thanks to the high efficacy for coloured light. Apart from the higher energy efficiency, another big advantage of SSL is the long life-time of more than 50,000 hours [BER2009, TIC2007].

White light emitting diode WLED lamps are recently becoming available on the market with increasing efficacy and increasing life-time as a result of decades of semiconductor research and development. In street lighting, amber LEDs, which offer a higher efficacy (e.g. 40 lumen/W) but a lower colour rendering, could be used as well. Applications where efficient coloured light is required benefit nowadays from LEDs too, e.g. traffic and other signs (applications with a lower power density). LEDs also have perfect dimming capabilities far better than HID lamps which could be beneficial for lighting where dimming is required, like in the case of indoor (office and residential) lighting. Several manufacturers are developing white LEDs (WLEDs) lamp luminaries. LEDs cannot tolerate high operational temperatures and are only available in relatively low power compared to the HID lamps (power range starts at 20W). The future application of WLEDs would therefore also influence luminaire design [BER2009].

The electronic ballasts for street lighting offer more power control and dimming and are more efficient than the classic magnetic ballasts. In recent years the ‘multi-watt’ and ‘multi-lamp’

[48] Estimates concerning CFL sales values have been performed in the framework of the 4E Mapping & Benchmanrking Project. For the period 2008-2010 these estimates are based on percentage growth from 2007 of individual product groups. Growth values are average aggregated values from industry and other sources

electronic ballast have become increasingly popular, making distribution and stock management easier.

Looking at office lighting, some examples of advanced office lighting from the GreenLight Programme[49] have reported lighting power densities in the range of 7 to 10 W/m2 for office buildings, and an annual power consumption density of 10-20 kWh/m2.

Commission Regulation No 245/2009 implementing Ecodesign Directive 2005/32/EC introduced Ecodesign requirements for fluorescent lamps without integrated ballast, high intensity discharge lamps, and of ballasts and luminaires. The measure came into force in April 2009 and provides also indicative benchmarks for products intended for use in office lighting and public street lighting. The types of lamps mentioned above are typically used in the tertiary sector for office and/or street lighting. The Ecodesign measures were introduced in two stages, the first phase in 2009 and the second one in 2012. The measure is expected to increase market penetration of technologies with improved energy efficiency leading to estimated energy savings of about 38 TWh in 2010 compared to a business as usual scenario.

- The regulation established minimum efficacy requirements for T5 and T8 lamps.
- T8 halophosphate lamps were banned in 2010; linear T10 and T12 halophosphate lamps are banned from 2012 on[50].
- In the second stage (2012) lamp efficacy requirements for high-intensity discharge lamps have been introduced.
- In a third stage (2017) fluorescent lamps without integrated ballast shall be designed to operate with ballasts of energy efficiency class of at least A2.
- Lamp performance requirements (minimum colour rendering index and minimum lamp lumen maintenance factors) are introduced in three stages.
- Ballast energy performance requirements are introduced also for high intensity discharge lamps.
- Phasing out of high pressure mercury lamps starting with the largest wattages.
- Luminaire energy performance requirements are introduced in three stages

As mentioned in section 3.5 a Commission Regulation implementing eco-design requirements for directional lamps, LED lamps and equipment designed for installation between the mains and the lamps was also adopted by the Regulatory Committee in July

[49] More information on the GreenLight Programme can be found here: http://www.eu-greenlight.org/
[50] There is an exception for special purpose lamps.

2012 [EC2012a]. Moreover a Commission Delegated Regulation introducing a new energy label for electrical lamps and luminaires has been adopted on July 2012 [EC2012]. These regulations affect also lamps and related equipment installed in tertiary sector and have been already described in the report section 3.5 dedicated to lighting in the residential sector.

5.4. Office Equipment and Data Centres

Personal computers, monitors and imaging equipment have been growing substantially during the last years. It is expected that this trend will continue. Based on the Ecodesign studies for personal computers and computer monitors, JRC estimates that in 2007 some 48.5 million desktop computers and 59.3 million laptop computers were installed in non-residential applications. Compared to the year 2005 the number of desktop computers grew by 6% and the number of laptop computers grew by almost 60% in two years time. For the period between 2007 and 2009 similar growth levels can be assumed leading to a stock of desktop computers of over 50 million and over 80 million laptop computers.

According to the same Ecodesign study, the EU-27 computer monitor stock in 2007 was around 13.3 million cathode ray tubes (CRTs) and more than 41 million flat panels. As in the case of television sets, flat panel monitors are growing very fast on the market (doubling the stock in only two years from 2005), replacing the out-dated CRT monitors. For 2009, it can be estimated that the stock in flat panel monitors has increased again significantly and will replace the CRT monitors completely in short time.

Growth in both laptop and flat-panel monitors has contributed to the decrease of the electricity consumption of computing office equipment reaching some 3.4% of the tertiary electricity consumption of around 23 TWh in 2007. For 2009 the share of office equipment in total electricity consumption of the services sector is estimated to have increased to over 4%.

Between 2006 and 2010 the Energy Star programme was implemented in the European Union.[51] As mentioned under section 3.6.4 the ENERGY STAR is a voluntary appliance specific label, identifying to consumers appliances that meet certain standards regarding energy efficiency. The EU ENERGY STAR Programme follows an Agreement between the USA Government and the European Union on the co-ordination of voluntary energy labelling of office equipment, approved by the EU Council in April 2003. The revised Energy Star technical specifications Version 5.0 for computers became effective on 1 July 2009 (EC2011).

Detailed information on the market penetration of the Energy Star Programme and on existing and forthcoming EU regulations related to personal computers, computer displays

[51] More information can be found under: http://www.eu-energystar.org/en/index.html

and imaging equipment have been already reported under section 3.6.4, as these regulations do not make distinctions among same products installed in different sectors.

Code of Conduct

In March 2007 the EU Code of Conduct for Data Centres was initiated. The Code of Conduct is a voluntary scheme within the EU that provides a platform to bring together European data centre owners and operators, data centre equipment and component manufacturers, service providers, and other large procurers of such equipment to discuss and agree on voluntary actions that will improve energy efficiency. The Code of Conduct (CoC), coordinated by the Joint Research Centre (JRC), proposes general principles and practical actions to be followed by all parties involved in data centres operating in the EU to result in more efficient and economic use of energy without jeopardising the reliability and operational continuity of the services provided by data centres.

The EU CoC for Data Centres is addressed to all buildings, facilities and rooms which contain enterprise servers, server communication equipment, cooling and power equipment and provide a form of data service. The CoC covers two main areas of energy consuming equipment in the data centres, IT loads and facilities loads, but considering the data centre as a complete system and being oriented on the optimisation of the IT system and the infrastructure in order to deliver the desired services in the most efficient manner.

The first Code of Conduct on Data Centres Energy Efficiency (Version 1.0) from October 2008 entered into force at the beginning of 2009.

At the end of 2011 about 150 Data Centres were participating in the Code of Conduct. Since energy consumption of data centres is rising rapidly in Europe, the Code of Conduct is a very important initiative in order to slow down this development. In 2007, energy consumption of data centres was at around 56 TWh, this figure is expected to rise to 104 TWh in 2020 [BER2010].

5.5. Commercial and Professional Refrigeration

A first Ecodesign preparatory study addressing commercial refrigeration and focusing on refrigerated display cabinets (both remote and plug-in), beverage coolers, ice-cream freezers, and cold vending machines was published in 2007. In 2011 a second Ecodesign preparatory study ([MUD2011]) was published addressing professional refrigeration equipment namely: service cabinets[52], blast cabinets[53], walk-in cold rooms, process chillers, water dispensers, ice-makers, dessert and beverage machines, minibars, wine storage

[52] Service cabinets include refrigerators, freezers and combined refrigerators-freezers.
[53] Blast cabinets include refrigerators, freezers and refrigerators-freezers.

appliances, and remote condensing units. Commercial refrigeration refers to products intended for display and sale of content, whereas professional refrigeration refers to products intended to store foodstuff and used in professional kitchens, food preparation areas of bars, bakeries, gelateria, institutional catering, etc.

The commercial refrigeration market is very fragmented and produces equipment and components with a multitude of applications. For 2009, the annual sales of commercial refrigeration equipments in the EU are estimated to be around € 6,051 millions. The market for commercial refrigeration equipment in the western EU is mature and saturated, but replacement demand continues to create sales opportunities. Eastern European markets are likely to continue their current dynamic growth [MUD2011].

The consumption of the stock of commercial refrigeration units in 2007 was estimated in the first Ecodesign preparatory study and is shown in the table below [BER2009]:

Tab. 28: Commercial refrigerating unit stock consumption in the EU-27 in 2007 (source [BER2009])

	consumption
Refrigeration unit	[TWh]
Open Chilled Vertical Multi-deck (RCV2)	37,04
Open Frozen Island (RHF4)	5,11
Beverage cooler	16,55
Ice-cream freezer	4,45
Spiral cold vending machine	2,98
Total	65,83

In the second preparatory study related to professional refrigeration, extrapolation from data from the UK and France gave market estimates for the EU-27 since there is no reliable data available for these product groups. For 2008, sales of service cabinets are estimated to be of around 397,444 units, sales for blast cabinets are estimated to be of around 173,655, walk-in cold rooms' sales are estimated to be of around 88,289, sales of packaged and plants industrial process chillers are estimated to be of around 6,918 and remote condenser units' sales are estimated to be of around 573,023 units. It is expected that sales of service cabinets and blast cabinets will continue to grow substantially until 2025, whereas it is expected that sales of remote condensing units will decrease significantly in the same period. For walk-in cold rooms and industrial process chillers only a slight increase in sales until

2025 is expected. About 90% of the sales in almost all product groups of commercial refrigeration are for replacement of existing units [MUD2011].
For 2008, the estimated stock of service cabinets is around 3.26 million units, the stock of blast cabinets is estimated to be of around 1.33 million units, the stock of walk-in cold rooms is estimated to be of around 1.52 million units, industrial process chillers' units were estimated to be of around 80,900, and remote condenser units were estimated to be of around 5.24 millions.
Eco-design requirements have not been implemented yet. Currently regulations for both product groups of commercial and professional refrigeration and freezers are under discussion. For products covered by LOT 12[54], Ecodesign requirements regarding energy consumption were suggested in a draft document by the related working group.

The working group estimates the energy consumption of the commercial refrigeration display appliances to be of around 57 TWh/year in 2008. The Ecodesign preparatory study estimated the total electricity consumption of all products covered under Lot12 at around 65.83 TWh /year in 2006. These figures are expected to rise significantly in the next 10 years without any Ecodesign measures being implemented. According to data from the preparatory study, energy consumption of commercial refrigerating display appliances covered by Lot12 could decline (in a best case scenario) to 55 TWh/yr by 2015 and 47 TWh/yr by 2020 if energy efficiency measures were implemented. This would mean energy savings of up to 26 TWh/yr by 2020 [ECb2011].
In 2005, some 2.9 million units of refrigerating appliances in four PRODCOM categories were produced in EU-25, corresponding to a total production value of €3 330 million. The total stock of commercial display refrigerators in EU-25 within the scope of this regulation is estimated at some 13.1 million units, comprising of 2.2 million remote refrigerated display cabinets, 1.9 million plug-in refrigerated cabinets for supermarkets, 6.3 million beverage coolers and 2.7 million plug-in freezers for sales of frozen products such as ice-creams. According to the preparatory study, EU-25 demand for remote commercial refrigerating display appliances is forecasted to have an annual growth of 2-3%, and the demand for plug-in appliances of 1-2% yearly, while world-wide annual demand is expected to grow at higher than above 5% [ECb2011].
Under discussion are Ecodesign measures for the following product categories: Commercial refrigeration display appliances take many forms: self-contained ("plug in") or with remote condensing units, for chilled or for frozen perishable materials, vertical, semi-vertical or

[54] Lot 12 covers commercial refrigerators and freezers such as commercial plug-in, remote refrigerated display cabinets, refrigerated vending machines, beverage coolers, and plug-in freezers for sales of frozen products.

horizontal appliances, with or without doors. There are currently two options for the implementation of the measures under discussion. Option 1 would mean one single, generic performance requirement set for all designs of commercial refrigeration display appliances. Option 2 would be several sets of requirements according to the use of the commercial refrigeration display appliance [ECb2011].

Also labelling for commercial refrigeration is currently under discussion. The market for commercial display appliances differs from the one for household appliances. Most sales are business-to-business. Also many actual users of such appliances will not own the equipment but lease it or receive it for free in order to sell branded products with it. The need for information by such users may be different than for purchasing customers.[55] However, energy labels are an easy way to communicate, for example, the procurement of a retailer ("We only use A-labelled refrigeration equipment").

5.6. Ventilation, Fans, and Air-conditioning

The market for air-conditioning, ventilation and fans is still growing rapidly. Projected figures show that there should be continuous growth in sales of chillers, with a slow decline in first-time installation sales and an increase in replacement sales during the next years. The installed stock of air conditioning chillers might increase from around 180 GW in 2010 to around 240 GW in 2020 and 270 GW in 2025 [ADN2011]. Because chillers have long lifetimes of more than 20 years for medium and large capacity products, 75% of the 2025 stock should be composed of pre-2020 products. These products will be impacted by future Ecodesign measures. The preparatory study estimates that the electricity consumption of the stock of ENTR Lot 6 air conditioning products was at least 74 TWh in 2010, acknowledging that the electricity consumption related to the heating function of reversible chillers is not included in this figure and should be around 15 TWh [ADN2011].

Air-conditioners

Air-conditioners and chillers have still a large potential for improvement by using the best available technologies, which encompass better individual component like EC motors for fans, larger heat exchangers, better part load control and optimized part load designs. To maximize the potential benefits, the efficiency is to be judged on a seasonal performance standard, which is almost ready for air conditioning products covered by Lot 6.

[55] Up-to-date information for ecodesign measures in the commercial sector can be found under: http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/index_en.htm

Fig. 84: Market share of ENTR Lot 6 Air-conditioning systems by type (shares by cooling capacity) in the EU, 2008 (source Preparatory Study ENTR Lot 6, Task 2 [ADN2011])

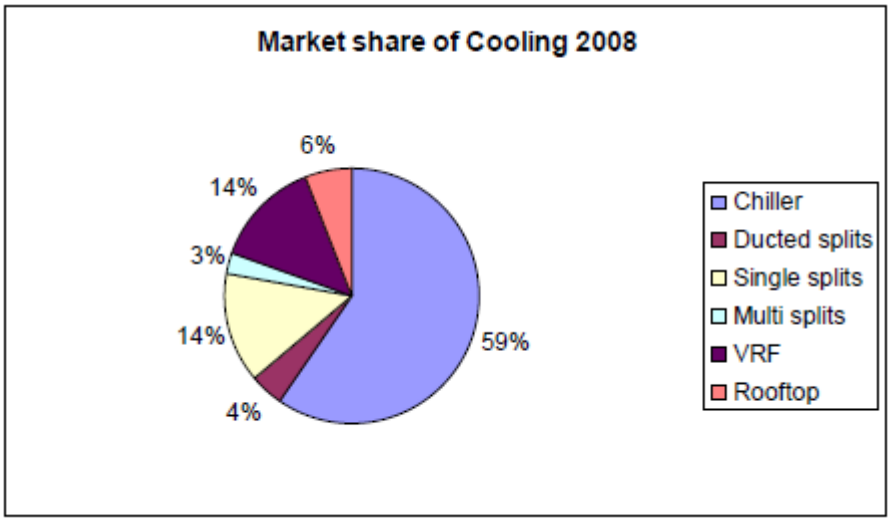


Fig. 85: EU-27 stock trends by cooling capacity in GW (source Preparatory Study ENTR Lot 6, Task 2 [ADN2011])

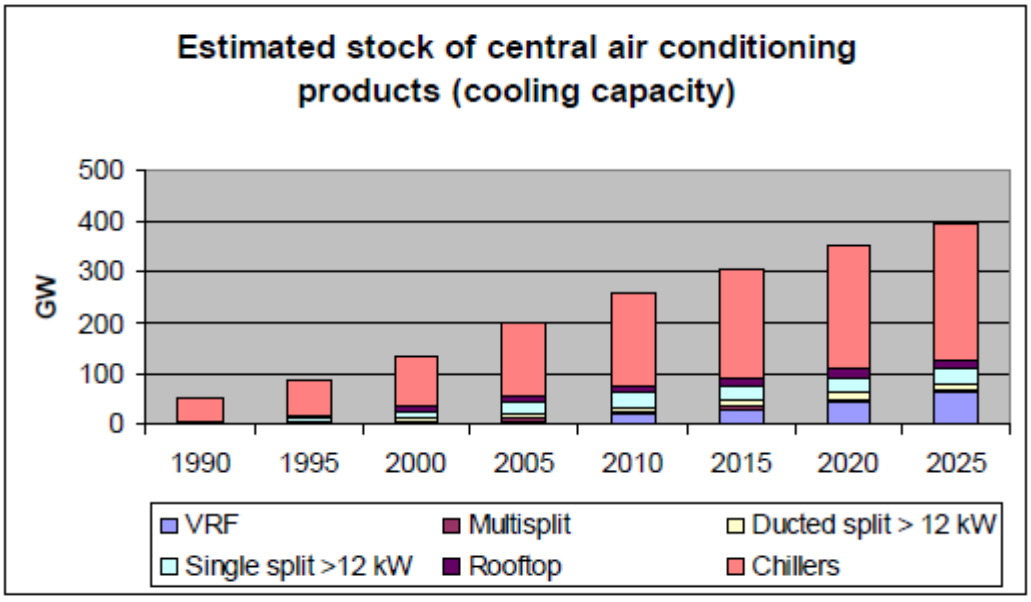
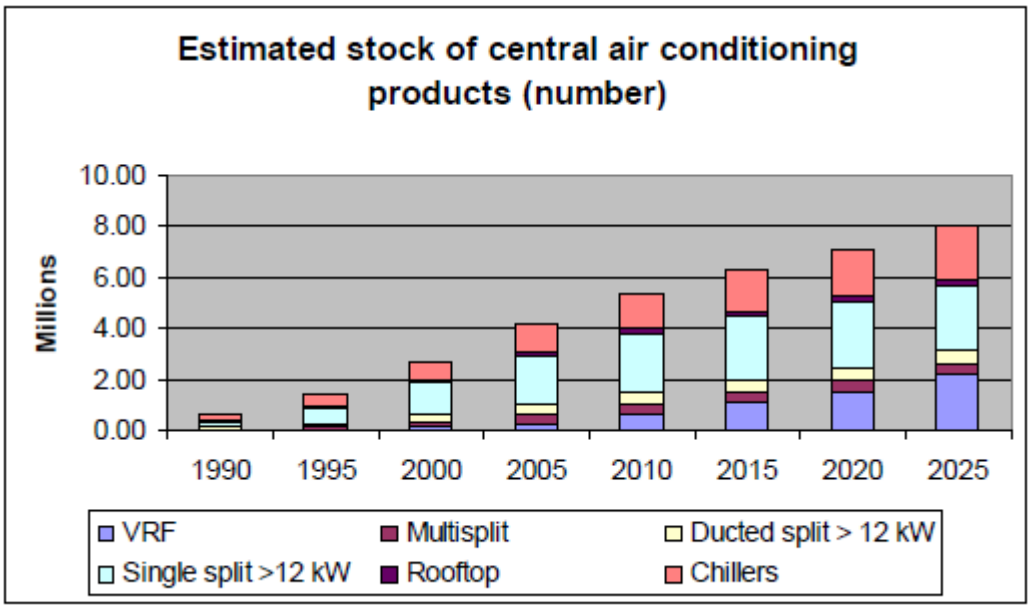


Fig. 86: Estimate stock of central air conditioning units by number (source Preparatory Study ENTR Lot 6, Task 2 [ADN2011])



Fans

Another important share of electricity is consumption by fans for ventilation systems (including fans) which account for about 96 TWh[56] of electricity consumption in 2007 [BER2009, RAD2008]. One important factor driving the energy consumption for ventilation systems is the way in which the space is ventilated. There are four main types of ventilation systems: natural ventilation, fan assisted exhaust ventilation, fan assisted supply ventilation, fan assisted balanced ventilation [BER2009].

Non-residential buildings refer to a broad range of building types, which have many similarities in the technologies used for ventilation, but could differ significantly in the way the building is used. The variety of applications range from concert halls in which fans are used only in the evening for a limited number of hours, to school building which might be in use only in the morning, over to office buildings where ventilation in mainly required during office hours. In addition, there are also workshops in which there is a three-shift production, making it necessary to operate the ventilation systems around the clock. As the ventilation is used to exchange the air and to remove heat, humidity and other contaminants, the required airflow varies typically over the year with higher ventilation rates during summer time [BER2009].

According to the Eco-design preparatory study Lot11 for fans, the energy consumption in use represents the main environmental impact (more than 90%) and efficiency improvements of the fan product are possible with the same or reduced life cycle costs. The cumulative

[56] This number includes domestic and non-domestic consumption by fans for ventilation systems and fans.

savings could be achieved by introducing minimum energy performance standards are estimated to be up to 30 TWh by 2020 [BER2009, RAD2008].

Commission Regulation (EU) 327/2011 of March 2011 implementing the Ecodesign Directive 2009/125/EC introduced eco-design requirements for fans driven by motors with an electric input power between 125W and 500 kW. The regulation estimates the total electricity consumption of fans falling under the regulation to be 344 TWh per year. It is expected that this figure will rise to 560 TWh in 2020 without Ecodesign measures. The cost-efficient improvement potential through design is about 34 TWh per year in 2020.

The regulation introduces minimum energy efficiency requirements in two phases (2013 and 2015) as well as a product information label.

Ecodesign requirements on ventilation products above 30W (Lot 6 and Lot 10) are currently under discussion and will be proposed to the Consultation Forum by the Commission at the end of 2012 after the completion of the preparatory study Lot 6. The regulation would include domestic and non-domestic ventilation products, i.e. exhaust fans, rooftop/boxed ventilation units, heat recovery ventilation and air handling units and range hoods. If appropriate, one single Ecodesign regulation, covering ventilation products, including individual fans (Lot 6, Lot 10 and Lot 11) will be proposed to the Consultation Forum at the event of the revision of Regulation 327/2011 in early 2015 [EC2011c].

The impacts considered for the regulation measure would include the electricity consumption of the unit and the effect on space heating (with and/or without heat recovery), including the impact of controls. Furthermore, apart from energy use and related emissions, maximum noise (sound power) requirements would be foreseen as part of the Ecodesign measures [EC2011c].

5.7. Elevators and lifts

It is expected that the number of lifts and escalators will continue to rise worldwide and in the EU in the next years. This trend can be attributed to a large extend to the growing need for convenience taking into account demographic trends [ALM2011]. At the moment, there are about 4.8 million lifts as well as about 75,000 escalators an moving walks installed in the EU-27; their energy consumption adds up to 3 to 5% of the overall energy consumption of a building [ALM2011]. About one third of the final energy consumption in the European Union occurs in the tertiary and residential sector, mostly in buildings. Until now, energy efficiency has not been a major market driver in this sector [ALM2011]. The E-4 project is targeted at the improvement of the energy performance of lifts and escalators in tertiary sector buildings and in multi-family residential buildings. In the framework of the project a market survey was

conducted as well as a monitoring campaign and a technological assessment of energy efficiency potentials in the lifts and elevators mark in the European Union.

Fig. 87: Lift distribution by sector in Europe (source E4-Project [ALM2011])

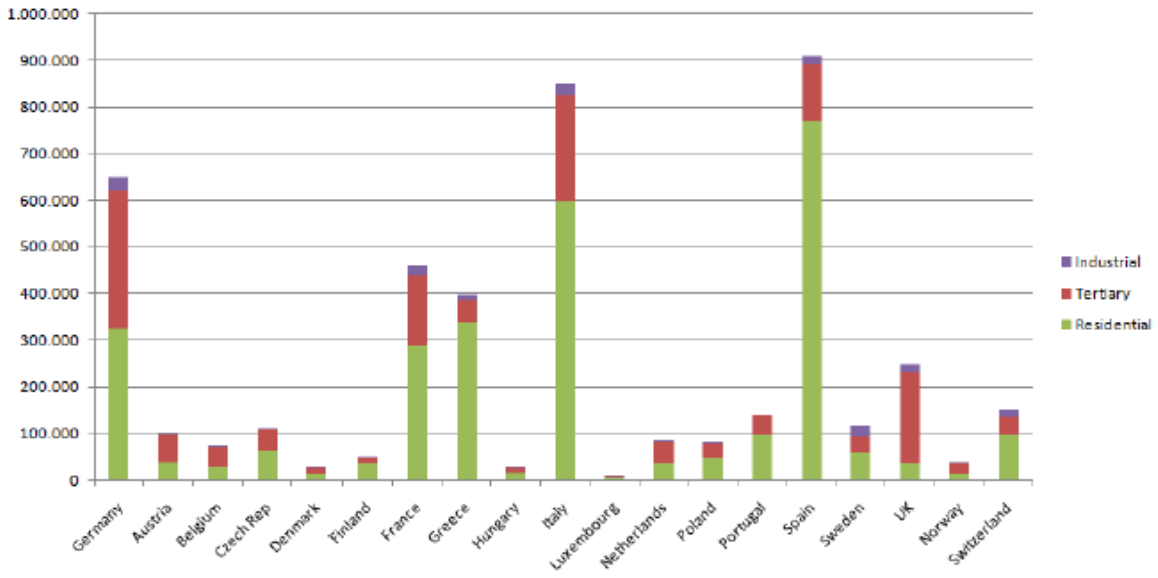


Fig. 88: Lift distribution according to building type in the EU (source E4-Project [ALM2011])

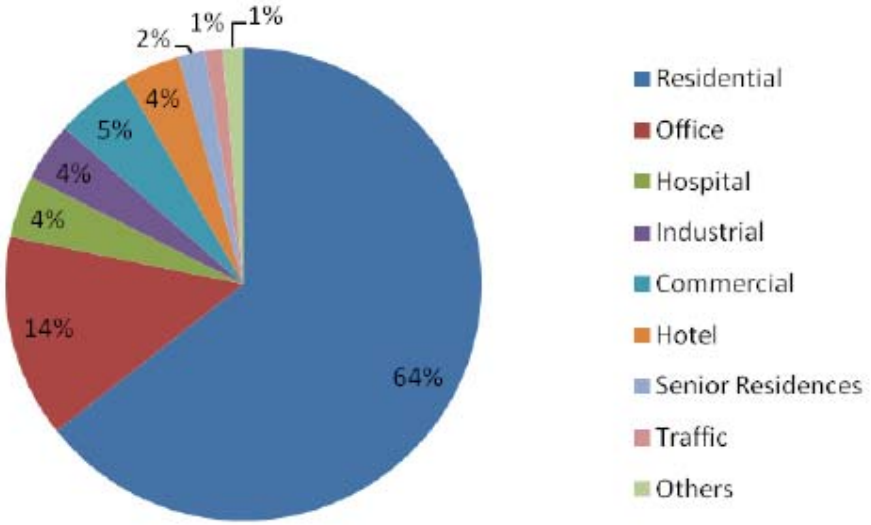
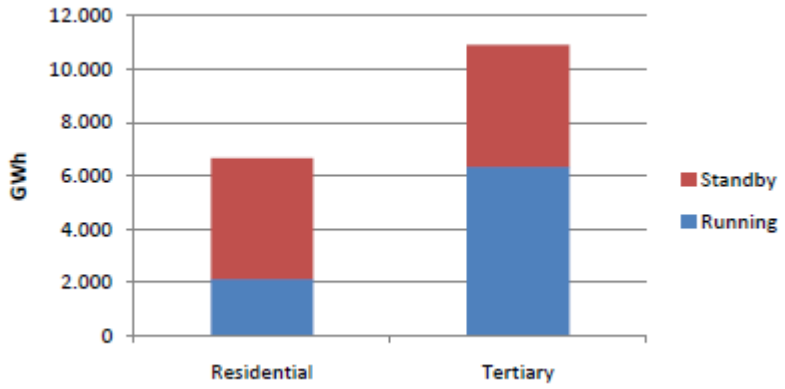


Fig. 89: Number of lifts installed in the EU-27 (source E4-Project [ALM2011])

	Hydraulic	Geared Traction	Gearless Traction	Total
Residential	743.979	2.254.112	100.330	3.098.421
Tertiary	333.248	946.208	270.344	1.549.801
Industrial	49.312	126.397	227	175.936
Total	**1.126.539**	**3.326.718**	**370.901**	**4.824.157**

The E4-Project estimates the total electricity consumption by lifts to be 18.4 TWh of which 6.7 TWh are in the residential sector, 10.9 TWh in the tertiary sector and only 810 GWh in the industrial sector [ALM2011]. Standby energy consumption represents and important share of the overall energy consumption, especially of lifts installed in the residential sector, there the time spent in standby mode is longer than in other sectors [ALM2011].

Fig. 90: Annual electricity consumption of lifts in the EU-27 (source E4-Project)



The results of the estimations done by the E4-Project show that overall savings of more than 65% in the electricity consumption of lifts are possible [ALM20111]. A reduction of over 11 TWh can be achieved using the Best Technologies Available and another reduction of 13 TWh can be achieved if technologies that are currently being developed were used [ALM2011]. Savings in the standby energy consumption are particularly noticeable even in the BAT scenario. In this scenario low power equipment is used but it is assumed that the equipment is always on standby even when not in use as it is the common practice at the moment. A reduction in standby power of over 70% is considered feasible with off-the-shelf technologies (in particular the use of LED lighting can play a major role here) [ALM2011].

Fig. 91: Estimation of total electricity consumption of lifts according to different scenarios (source E4-Project)

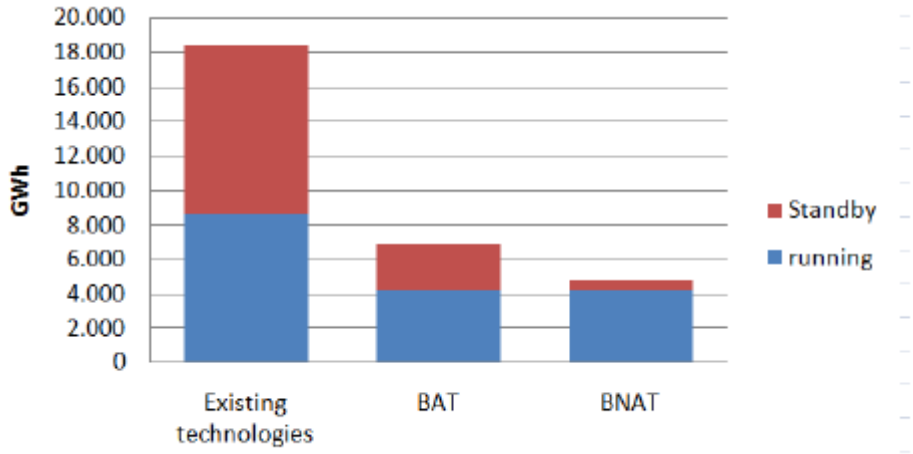
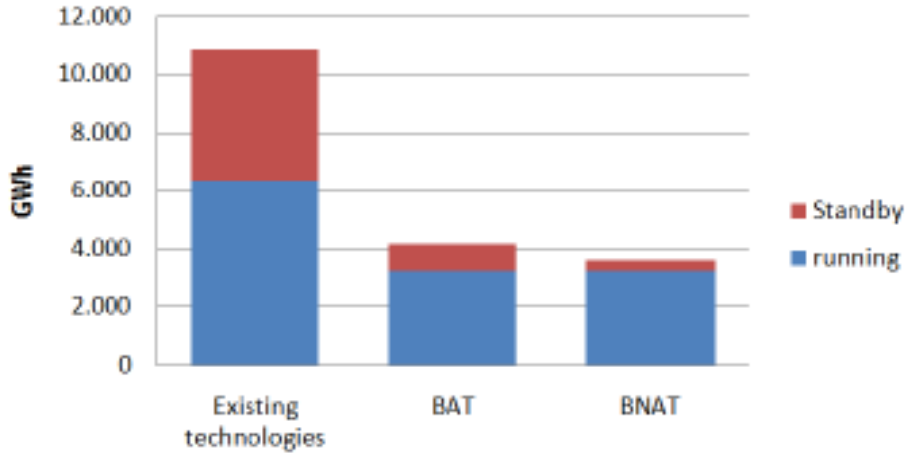


Fig. 92: Estimation of electricity consumption of lifts in the tertiary sector according to different scenarios (source E4-Project)



6. Conclusion

Residential sector

In the last years, residential energy consumption in the EU has started to decrease. The decreasing trend continued until the year 2010 when consumption grew again. 2005 marked a peak in final residential energy consumption reaching the second highest consumption level after the year 2010. Looking at the consumption statistics, it can be observed that between 2004 and 2009 final energy consumption in the EU-27 in the residential sector fell by 2%, reaching the lowest consumption level of the last 20 years in 2007. However, this important decrease (-4% compared to 2006) in 2007 can be explained with warmer temperatures during this year that led to a lower number of heating degree days compared to the average heating days.

Total final energy consumption in the EU-27 fell by -3.29% between 2005 and 2010. The total final energy consumption level of 2009 is almost equal to the consumption ten years earlier in 1999 (0.10% bigger than in 1999). Since 1990 total final energy consumption in the EU-27 grew by only 3.25%. Up to the year 2005 consumption was growing and reached 1,192,536 ktoe in 2005. From then on consumption started to decrease. Between 2008 and 2009 total final energy consumption decreased by -5.2%, but between 2009 and 2010 consumption increased by 3.56%.

Residential electricity consumption is still rising, between 2005 and 2010 the growth rate was 1.69%. Although many appliances are getting more efficient, the number of appliances is rising, appliances are used more often and for longer periods of time, and many appliances are having more functions or special features that require more energy.

Between 1990 and 2010 final residential electricity consumption grew by 31.92%. In the year 2010 the consumption level of electricity by households in the EU-27 reached with 842,663 GWh its highest point since 20 years. In 1990 residential electricity consumption was 603,692 GWh, in 1999 it was 708,167 and in 2004 it was 786,625 GWh.

The general trend in the residential sector is therefore an increase in electricity consumption. There are, however, important differences between different household electricity end-uses. The electricity consumption of residential lighting is, for instance, decreasing. This decrease is to a large extent the result of the phasing-out of less energy efficient incandescent light bulbs. JRC estimates the lighting electricity consumption in the residential sector to be 10.5% of total electricity consumption in 2007. In 2009, the share is estimated to have decreased to 10%.

Energy efficiency policies in the white appliances sector turned out to be very successful. The success is due to a combination of EU legislation (energy labeling and minimum energy performance standards, national programmes (e.g. tax deduction in Italy, scrapping bonus for cold appliances in Austria, price rebate schemes in Spain, supplier obligations and White Certificate scheme in France, Italy and the UK) as well as the voluntary agreements of manufacturers (CECED). Within the framework of the Ecodesign Directive preparatory studies for cold appliances, washing machines and dishwashers have led to the implementation of eco-design regulations; for ovens, hobs and grills working groups started in June 2009.

In the period between January and February 2011, 15% of washing machines were already better than energy class A (A+, A++ and A+++), whereas for dishwashers this share was already 10%. For cooling and freezer appliances these shares were 51% and 56% respectively.

The air-conditioning market in the EU has seen a positive transformation into a more efficient one with the introduction of the energy label. The recent introduction of ecodesign requirements will enhance this trend even further. A recent gfK market survey shows that between January 2010 and December 2010 55.7% (55.1% in 2009) of all fixed air-conditioner units sold were A class appliances. In Western Europe this trend was even more profound with 77.3% in the same period and 70.2% in 2009.

The market for television is growing and changing rapidly. The most important trends are: bigger screen sizes, flat panel displays, digital television broadcasting and high-resolution television (HD). Television sales have been increasing substantially during the last years. Gfk data shows that in the EU-15 a total of 34.7 million TV units were sold in the year 2006. In 2010 the sales were already 51.4 million units. In 2006 flat screens already made more than 50% of total sales in the EU-15. Only a few years later, in 2010, this share was 100%.

In 2007, estimated electricity consumption was around 54 TWh. Despite an increase in energy efficiency total consumption of television sets has been increasing over the last years. Between 2007 and 2009 the increase in consumption is estimated at around 2-3% reaching 56 TWh in 2009.

Information and Communication Technologies (ICTs) are among the fastest growing electricity end-use in the residential and tertiary sector. In 2008 the digital technology world market reached € 2,000 billion and is currently growing at around 4% per year. Europe's digital technology sector in Europe represents 30% of the world total. The size of the digital technology sector in Europe represents 4.5.% of EU aggregate GDP and even more if value added of digital technologies in other sectors is also accounted for.

In the last decade, computers have become ubiquitous and their role will continue to be more and more important due to their impacts on productivity, education, society, and personal lives. Consequently, the number of computers and information technologies is continuously growing, Europe is becoming more computerised, and internet access is spreading among households across the European Union.

It is estimated that without the ENERGY STAR Programme the electricity consumption of new office equipment sold in the EU in the last three years would have been approx. 67 TWh. ENERGY STAR succeeded in reducing this by around 11 TWh, i.e. by approx. 16 %. This translates into more than EUR 1.8 bn saved on energy bills and 3.7 Mt of avoided CO2 emissions. It needs to be noted that these numbers represent a 'snapshot', i.e. they do not take into account the current impact of earlier (pre-2008) specifications and do not give information about the future impact of current specifications. If earlier specifications are taken into account, it is estimated that ENERGY STAR will succeed by 2020 in reducing the energy consumption of the installed base of computers, displays and imaging equipment in the EU by more than 30%.

Eco-design requirements for computers are currently being finalized. In the working document of implementation measures of the Eco-design Directive for personal computers, the following equipments are covered: desktop computers, notebook computers, integrated desktop computers, workstations, and thin clients.

Tertiary sector

The tertiary sector accounts for 13.21% of total final energy consumption in 2010. Considering its share in value added this is relatively low compared to the industry sector, which consumed 25.29% of total final energy but only contributed with 19% to the total value added in the same year.

Final energy consumption in the tertiary sector has been growing during the last years. In 199, total final energy consumption of the services sector in the EU-27 was 123,476 ktoe whereas in 2009 the sector consumed 143,295 ktoe and in 2010 the consumption level rose up to 152,338 ktoe. There is a large difference in consumption between the EU-15 (130,064 ktoe in 2010) and the NMS-12 (22,273 ktoe in 2010).

Electricity consumption in the tertiary sector is also continuing to grow. Electricity consumption grew from 588,559 GWh in 1991 to 797,281 GWh in 2009, and 834,117 GWh in 2010 in the EU-27. In the EU-15 electricity consumption was 520,532 GWh in 1991, 696,958 GWh in 2009, and 728,069 GWh in 2010. In the NMS-12 consumption grew from 68,027 GWh in 1991 to 121,799 GWh in 2009, and 128,230 GWh in 2010.

Between 1991 and 2009 electricity consumption in the tertiary sector has increased by 66% in the EU-27. In the NMS-12, the increase in consumption was 142% and in the EU-15 the

increase was 58.57%. Between 2000 and 2010 electricity consumption in the tertiary sector in the EU-27 increased by 33.88% compared to 31.92% in the EU-15 and 53.88% in the NMS-12. Between 2005 and 2010 the growth levels were 17.05% in the EU-27, 15.75% in the EU-15, and 33.14% in the NMS-12.
According to the Ecodesign preparatory studies for office and public lighting, the EU-27 office lighting consumption is the biggest share of total consumption in the tertiary sector with 21.57%, representing 164 TWh in 2007. The street outdoor lighting takes a share of 4.73% of the overall tertiary sector electricity consumption, representing 36 TWh in 2007. These figures are estimated to remain almost constant in 2009 with a trend to decrease in the next years considering the Ecodesign measures, energy labelling and also voluntary programmes.

A first Ecodesign preparatory study addressing commercial refrigerator and focusing on refrigerated display cabinets (both remote and plug-in), beverage coolers, ice-cream freezers, and cold vending machines was published in 2007. In 2011 a second Ecodesign preparatory study addressing professional refrigerators was published and covered: service cabinets[57], blast cabinets[58], walk-in cold rooms, process chillers, water dispensers, ice-makers, dessert and beverage machines, minibars, wine storage appliances, and remote condensing units.

The commercial refrigeration market is very fragmented and produces equipment and components with a multitude of applications. For 2009, the annual sales of commercial refrigeration equipments in the EU are estimated to be around € 6,051 million. The market for commercial refrigeration equipment in the western EU is mature and saturated, but replacement demand continues to create sales opportunities. Eastern European markets are likely to continue their current dynamic growth.

Energy savings resulting in Ecodesign measures are estimated at around 376 TWh in total. The largest savings in the household sector will be realized with domestic lighting and televisions. The largest savings in the tertiary sector will be realized with street lighting & office lighting. Office equipment is not yet included in this list but will bring on substantial savings in both the domestic and the tertiary sectors.

[57] Service cabinets include refrigerators, freezers and combined refrigerators-freezers.
[58] Blast cabinets include refrigerators, freezers and refrigerators-freezers.

Tab. 29: Estimated savings of the Ecodesign measures (source EC)

Ecodesign Measure	Adoption	Estimated savings
Stand-by	December 2008	35 TWh
Simple set top boxes	February 2009	9 TWh
Street&Office Lighting	March 2009	38 TWh
Domestic Lighting	March 2009	39 TWh
External power supplies	April 2009	9 TWh
Electric motors	July 2009	135 TWh
Circulators	July 2009	23 TWh
Domestic refrigeration	July 2009	8 TWh
Televisions	July 2009	43 TWh
Domestic dishwashers	November 2010	2 TWh
Domestic washing machines	November 2010	1,5 TWh
Fans	March 2011	34 TWh
Total		376 TWh

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Abstract: This report presents the status of energy consumption in the residential and tertiary sectors in the EU-27 with a special focus on the consumption of main electrical household appliances and equipment.
The report highlights the energy efficiency progress of end-use electricity consuming equipment, with special focus on the EU-27 residential sector. The report summarises the most recent policy actions introduced at EU level for end-use equipment and also outlines some of the important national policies regarding energy efficiency and energy consumption.

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