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Preparatory Studies for Eco-design Requirements of EuPs**

**Lot 19: Domestic lighting  
Part 1 - Non-Directional Light Sources  
Draft final task reports  
Task 2: Economic and Market Analysis**

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## 0 PREFACE

VITO and its partners are performing the preparatory study for the eco-design directive for Energy Using Products (EuP) related to domestic lighting, on behalf of the European Commission (more info [http://ec.europa.eu/enterprise/eco\\_design/index\\_en.htm](http://ec.europa.eu/enterprise/eco_design/index_en.htm)).

The environmental impacts of Energy-using Products such as those used in domestic lighting take various forms, including: energy consumption and the related negative contribution to climate change, consumption of materials and natural resources, waste generation and release of hazardous substances. Eco-design, which means the integration of environmental considerations at the design phase, is arguably the best way to improve the environmental performance of products.

The creation of a coherent framework for environmental product policy avoids the adoption of uncoordinated measures that could lead to an overall negative result; for example eliminating a toxic substance from a product, such as mercury from lamps, might lead to increased energy consumption, which could in total have a negative impact on the environment. A Community framework also ensures that divergent national or regional measures, which could hinder the free movement of products and reduce the competitiveness of businesses, are not taken. It is not the intention to decrease the quality of domestic lighting.

You can follow the progress of our study and find general information related to lot 19 on the project website when you register as stakeholder: <http://www.eup4light.net>  
Please, also consult the website for timing and organisation of the tasks.



# 1 PRODUCT DEFINITION

For more info see website [www.eup4light.net](http://www.eup4light.net).





## 2 ECONOMIC AND MARKET ANALYSIS

The aims of the economic and market analysis are:

- to place the product group “domestic lighting” within the total of EU industry and trade policy (see 2.1),
- to provide market and cost inputs for the assessment of EU-27 environmental impact of the product group (see 2.2),
- to provide insight in the latest market trends so as to indicate the place of possible eco-design measures in the context of the market-structures and ongoing trends in product design (see 2.3), and
- to provide a practical data set of prices and rates to be used in the Life Cycle Cost calculation (LCC) (see 2.4).

### 2.1 Generic economic data

#### 2.1.1 Definition of 'Generic economic data' and data sourcing

“Generic economic data” gives an overview of production and trade data as reported in the official EU statistics. It places domestic lighting products within the total of EU industry and trade and also enables to check whether the product complies with the eligibility criterion of Art. 15., par. 2, sub a, of the EuP Directive:

*“the EuP [to be covered by an implementing measure] shall represent a significant volume of sales and trade, indicatively more than 200,000 units a year within the Community according to more recently available figures.”*

To investigate the volume of sales and trade of a product group, it makes sense to rely on Eurostat’s product-specific statistics. For trade and production figures, these are the so-called Europroms<sup>1</sup>-Prodcom statistics.

Although the aim is to take into account the specific attributes of the Member States’ national lighting markets, much of the analysis could only be performed at the level of the EU total lighting market or regions of EU, as data were only available for few years and only in an aggregated form. The comparisons of imports, exports, production and apparent consumption<sup>2</sup> give an impression of the relative scales within the total lighting market but for numerous

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<sup>1</sup> Europroms is the name given to published Prodcom data. It differs from Prodcom in that it combines production data from Prodcom with import and export data from the Foreign Trade database.

<sup>2</sup> “Apparent consumption” is the estimation of the yearly consumption for each product based on the amount produced plus the amount imported minus the amount exported. This is the rationale for combining Prodcom and Foreign Trade data in Europroms (Eurostat Data Shop Handbook, part 6.4.2 Europroms-Prodcom data, version 29/08/2003).

reasons<sup>3</sup> the comparisons must be considered only as approximations. The required data for all lamps (in both physical volume and in money units) is expressed by:

$$\text{Apparent EU-27 consumption} = \text{Production} + \text{Imports} - \text{Exports}$$

## 2.1.2 Generic economic data on lamp sales

At present, the main relevant domestic lamp types<sup>4</sup> are: GLS lamps, halogen lamps, linear fluorescent and compact fluorescent lamps. New lamp types like LED (Light Emitting Diode) and metalhalide are relevant as new technologies. Table 2.1 shows the relevant lamp categories in Eurostat.

*Table 2.1: Domestic Lighting categories in Eurostat*

PRODCOM Code	DESCRIPTION
3150 1293	Halogen lamps : HL-MV, HL-R-MV
3150 1295	Halogen lamps : HL-LV, HL-R-LV
3150 1300	GLS lamps : GLS-F, GLS-C, GLS-R
3150 1493	GLS lamps : GLS-C-HW
3150 1510	Linear fluorescent lamps: LFL
3150 1530	Compact fluorescent lamps: CFLi + CFL-R-I and nearly not domestic used CFLni + CFL-R-ni

The market data in physical volume and monetary units was retrieved for these product categories from the Eurostat<sup>5</sup> for EU-27 trade<sup>6</sup> and production for the years 2003-2007. Results including the calculated apparent consumption are presented in Figure 2.1 and Figure 2.2.

Figure 2.1 shows that for EU-27:

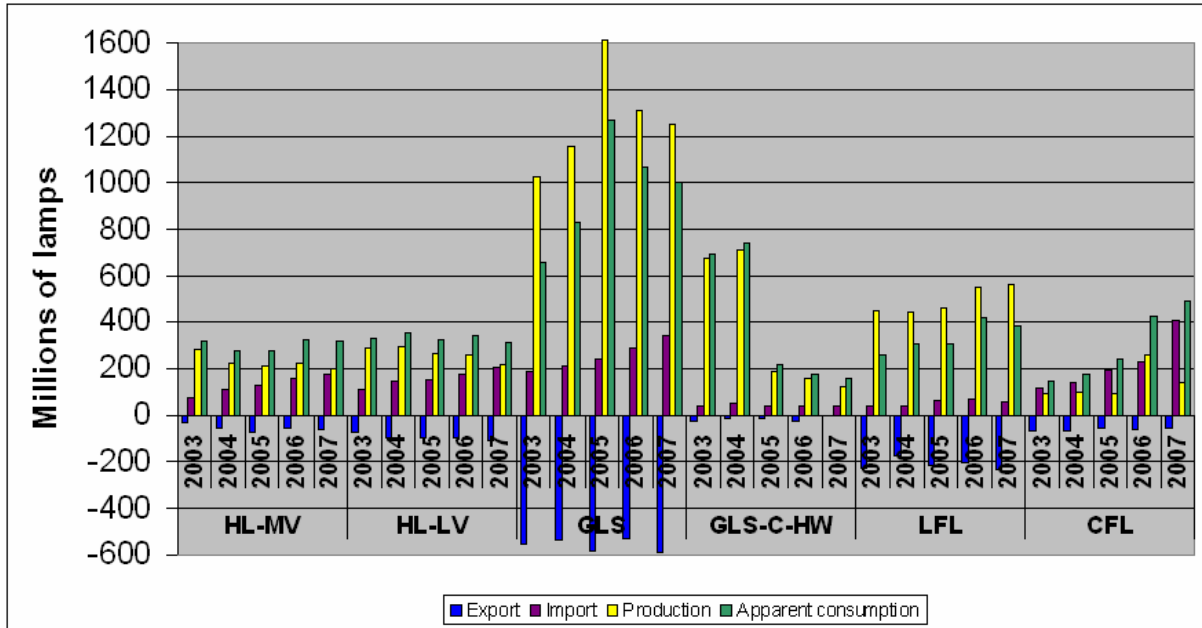
- In the last two years, the apparent consumption of GLS lamps has decreased with 21% from 1271 million in 2005 to around 1001 million in 2007.
- Apparent consumption of GLS-C-HW has over the last three years decreased from 214 to 158 million (the high numbers in 2003 and 2004 seem to be wrong as they don't match with information received from the manufacturers).
- Apparent consumption of HL-MV and HL-LV was both around 300 million/year. A substantial part of these lamps are sold in the commercial sector. Table 2.3 shows a large increase in ELC sales from 2004-2006 with respectively 14% for HL-LV and 18% for HL-MV. Several countries report their domestic stock of HL has considerably increased during the last years, e.g. Denmark where the halogen part of the stock increased from 15% in 2000 to 29% in 2006. For 2006, the contribution of halogen lamps has increased to 31% of the stock in Germany and 24% for EU-27 (see table 2.11). Eurostat data do not seem to include all halogen sales maybe because sales of 6- and 8-packs are counted as 1 lamp and lamp sales along with luminaires are missing.

<sup>3</sup> The general advantages, flaws and limitations of these official EU statistics are extensively discussed in i) the MEEUP Methodology Report and ii) the Eurostat data shop Handbook (part 6.4.2.) Europroms-Prodcom data, version 29/08/2003.

<sup>4</sup> See in chapter 1 for an overview of lamp types, names and codes.

<sup>5</sup> <http://epp.eurostat.ec.europa.eu> (Theme "Industry, trade and services", last consulted 06/08/2008)

<sup>6</sup> In this study the interest is trade leaving and entering the EU27 - Eurostat also includes data per EU country.



Production of GLS in 2007 is an estimated value as the statistical value is not available now

Figure 2.1: Volume of production, trade and sales of lamps for EU-27

- Apparent consumption of LFL has increased from 250 to 400 million. Most of these lamps are used in the commercial sector.
- There has been a 340% increase in the apparent consumption of CFL (CFLi+CFLni) from 145 million in 2003, 177 million in 2004, 241 million in 2005, a dramatic increase to 426 million in 2006 and finally 493 million in 2007 – or even 628 million which seems to be the apparent consumption in the Eurostat update taking place in October 2008. A considerable part of these lamps are CFLi used in the domestic sector (see details in the end of 2.2.2).
- EU-27 is a net-exporter of GLS and LFL and net-importer of HL, GLS-C-HW and CFL (CFLi+CFLni).

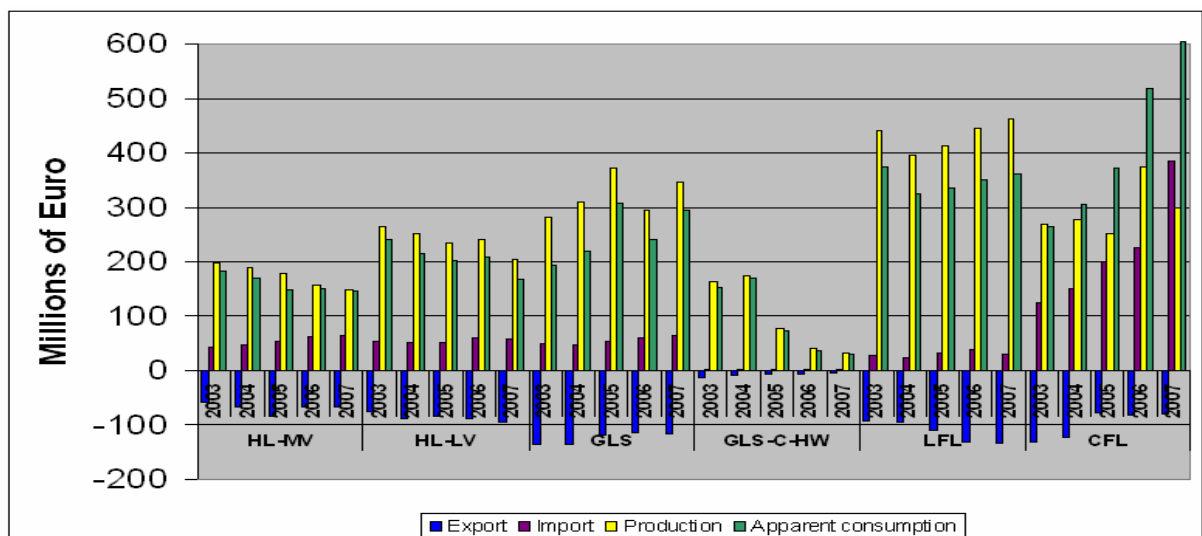


Figure 2.2: Value of production, trade and sales of lamps for EU-27

Comparison of the export value to the production value in Figure 2.2 shows:

- an increase from 29% in 2003 to 46% in 2007 for both HL-MV and HL-LV,
- a decrease from 49% in 2003 to 34% in 2007 for GLS,
- an increase from 7% in 2003 to 18% in 2007 for GLS-C-HW but this is not very important since the use of this lamp type is reduced to a very small amount in the period,
- an increase from 21% in 2003 to 29% in 2007 for LFL,
- a decrease from 49% in 2003 to 27% in 2007 for CFL (CFLi+CFLni) so a growing share of the produced CFLs are used in EU-27.

Comparison of the value of import to the value of apparent consumption in Figure 2.2 shows:

- an increase from 23% to 45% for HL-MV in the period 2003-2007 – so there is a growing and rather large import of this lamp type,
- an increase from 22% to 35% for HL-LV in the period 2003-2006,
- a decrease from 25% to 22% for GLS in the period 2003-2007 – so the import is rather small for this lamp type,
- an increase from 1% to 4% for GLS-C-HW in the period 2003-2006,
- an increase from 7% to 9% for LFL in the period 2003-2006 – so the import is very small,
- an increase from 48% to 64% for CFL (CFLi+CFLni) in the period 2003-2007 – the main and very large increase happens in 2007; the import is thus very high for this lamp type and the monetary value of the import is high.

One must bear in mind that these results hold for all lamps in all sectors (the whole society and not only domestic lighting application). In section 2.2, the use of different lamps in lighting is studied in more detail. Please note that some lamps are sold in multipacks that could have been introduced as 'one' unit in Eurostat data and that many luminaires sold for domestic lighting are sold with lamps, hence for some lamp categories these figures might be higher. This could especially affect new trendy lamps, e.g. HL-MV with G9, GU10 or R7s caps.

### **2.1.3 Generic economic data on luminaire sales**

This section will be elaborated in part 2 of the study.

## **2.2 Market and stock data**

The purpose of this sub-task is to provide market data for the identification of the most representative products in the European market and for the EU-wide environmental impact assessment of the product group 'domestic lighting' (chapters 5 and 8) as defined in section 1.1 and to provide market inputs for scenario analysis up to 2020 (chapter 8).

Market and stock data are required for the following time periods:

- 1990 (Kyoto reference);

- 2003-2006 (most recent real data);
- 2010-2012 (forecast, end of Kyoto phase 1) in a Business as Usual scenario;
- 2020-2025 (forecast, year in which all – or at least a substantial share of - new ecodesigns of today will be absorbed by the market) in a Business as Usual scenario.

Please note that it is not the purpose of chapter 2 to forecast the effect of future policy options related to domestic lighting, however we should keep in mind that market data of the past are influenced by promotional campaigns for energy efficient lighting. Future policy options and their estimated impacts are discussed in chapter 8.

In order to assess the environmental impact, according to the MEEuP methodology, 'primary MEEuP market parameters' that will be used for impact modelling in chapters 5, 7 and 8 are identified (see Table 2.2). These parameters should reflect:

- Installed lamps (stock) in domestic lighting according to the product categories defined in section 1.1 most recently (2003-2007) and in the past (1990 estimation) per EU-27 country;
- Annual lamp sales according to the product categories defined in section 1.1 per EU-27 country;
- Lamp sales growth (% or physical units) according to the product categories defined in section 1.1 to forecasting the impact in Business as Usual for 2011 and 2020 for a BAU scenario;
- Average Product Life (in years);

From the above data, the following dedicated MEEuP parameters will be derived:

- Total sales according to the product categories defined in section 1.1 versus generic data, (also in €, when available);
- Total sales estimated when purchasing a new luminaire versus replacement lamp sales for existing luminaires (derived, if available);

In this section will be defined 'additional MEEuP model parameters' because the 'Primary MEEuP market parameters' are not always available.

As average product data in years are not directly available for domestic lighting, the product life in years can be deducted, based on the average operational hours and the operational lifetime in hours. Operational lifetime data are included in chapter 4.

Some country market data are available from R&D along a number of households per country. Some data are available per region and some regional differences can be observed and used.

Table 2.2 gives an overview of the market parameters that are chosen to be included in the MEEuP model for EU-27. Regarding the parameters, it is important to note that:

- 1, 2, 3, 6, 8: available data per EU-27 Member State are used, which are then accumulated to generate total EU-27 data.
- 1, 2, 5, 6, 7, and 8: data change over the concerned time frame 1990-2020 (forecast trends), but these data do not vary between different scenarios.

- 3 and 4 data change over the concerned time frame 1990-2020 (forecast trends), and these data also vary depending on the scenario that is applied: business as usual, least life cycle cost, best available technology etc.

*Table 2.2: Input data included in the MEEuP Model totals for EU27*

Ref.	Table. inputs for EU-27 Totals	Unit	Primary MEEuP market parameter	Additional MEEuP market parameter
1	Number of households per country and total	Households		x
2	Increase in number of households (per 5 years)	%		x
3	Number of different types of lamps per household	Lamps		x
4	Per lamp types % division on NDLS and DLS lamps	%	x	
5	Forecast of increase in number of lamps (per 5 years)	%	x	
6	Weighted average Wattage per lamp type	W	x	
7	Lamp life time per lamp type	Hours		x
8	Average operational hours per lamp type	Hours/year	x	

Ballasts for LFL and CFL in the domestic sector are included in the luminaire that customers buy. As a consequence, they are not handled as a separate parameter in this study on domestic lighting. For details on ballasts, please refer to the preparatory study on Office lighting (Lot 8).

Luminaires for the domestic sector include a huge amount of different products with a very large price range. They are sold by thousands of luminaire manufacturers organised in CELMA<sup>7</sup>. It is very difficult for CELMA to provide statistics for the luminaire market due to this large number of companies from many countries with different statistical reporting systems. Since no reliable EU-27 luminaire market data exist, it is chosen to handle the luminaires as a part of the system.

Nevertheless, an analysis of the system and its impacts will be included in part 2 of the study.

For part 1 of the study, section 2.2.6 summarizes the market and stock data that will be used in the other chapters.

### 2.2.1 Data retrieval

The following 4 approaches for retrieving market data (complementary to Eurostat data in section 2.1) were explored:

1. **Literature research and EU R&D project data:** various studies have been conducted on the energy use of domestic lighting for EU R&D programmes and several Member States have delivered useful data on the number of installed lamps and their related energy consumption. The most recent overview of the global trade in lamps and lighting products

<sup>7</sup> Federation of National Manufacturers Association for Luminaires and Electronical Components for Luminaires in the European Union., CELMA represents 16 national associations.

and the global market value and trends can be found in the recently published IEA Light's Labour's Lost (IEA, 2006).

2. **Consultation of ELC<sup>8</sup>, major retailers, Chinese Chamber of Commerce and CELMA:** a request for lamp and luminaire sales data and any other relevant information was launched at the first stakeholder meeting (19/07/2007). The following data are largely based on the answers from ELC: sales of lamps divided by types and wattages and estimation of lamp sales over the different EU regions. Based on sales data and average lamp lifetimes, stocks can be estimated.
3. **Expert-inquiry:** DG JRC (Joint Research Centre) of the European Commission sent in spring 2007 a 10-question-survey to experts in different Member States and to other lighting related organisations. Experts from nearly all EU-27 filled in the questionnaire and the responses provided useful data on number of lamps per household and numbers and use of energy efficient lamps for the different Member States. These data are used along with new and more detailed information collected in the EU R&D project REMODECE<sup>9</sup> including 12 countries plus some national research projects in other EU countries. Data for the remaining countries are estimated based on the above data.
4. **Calculated estimations based on the number of households in EU-27 and stock data from EU R&D projects:** Data on the number of households per Member State can be found in Eurostat. The EU-27 total installed base of domestic lamps can be derived by combining this with the lamps-per-household data available for a number of EU countries and the average measured and estimated lifetime of different lamp types. Forecast on population, number of households, number of luminaires and lamps can be used to make projections regarding the future installed base and annual sales of domestic lighting products (up to 2020).

### 2.2.2 Annual lamp sales

The objective of this section is to determine the actual sales as reliably as possible for the domestic lighting lamp types as defined in section 1.1 for the latest full year for which data are available. A questionnaire for sales data and other relevant market information was addressed directly to ELC, 2 major European lamp retailers, and The China Chamber of Commerce. All other stakeholders were also invited to contribute; the questionnaire can be downloaded by registered stakeholders on the project website ([www.eup4light.net](http://www.eup4light.net)).

In December 2007, ELC has been answering the questionnaire as far as possible for the period 2004-2006. ELC has kindly provided data for 4 regions of EU: Central&Eastern, Middle, Northern and Southern. The available data include sales in all sectors in the society and unfortunately no data are available on the division of these sales between different sectors.

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<sup>8</sup> European Lamp Companies federation including 8 members

<sup>9</sup> Residential Monitoring to Decrease Energy Use and Carbon Emissions in Europe

The sales figures for application in domestic lighting can only be estimated using information from research, lamp industry experts and assumptions. At present, the most used lamps in the domestic sector are GLS and halogen lamps, a small amount of linear fluorescent lamps (LFL's) and an increasing amount of CFL's with integrated ballast.

Table 2.3 presents the annual sales for the different types of lighting sources and shows that:

- more changes in the sales from 2004 to 2005 than from 2005 to 2006,
- sales of GLS are decreasing but still in 2006 they represent around half of the total sales volume,
- HL-MV is the fastest growing category within HL lamps,
- CFLi has the fastest growth but in 2006 it represents only around 5% of total sales volume,
- LFL's are primarily used in the non-domestic sectors (see more in section 2.2.3)

*Table 2.3: Volume of ELC sales in EU-27, 2004-2006*

	2004	2005	2006	% Change 2004-2006
<b>GLS-F, GLS-C</b>	<b>1.230.600.887</b>	<b>1.121.433.531</b>	<b>1.096.187.033</b>	-11%
<b>GLS-R</b>	<b>163.822.491</b>	<b>144.513.034</b>	<b>138.360.572</b>	-16%
<b>HL-LV</b>	<b>53.121.906</b>	<b>58.318.203</b>	<b>60.348.996</b>	14%
<b>HL-MV</b>	<b>37.225.445</b>	<b>39.554.523</b>	<b>43.765.438</b>	18%
<b>HL-R-LV</b>	<b>66.915.971</b>	<b>71.422.261</b>	<b>73.181.823</b>	9%
<b>HL-R-MV,HL-R-MV colour</b>	<b>28.753.170</b>	<b>29.758.531</b>	<b>31.705.477</b>	10%
<b>LFL</b>	<b>377.650.078</b>	<b>394.780.333</b>	<b>385.637.398</b>	2%
<b>CFLi</b>	<b>73.073.235</b>	<b>92.593.327</b>	<b>97.412.114</b>	33%
<b>Others **)</b>	<b>49.806.285</b>	<b>43.484.686</b>	<b>44.167.210</b>	-11%
<b>TOTAL</b>	<b>2.080.969.470</b>	<b>1.995.858.428</b>	<b>1.970.766.061</b>	-5%

\*\*\*) including <=25W of GLS-colour, -deco, -lin, -signal, -special plus HL-R-LV 15W

Concerning GLS and HL sales, the annual percentage distribution of the sales on wattages and regions is not changing much in the period 2004-2006, so to get a picture of the distribution it is enough to look at the last year with available data (2006).

Table 2.4 shows that:

- one third of the sold GLS lamps are 60W and nearly another third are 40W,
- sales of 100W lamps are substantial with 12,2% of the GLS sales (equal to around 134 million/year) and these sales are spread over all regions of EU-27,
- sales of lamps with wattage above 100W account for only 0,6% (around 7 million/year) and thus relatively speaking very limited.



Table 2.4: GLS-F + GLS-C % distribution of ELC sales in EU-27, 2006

% ELC sales 2006	EU Region				
GLS Wattage	Central & Eastern	Middle	Northern	Southern	Total
<=25W	3,2	7,3	2,9	3,4	16,8
40W	5,1	16,6	3,1	6,7	31,6
60W	7,1	16,8	1,9	7,2	33,0
75W	2,4	2,4	0,2	0,9	5,8
100W	4,2	4,9	0,2	2,9	12,2
150W	0,2	0,1	0,0	0,1	0,4
>=200W	0,05	0,05	0,0	0,1	0,2
<b>Total</b>	<b>22,2</b>	<b>48,2</b>	<b>8,4</b>	<b>21,3</b>	<b>100</b>

Table 2.5 shows that:

- 55% of the GLS-R lamps sales are 40W and more than half of the rest are 60W,
- 6,5% (around 9.000.000/year) of the GLS-R sales are wattages of 100W or higher.

Table 2.5: GLS-R % distribution of ELC sales in EU-27, 2006

% ELC sales 2006	EU Region				
GLS Wattage	Central & Eastern	Middle	Northern	Southern	Total
<=25W	2,0	5,0	1,4	0,6	9,0
40W	10,1	37,7	2,4	4,9	55,2
60W	5,0	18,1	0,4	3,4	26,9
75W	0,2	1,6	0,0	0,6	2,4
100W	0,2	2,4	0,0	0,8	3,5
150-200W	0,3	2,3	0,0	0,4	3,0
<b>Total</b>	<b>17,7</b>	<b>67,1</b>	<b>4,3</b>	<b>10,8</b>	<b>100</b>

Table 2.6 shows that:

- HL-LV are rather equal spread on 10W, 20W and >20W,
- HL-R-LV is one third 20W and two third >20W.
- The largest sales increase is seen for HL-R-LV 20W.

Table 2.6: HL-LV EU-27 % distribution of ELC sales in 2006 and 2004-6 sales increase

% ELC sales 2006	EU Region				
Wattage	Central & Eastern	Middle	Northern	Southern	Total
HL-LV 10W	2,2	16,4	3,3	7,2	29,0
HL-LV 20W	3,0	23,1	3,5	8,9	38,4
HL-LV >20W	1,4	23,4	1,9	5,9	32,6
<b>HL-LV total</b>	<b>6,5</b>	<b>62,9</b>	<b>8,6</b>	<b>22,0</b>	<b>100</b>
HL-R-LV 20W	2,2	20,1	2,0	9,8	34,2
HL-R-LV >20W	3,8	37,3	2,7	21,9	65,8
<b>HL-R-LV total</b>	<b>6,0</b>	<b>57,4</b>	<b>4,8</b>	<b>31,7</b>	<b>100</b>
Wattage	2004	2005	2006	Increase in sales (%)	
HL-LV 10W	15.148.171	16.422.461	17.495.671	15%	
HL-LV 20W	20.580.911	22.783.516	23.163.963	13%	
HL-LV >20W	17.392.824	19.112.226	19.689.362	13%	
HL-R-LV 20W	19.466.508	24.142.385	25.010.136	28%	
HL-R-LV >20W	47.449.463	47.279.876	48.171.687	2%	

HL-R-LV 15W is included by ELC in the general category (see Table 2.3) because of lack of answers

Table 2.7 summarizes sales of very different products, among others R7s double-ended lamps and lamps with E/B sockets. The results are:

- In 2006, HL-MV sales are distributed as follows: 39%  $\geq$  200W, 32% 75-100W, 21% 26-50W and 7% 25W.
- Sales of HL-MV 25W is increasing with 152% but 2004 sales volume is very low.
- Sales of HL-MV 26-50W are increasing with 30% but sales volume is not the highest.
- Sales of HL-R-MV sales are distributed as follows: 42% >60W, 35% 60W and 23%  $\leq$  40W. Sales of HL-R-MV  $\leq$  40W are anyway increasing fast with 44%.

Table 2.7: HL-MV EU-27 % distribution of ELC sales in 2006 and 2004-2006 sales increase

% ELC sales 2006	EU Region				
Wattage	Central & Eastern	Middle	Northern	Southern	Total
HL-MV 25W	2,7	2,9	0,3	1,3	7,2
HL-MV 26-50W	1,4	13,2	0,8	5,8	21,2
HL-MV 75-100W	2,5	16,5	3,3	10,1	32,3
HL-MV $\geq$ 200W	4,7	21,0	1,8	11,8	39,3
<b>HL-MV total</b>	<b>11,1</b>	<b>53,6</b>	<b>6,3</b>	<b>29,0</b>	<b>100</b>
HL-R-MV $\leq$ 40W	2,3	15,8	2,0	3,2	23,2
HL-R-MV 60W	1,8	23,3	3,4	6,7	35,2
HL-R-MV >60W	1,5	30,0	3,1	7,0	41,6
<b>HL-R-MV total</b>	<b>5,6</b>	<b>69,0</b>	<b>8,6</b>	<b>16,8</b>	<b>100</b>
Wattage	2004	2005	2006	Increase in sales (%)	
HL-MV 25W	1.245.917	1.650.277	3.137.223	152%	
HL-MV 26-50W	7.115.644	7.886.819	9.284.155	30%	
HL-MV 75-100W	12.513.781	13.529.781	14.154.779	13%	
HL-MV $\geq$ 200W	16.350.103	16.487.646	17.189.281	5%	
HL-R-MV $\leq$ 40W	5.103.999	5.863.506	7.369.583	44%	
HL-R-MV 60W	10.176.305	10.513.726	11.151.501	10%	
HL-R-MV >60W	13.472.866	13.381.299	13.184.393	-2%	

Table 2.8: CFLi volume and % distribution of ELC sales in EU-27, 2004-2006

CFLi Wattage	EU Region	2004	2005	2006	2006 %
<=7W	Central & Eastern	345.283	402.129	482.736	0,5
	Middle	1.351.001	1.823.951	2.152.422	2,2
	Northern	114.777	131.455	195.650	0,2
	Southern	341.878	371.730	547.833	0,6
	<b>EU Total</b>	<b>2.152.938</b>	<b>2.729.264</b>	<b>3.378.641</b>	<b>3,5</b>
8-10W	Central & Eastern	1.197.376	1.221.123	1.379.275	1,4
	Middle	6.128.107	8.790.830	10.370.058	10,6
	Northern	505.317	508.097	615.116	0,6
	Southern	2.363.315	2.750.290	3.314.585	3,4
	<b>EU Total</b>	<b>10.194.114</b>	<b>13.270.340</b>	<b>15.679.034</b>	<b>16,1</b>
11-14W	Central & Eastern	2.428.500	2.426.132	2.638.215	2,7
	Middle	12.176.283	21.576.425	22.270.544	22,9
	Northern	944.198	1.017.624	1.588.646	1,6
	Southern	4.592.422	5.759.366	6.378.072	6,5
	<b>EU Total</b>	<b>20.141.404</b>	<b>30.779.546</b>	<b>32.875.477</b>	<b>33,7</b>
15W	Central & Eastern	797.590	892.987	1.071.267	1,1
	Middle	6.818.021	6.875.306	5.446.916	5,6
	Northern	459.673	532.971	640.151	0,7
	Southern	3.612.455	4.563.609	6.922.551	7,1
	<b>EU Total</b>	<b>11.687.740</b>	<b>12.864.872</b>	<b>14.080.885</b>	<b>14,5</b>
>15W	Central & Eastern	3.282.179	3.440.097	3.899.581	4,0
	Middle	16.705.927	19.263.858	12.432.857	12,8
	Northern	365.726	363.359	396.482	0,4
	Southern	8.543.207	9.881.989	14.669.156	15,1
	<b>EU Total</b>	<b>28.897.039</b>	<b>32.949.303</b>	<b>31.398.077</b>	<b>32,2</b>
<b>CFLi Total</b>		<b>73.073.235</b>	<b>92.593.327</b>	<b>97.412.114</b>	<b>-</b>

Table 2.8 shows that:

- One third of the CFLi sales are 11-14W where Middle EU is growing fast in 2005.
- Another third of the CFLi sales are >15W where Southern EU is growing fast and Middle EU is decreasing in 2006.
- CFLi sales in Central and Eastern EU are small compared to the number of homes.

Table 2.9 summarizes sales data for the year 2006:

- The total for GLS is adjusted to 1350 million (from 1067 million in Eurostat, see Figure 2.1) as Eurostat data are lower than the sum of the sales data from the manufacturers – maybe because some sales of packages of two bulbs sometimes go into statistics as sales of one bulb. Reasons for significant differences between sales data and apparent consumption from official statistics are extensively discussed in the MEEuP report (VHK, 2005).
- ELC data are summarized data from Table 2.3.
- 2 major European lamp retailers have kindly informed the rough size of their yearly 2006/2007 sales.
- Other sales are including the residual sales from other manufactures.
- ELC provided their 2006 CFLni sales, i.e. 170 million.

- The data about EU regulation n° 1205/2007 of 15. Oct. 2007 imposing anti-dumping duties on imports of CFLi result in an EU-27 CFLi consumption of 144 million in 2004, 198 million in 2005 and 214 million in the period 1/7 2005 – 30/6 2006. The MEEuP Model calculation of a consumption of 244 million CFLi (see Table 2.25) is verily fine in line with the above data found in the regulation analysis.

*Table 2.9: Volume of EU-27 sales (millions/year) for all sectors in 2006*

Lamp type	Total (Eurostat)	ELC Sales	2 major European lamp retailers Sales	Other Sales (residual)	Non Direct and Direct Lamp Sources %
<b>GLS</b>	1.350	1.096	62	44	NDLS 89%
<b>GLS-R</b>		138	10		DLS 11%
<b>HL-LV</b>	300	60	26	120	NDLS 45%
<b>HL-R-LV</b>		73	21		DLS 55%
<b>HL-MV-LW</b>	330	20 <sup>10</sup>	10	193	NDLS 58%
<b>HL-MV-HW</b>		24	1		
<b>HL-R-MV-LW</b>		25	46		DLS 42%
<b>HL-R-MV-HW</b>		7	4		
<b>LFL</b>	390	386	0	4	NDLS 100%
<b>CFLi</b>	426	97	60 (3% DLS)	159	NDLS 99%
<b>CFLni</b>		90 <sup>□</sup>	0	20	-

<sup>□</sup> Value estimated from EuP lot 8 information and informal data about ELC CFLni sales in 2007

Table 2.9 shows 2006 data for all sectors and that ELC is covering nearly all GLS and LFL sales but less than half of the HL and CFL sales. 2 major European lamp retailers covered 25% of the CFLi sales in 2006. The NDLS/DLS distribution for halogen lamps is derived from new data received in 2008 and the distribution is a bit different from MEEuP model in Table 2.25 developed earlier in the study. Instead of updating the MEEuP model and all calculations in chapter 5, 7 and 8, a sensitivity analysis was executed in chapter 8 to see the influence of using the new NDLS/DLS distributions. The results show a small difference of about 2-3% in energy savings and no influence on the outcome of comparison and ranking of the scenarios.

Table 2.10 shows the CFL sales during the last 5 years. It shows that CFLi sales has been growing very much during 2006 and 2007.

*Table 2.10: EU-27 sales (millions/year) of CFL for all sectors 2003-2007*

	2003	2004	2005	2006	2007
<b>Eurostat sales</b>	145	177	241	426	493 (628) <sup>□</sup>
<b>CFLni</b> <sup>11</sup>	51	56	88	110	140
<b>CFLi</b> <sup>12</sup>	94	121	153	316	353

<sup>□</sup> Eurostat is about to update CFLi production for 2007 and it seems the apparent consumption will then be 628 million

<sup>10</sup> ELC HL-MV sales 44 million and HL-R-MV sales 32 million is divided on LW ( $\geq 75W$ ) and HW ( $>75W$ ) by own judgement

<sup>11</sup> 2003-2004 comes from EuP lot 8 (Office Lighting) table 133, CFL retrofit. 2007 is ELC sales 99 million plus estimates 41 million sales by others. 2005 and 2006 is found by interpolation.

<sup>12</sup> Found as difference between Eurostat and CFLni sales.

### 2.2.3 Stock of different lamp types per household

The current stock data in Table 2.11 are kindly provided by an end-user survey in the ongoing EU R&D project REMODECE including 500 consumers/country for 11 countries. Besides this, Sweden and UK have provided data from large national surveys performed in 2007. It includes data from a JRC questionnaire to national experts [Bertoldi and Atanasiu, 2007]. and it was estimated that the mentioned 13 countries use 76% of the total EU-27 stock. The detailed data for the 13 countries was finally rescaled to four EU regions.

Table 2.11 shows big differences in numbers of different types of lamps used per country:

- the EU-27 average is 24,3 lighting points/household (variation: 10-40 points/country),
- the average share of GLS lamps is 13,1 GLS/households equal to 54% of the lamps,
- the average share of HL-LV is 4,46 equal to 18% of the lamps,
- the average share of HL-MV is 1,32 equal to 5% of the lamps,
- the average share of LFL is 1,83 equal to 8% of the lamps,
- the average share of CFLi is 3,58 equal to 15% of the lamps.

Table 2.12 shows an estimation of the stock of lamps for 1995 for EU-27 although the EU did not include that many countries at that time:

- the EU-27 average is 21,3 lighting points/household (variation: 6-36 points/country),
- the average share of GLS lamps is 18,0 GLS/households equal to 85% of the lamps,
- the average share of HL-LV is 0,9 equal to 4% of the lamps,
- the average share of LFL is 1,4 equal to 6% of the lamps,
- the average share of CFLi is 1,0 equal to 5% of the lamps.

Table 2.11: Stock of lamps used in EU-27 in 2007

			REMODECE survey						JRC questionnaire		
EU region	Country	Number of house holds	GLS	Halogen LV	Halogen MV	LFL	CFLi	Lamp per HH	Lighting points	% of HH with CFLi's	CFLs/HH incl. HH without CFLi
		millions	no/HH	no/HH	no/HH	no/HH	no/H H	No/HH	no/HH	%	no/HH
Central and Eastern	BG	3,7	9,10	4,11	0,24	0,55	1,73	15,7	10,0	7	0,20
	CZ	4,40	8,85	3,50	0,38	1,60	4,80	19,1	10,0	70	2,90
	CY	0,32							16,0	79	2,00
	EE	0,60							6,0	20	0,25
	HU	4,10	8,30	1,40	0,00	0,30	3,20	13,2	18,0	60	1,00
	LV	0,97							20,0	19	0,42
	LT	1,30							6,0	20	0,25
	MT	0,13							15,0	50	1,00
	PL	13,3							20,0	50	0,50
	RO	8,13	8,37	0,80	0,27	0,75	1,05	11,2	10,0	20	0,20
SK	2,1							15,0	60	1,00	
SI	0,69							19,0	50	1,00	
Middle	AT	3,3							26,0	70	4,00
	BE1	4,3	9,3	10,0	1,10	3,0	7,2	30,7	26,0	71	2,50
	FR	32,2	12,80	2,10	0,80	1,50	3,20	20,4	18,9	52	2,26
	DE	39,1	12,50	7,10	0,70	1,90	3,10	25,3	32,0	70	6,50
	EI	1,44							18,0	38	1,50
	LU	0,20							20,0	70	2,00
	NL	7,0							40,0	60	4,00
UK	26,20	15,6	2	3,80	1	2,3	25,0	20,0	50	2,00	
Northern	DK	2,5	14,10	9,10	1,70	2,40	5,40	32,7	25,4	65	4,90
	FIN	2,5							23,5	50	1,00
	SE	4,5	21,0	4,0	1,0	4,8	4,0	34,8	22,0	55	2,20
Southern	GR	3,7	11,3	2,6	0,5	1,4	3,0	18,8	7,0	50	1,00
	IT	22,5	15,4	7,0	2,0	3,2	5,8	33,4	18,0	60	0,80
	PT	4,2	11,84	3,51	0,79	1,80	3,39	21,3	11,4	54	1,70
	ES	17,2							25,0	15	2,00
EU region	House-holds	GLS	Halogen LV	Halogen MV	LFL	CFLi	Lamps in survey	Lighting points by Remodece +JRC (rest)	Percentage of HH with CFLi's (JRC)	CFLs/HH incl. HH without CFLi, JRC	
	millions	millions	millions	millions	mio.	mio.	mio.	millions	%	No/HH	
Central+Eastern	39,73	386	95	10	36	109	288	636	42	0,8	
Middle	113,74	1569	525	183	185	367	2433	2829	59	3,8	
Northern	9,50	162	51	11	34	39	238	297	56	2,6	
Southern	47,60	653	269	73	130	239	934	1364	42	1,3	
EU-27	210,57	2770	939	277	385	753	3893	5125	52	2,6	
	<b>No/hh</b>	13,15	4,46	1,32	1,83	3,58		<b>24,34</b>			

1 In the Podo project (2005-2006) Socio Technical factors influencing residential energy consumption, a survey in 40 older (> 20 years) homes there could apply for renovation (might explain that the number of halogen LV was low) the numbers were GLS 10.28, HL-LV 1.0, HL-MV 0.73, LFL 2.03 and CFL 2.23 in total 16.25 lamps.

Table 2.12: Estimation of the stock of lamps used in EU-27 in 1995

Data from DELIGHT, CFLi DISSEMINATION and JRC									
EU region	Country	Number of house holds 1995	GLS	Halogen LV	Halogen MV	LFL	CFL	Total number of lamps	Lighting points
		millions	no/HH	no/HH	no/HH	no/HH	no/HH	no/HH	no/HH
Central and Eastern EU	BG	3,1	10,25	1,00	0,00	0,55	0,00	11,8	11,8
	CZ	3,7							10,0
	CY	0,3	15,40				0,6	16,0	16,0
	EE	0,5							6,0
	HU	3,5	13,00	0,00	0,00	0,30	0,70	14,0	14,0
	LV	0,8							18,0
	LT	1,1							6,0
	MT	0,1							14,0
	PL	11,3	14,50				0,5	15,0	15,0
	RO	6,9	8,25	0,00	0,00	0,75	0,00	9,0	9,0
	SK	1,8							14,0
SI	0,6							17,0	
Middle EU	AT	3,3	25,20				0,8	26,0	26,0
	BE	4,1	24,70	2	0,00	3	1,0	30,7	30,7
	FR	24,8	15,50	1,00	0,00	1,50	0,50	18,5	18,5
	DE	36,9	23,00	2,00	0,00	1,90	2,10	29,0	29,0
	EL	1,2	24,10				0,9	25,0	25,0
	LU	0,1	17,60				0,4	20,0	18,0
	NL	6,4	33,60				2,4	36,0	36,0
	UK	21,5	18,40		0,00	1	0,7	20,0	20,0
Northern EU	DK	2,3	19,60	2,00	0,00	2,40	2,00	26,0	26,0
	FIN	2,1	21,00		0,00		1,0	22,0	22,0
	SE	3,9	28,80	1,0	0,0	4,8	0,4	35,0	35,0
Southern EU	GR	3,6	12,50	0,00	0,00	1,40	0,10	14,0	14,0
	IT	22,3	13,70	2,00	0,00	3,20	1,10	20,0	20,0
	PT	3,6							11,0
	ES	15,1	19,40				0,6	20,0	20,0
EU region	Number of households 1995	GLS	Halogen LV	Halogen MV	LFL	CFL	Lamps surveyed	Lighting points	
	millions	millions	millions	millions	millions	millions	millions	millions	
Central+Eastern EU	33,76	395	4	0	10	11	322	420	
Middle EU	98,36	2060	107	0	139	128	2434	2434	
Northern EU	8,30	202	9	0	24	8	243	243	
Southern EU	44,60	675	47	0	80	36	798	838	
EU 27	186,02	3332	166	0	254	183	3797	3935	
	no/hh	18,01	0,90	0,00	1,37	0,99		21,27	
1995 lighting points and CFLi data based on a mix of data from two EU SAVE project DELIGHT and Dissemination of CFLi.									
1995 LFL s assumed to be similar in 1995 as in 2006.									
In 1995, there is assumed to be no HL-MV lamps in use and only a fraction of the HL-LV used in 2006.									
No of households from European Environment Agency for EU-15 - for other countries assumed 15% increase from 1995 to 2007.									

## 2.2.4 Average lamp wattages for different lamp types

Table 2.4 to Table 2.8 contain usefull information about ELC yearly sales of different wattages but this is not the same as the wattages stock distribution per household. Table 2.13 to Table 2.17 contain information about the stock of lighting sources divided by wattages originating from:

- EU R&D project EURECO (1999-2000) provided for Denmark, Greece, Italy and Portugal
- "Eclairage 100" (1999) for France
- UK lighting market transformation survey (2007)
- Belgium Podo project (2005-2006)

*Table 2.13: Use of GLS divided by wattages*

<b>Wattages</b>	<b>Belgium</b>	<b>Denmark</b>	<b>France</b>	<b>Greece</b>	<b>Italy</b>	<b>Portugal</b>	<b>UK</b>	<b>EU-27 estimate</b>	<b>ELC sales</b>
<b>15-20W</b>	-	3%	1%	0%	1%	2%	2%	1%	17%
<b>25-30W</b>	6%	23%	10%	3%	1%	12%	4%	9%	
<b>35-40W</b>	35%	45%	40%	17%	22%	43%	42%	40%	32%
<b>50W</b>	-	0%	0%	2%	5%	1%	-	1%	-
<b>60W</b>	49%	22%	31%	33%	34%	32%	43%	35%	33%
<b>70-80W</b>	5%	2%	10%	18%	16%	6%	-	6%	6%
<b>100W</b>	5%	1%	8%	24%	19%	7%	7%	7%	12%
<b>120-150</b>	-	0%	0%	1%	1%	1%	2%	1%	0,6%
<b>Weighted average</b>	<b>53 W</b>	<b>40 W</b>	<b>52 W</b>	<b>67 W</b>	<b>64 W</b>	<b>53 W</b>	<b>51 W</b>		



Table 2.14: Use of halogen lamps divided by wattages

Wattages	Belgium		Denmark	France		Greece	Italy	Portugal	UK		
	LV	MV		LV	MV				LV	MV	
10W	-	-	2%	13%	0%	0%	0%	0%	1%	2%	
15W	-	-	2%			0%			0%	1%	3%
16-20W	-	-	7%	43%		3%		18%	18%	12%	
22W	-	-	50%		12%	0%		0%	-	-	
25W	-	-	6%			6%			14%	10%	
30-39W	35% (35W)	-	12%	10%	39%	3%		14%	-	-	
40-60W	65% (50W)	-	4%	33%		39%		37%	66% (40W)	46%	
100-250W	-	31%	5%	0%	16%	13%		29%	32%	0%	2%
300W	-	55%	1%			19%		59%	0%	0%	25% (Other)
500W	-	14%	0%		33%	16%		12%		0%	
<b>Weighted average</b>	<b>45 W</b>	<b>284</b>	<b>32 W</b>	<b>29 W</b>	<b>209 W</b>	<b>182 W</b>	<b>288 W</b>	<b>83 W</b>	<b>33 W</b>	<b>39 W</b>	

For Belgium there was no MV data for wattages below 100W (data from Podo project)

Since 1999 (Table 2.14 originates from this year), the use of halogens and especially HL-MV-LW 40-60W has increased considerably. Table 2.14 shows also that HL-MV-HW 300W is an appropriate base case wattage. Below is made an estimate of the distribution related to the yearly sales data from ELC (Table 2.6 and Table 2.7):

**EU-27 HL-MV estimate**

- 10-20W 5% ELC ≤25W 7%
- 20-30W 10%
- 30-40W 15% ELC 26-49W 21%
- 40-60W 25% ELC 50-100W 32%
- 100-150W 25%
- 200-250W 15% ELC ≥200W 39%
- 300-500W 5%

**EU-27 HL-LV estimate**

- 10W 20% ELC 10W 29%
- 15W 6%
- 16-20W 40% ELC 20W 38%
- 21-30W 15% ELC >20W 33%
- 31-40W 15%
- 41-60W 4%

Table 2.15: Use of LFL lamps divided on wattages

Wattages	Belgium	Denmark	France	Greece	Italy	Portugal	UK
8W	-	0%	15%	2%	0%	0%	1%
11-13W	7%	2%		2%	2%	2%	1%
15W	-	2%		2%	2%	0%	-
16-18W	15%	5%	25%	8%	5%	39%	-
20-25W	15%	35%		4%	27%	0%	5%
26-30W	-	4%	1%	4%	10%	4%	-
31-39W	36%	16%	44%	45%	40%	39%	-
40-45W	15% (40W)	23%		20%	8%	0%	17% (40 W)
50-60W	12%	7%	2%	4%	8%	16%	32%
70-72W	-	1%	13%	10%	0%	0%	17% (100W)
Weighted average	33 W	31 W	31 W	38 W	32 W	30 W	57 W

Table 2.16: Use of CFLi lamps divided on wattages

Wattages	Belgium	Denmark	France	Greece	Italy	Portugal	UK	ELC sales
5-7W	10%	23%	4%	4%	0%	0%	-	4%
8-10W	19%	15%	6%	0%	3%	7%	5%	16%
11-12W	38%	37%	19%	20%	8%	38%	-	34%
13-15W	9%	14%	42%	15%	20%	21%	26%	15W 15%
16-18W	-	6%	0%	4%	9%	6%	-	32%
19-20W	15%	1%	29%	33%	22%	9%	35%	
22-26W	9%	1%	0%	24%	39%	19%	17%	
40W	-	-	-	-	-	-	17%	
Weighted average	13 W	10 W	15 W	18 W	19 W	15 W	21 W	

Table 2.17 summarizes the finding in Table 2.13 to Table 2.16, and makes an upscaling of the average wattages found per country to EU-27. Central & Eastern Europe (with no data available) are assumed to be rather similar to data for Middle EU.

Table 2.17: Calculation of weighted average wattage per lamp types for EU-27

EU region	Country	Number of households	Lamps per HH	GLS	Halogen LV	Halogen MV	LFL	CFLi	HH survey
		millions	no/HH	W	W	W	W	W	millions
Central and Eastern EU	BG	3,7	10,0						13,3
	CZ	4,40	10,0						
	CY	0,32	16,0						
	EE	0,60	6,0						
	HU	4,10	18,0						
	LV	0,97	20,0						
	LT	1,30	6,0						
	MT	0,13	15,0						
	PL	13,3	20,0	50	35	150	32	15	
	RO	8,13	10,0						
	SK	2,1	15,0						
SI	0,69	19,0							
Middle EU	AT	3,3	26,0						4,3 32,2
	BE	4,3	26,0	53	45	284	33	13	
	FR	32,2	18,9	52	29	209	31	15	
	DE	39,1	32,0						
	EI	1,44	18,0						
	LU	0,20	20,0						
	NL	7,0	40,0						
UK	26,20	20,0	51	33	100	57	21	26,2	
Northern EU	DK	2,5	25,4	40	22	100	31	10	2,5
	FIN	2,5	23,5						
	SE	4,5	22,0						
Southern EU	GR	3,7	7,0	67	26	200	38	18	3,7 22,5 4,2
	IT	22,5	18,0	64	27	288	32	19	
	PT	4,2	11,4	53	28	100	30	15	
	ES	17,2	25,0						

EU region	Number of households	Lamps	GLS	Halogen LV	Halogen MV	LFL	CFLi	HH surveyed
	millions	millions	W	W	W	W	W	millions
Central+Eastern EU	39,73	584	50	35	150	32	15	13,3
Middle EU	113,74	2891	52	32	160	44	18	62,7
Northern EU	9,50	221	40	22	100	31	10	2,5
Southern EU	47,60	909	63	27	251	32	18	30,4
<b>EU-27</b>	<b>210,57</b>	<b>4606</b>	<b>54</b>	<b>31</b>	<b>178</b>	<b>38</b>	<b>17</b>	<b>108,9</b>

Since there is no deviation on Halogen LV and halogen MV in the EURECO project, this division has been estimated.  
Data for PL are assumptions based on results from Middle EU as the calculation method requires data for at least one county per region.

## 2.2.5 Average operational hours per lamp type

The average operational hours per lamp type is an important parameter necessary for estimating the total stock of lamps along with the technical lamp lifetime and lamp sales.

The average operational hours for lamps depend on the user behaviour and on the environment; these topics are discussed in chapter 3 and also include presence of household members, activities, lighting control e.g. by clock, burglar protection, outdoor lighting level and/or presence detection. This chapter only focuses on measured market data for operational hours.

Spring 2007, JRC [Bertoldi and Atanasiu, 2007] asked national experts for their estimate of average operational hours for the **three most used lamps** in the household. The results varied from 700 – 2200 hours/year. The weighted average for EU-27 was calculated to be 1150 hours.

In the EU EURECO project, burning hours were monitored in different room types during one year (1999-2000) as shown in Table 2.18 to Table 2.23. For “All lighting sources”, “n°1” is the average burning hours for the most used lamp per home without looking at the type of lamp – that means that all 100 households are included when calculating this average. The burning hours for specific lamp types (e.g. CFLi) only households using CFLi’s were evaluated. This explains that “n°1” can be higher for CFLi than for “All lighting sources”.

*Table 2.18: Average operational hours for lamps in the kitchen*

Lighting source	Luminaires	Kitchen				
		Denmark hours/year	France hours/year	Greece hours/year	Italy hours/year	Portugal hours/year
All lighting Sources	n°1	1144	736	1044	1150	1022
	n°2	610	301	349	488	-
	n°3	410		-	-	-
	n°4	-		-	-	-
GLS	n°1	865	571	795	894	668
	n°2	562	294	-	537	-
	n°3	363		-	-	-
	n°4	-		-	-	-
Halogen	n°1	869	536	381	-	-
	n°2	563	244	-	-	-
	n°3	-		-	-	-
LFL	n°1	804	525	951	1416	1118
	n°2	295		-	-	-
CFLi	n°1	1280	839	1277	1084	816
	n°2	449		-	-	-

Table 2.19: Average operational hours for lamps in the dining/living room

		Dining room/living room				
Lighting source	Luminaires	Denmark hours/year	France hours/year	Greece hours/year	Italy hours/year	Portugal hours/year
All lighting sources	n°1	1427	757	801	683	1122
	n°2	866	352	470	316	553
	n°3	533	250	-	189	-
	n°4	421		-	-	-
GLS	n°1	822	561	670	574	878
	n°2	551	284	345	373	614
	n°3	223	209	333	183	-
	n°4	139		-	-	-
Halogen	n°1	497	486	817	504	1360
	n°2	233		-	-	-
	n°3	-		-	-	-
LFL	n°1	-	-	-	-	-
	n°2	-	-	-	-	-
CFLi	n°1	1066	793	1826	1150	1216
	n°2	480	493	-	-	

Table 2.20: Average operational hours for lamps in the sleeping room

		Sleeping room				
Sources lumineuses	Luminaires	Denmark hours/year	France hours/year	Greece hours/year	Italy hours/year	Portugal hours/year
All lighting Sources	n°1	711	432	608	414	452
	n°2	320	226	323	148	368
	n°3	194	162	-	-	-
	n°4	161		-	-	-
GLS	n°1	711	355	675	451	469
	n°2	448	174	420	189	316
	n°3	242	119	345	-	-
	n°4	-		-	-	-
Halogen	n°1	542	311	-	289	582
	n°2	-	110	-	-	-
	n°3	-		-	-	-
LFL	n°1	-	-	918	335	-
	n°2	-	-	-	-	-
CFLi	n°1	723	542	567	498	780
	n°2	357	410	-	123	-

Table 2.21: Average operational hours for lamps in the bathroom

Sources lumineuses	Luminares	Bathroom				
		Denmark hours/year	France hours/year	Greece hours/year	Italy hours/year	Portugal hours/year
All lighting Sources	n°1	681	334	765	458	594
	n°2	236	185	246	231	-
	n°3	-	88	-	-	-
	n°4	-	-	-	-	-
GLS	n°1	641	317	757	440	570
	n°2	411	202	-	233	282
	n°3	257	101	-	-	-
	n°4	161	-	-	-	-
Halogen	n°1	548	299	-	-	346
	n°2	-	213	-	-	-
	n°3	-	-	-	-	-
LFL	n°1	430	209	838	404	594
	n°2	-	-	-	-	-
CFLi	n°1	704	364	-	518	960
	n°2	-	-	-	-	-

Table 2.22: Average operational hours for lamps in the office at home

Sources lumineuses	Luminares	Office			
		Denmark hours/year	Greece hours/year	Italy hours/year	Portugal hours/year
All lighting Sources	n°1	603	589	-	-
	n°2	348	-	-	-
	n°3	-	-	-	-
	n°4	-	-	-	-
GLS	n°1	692	380	-	-
	n°2	562	-	-	-
	n°3	283	-	-	-
	n°4	201	-	-	-
Halogen	n°1	415	-	-	-
	n°2	-	-	-	-
	n°3	-	-	-	-
LFL	n°1	472	-	-	-
	n°2	-	-	-	-
CFLi	n°1	649	916	-	-
	n°2	140	-	-	-

Table 2.23: Average operational hours for lamps in the entrance/hall

Sources lumineuses	Luminaires	Entrance/Hall				
		Denmark hours/year	France hours/year	Greece hours/year	Italy hours/year	Portugal hours/year
All lighting Sources	n°1	878	389	800	337	773
	n°2	364	162	346	-	-
	n°3	-	145	-	-	-
	n°4	-	-	-	-	-
GLS	n°1	973	288	530	343	1112
	n°2	588	111	212	152	-
	n°3	384	-	-	-	-
	n°4	242	-	-	-	-
Halogen	n°1	448	323	-	-	-
	n°2	-	-	-	-	-
	n°3	-	-	-	-	-
LFL	n°1	-	-	-	-	-
	n°2	-	-	-	-	-
CFLi	n°1	1340	667	2800	665	501
	n°2	-	418	-	-	-

In 2007/2008 the Remodece project measured the operating time in 100 homes/country for the around 7 most used lamps per home during 2 weeks except for France that included nearly all lamps in the home. Table 2.24 shows results for 6 countries plus UK (large survey performed in the UK lighting market transformation project (2007) that estimated the average operational hours for all lamps in the household.

Table 2.24: Average operational hours for different types of lamps (only including the most used lamps except for France that included all lamps)

Country	Number of households	GLS	Halogen LV	Halogen MV	LFL	CFLi
	Millions	Hours/year	Hours/year	Hours/year	Hours/year	Hours/year
BG	3,7	864	1049	1048	1706	946
CZ	4,4	576	868	689	1080	1058
DE	39,1	536	739	491	607	928
FR	32,2	280	358	238	383	674
GR	3,7	585	877	1032	802	996
PT	4,2	394	351	417	714	564
UK	26,2	450	780		925	750
Weighted average		452	646	527	681	809
Lamps/hh measured		4,7	0,5	0,2	0,4	0,9

Table 2.24 shows that the operating hours for France (including all lamps) are remarkable lower than for the other countries (only including the most used lamps). For France must be considered that 10% of the total number of dwellings are second homes which is equal to 3,2 million homes and these homes will lower the average.

Except for LFL and CFLi, the calculated weighed averages of operating hours are evaluated to be too high since only the most used lamps are included except for France. Based on all the

tables in this section is assumed the following average EU-27 operational hours for the domestic sector:

- GLS-F and GLS-C 400 hours
- HL-MV 450 hours
- HL-LV 500 hours
- LFL 700 hours
- CFLi 800 hours

It has to be mentioned here that the impact assessment calculations use **lumen / hour** as the functional unit. As a consequence, differences in burning hours will have a low impact on the calculations in chapter 7 (improvement options) and 8 (scenarios).

## 2.2.6 Summary of MEEuP market parameters

Table 2.25 summarizes the data to be used in the EcoReport calculations in the next chapters of the study. Comments to this table are:

- 2006 stock of lamps/household are from Table 2.11 (R&D surveys). These data are to be considered as bottom line data because a luminaire with two lamps might have counted as one and some sockets might have been forgotten.
- %NDLS and %DLS are based on sales data in Table 2.9.
- Forecast of changes in NDLS and DLS for 2011 and 2020 are estimates. Alternatively, was considered to perform a trend analysis based on the UNECE database<sup>13</sup> but this was refused since the large changes between lighting sources have happen within the last few years.
- Based on impressions from contacts and visits is assumed 70% GLS-F and 30% GLS-C.
- Weighted wattages are based on values calculated in Table 2.17.
- Lamp lifetimes are presented in chapter 4 by studying the manufacturers catalogues.
- Average operational hours are based on Table 2.18 to Table 2.24.
- Any yearly forecast of the stock = Yearly replacement sales + Yearly change in stock.
- Yearly replacement sales = Stock in 2006 \* lamp lifetime/ operational hours per year.
- Yearly change in sales is calculated from an forecast of the stock of different lamps as explained in part 2.27 and 2.3.
- Number of homes is not available in Eurostat so these data is collected from a comparative study of UNECE House statistics (old data from 2002), House Statistics

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<sup>13</sup> The database model of the Statistical Division (UNECE/STAT) maintained by the Environment and Human Settlements Division, contains data with specific reference to data on housing and building. Data are collected for the ECE Bulletin of Housing and Building Statistics and through the Country Profiles on the Housing Sector from a number of both national and international sources.



in EU (2004), data used in other studies and national statistics. The actual number of homes (dwellings) in EU-27 is found to be 210 million homes.

- It is a trend that more and more people live alone and naturally this results in an increase in number of homes whereas the population size seems to be rather stable in most EU countries.
- The growth rates are related to trends and are explained in section 2.3.1. Amongst others it explains the relative high assumed HL-MV-HW stock increase between 2006 and 2011.

Table 2.25: MEEuP lighting model with Business as Usual (BAU) forecast

Scenario: BAU		MEEuP Lighting Model							
EU27		Domestic sector							Total
		GLS-F	GLS-C	HL-MV LW	HL-MV HW	HL-LV	LFL	CFLi	
Capita	477.000.000	9,2	3,95	0,61	0,71	4,46	1,83	3,58	24,3
Homes	210.000.000	99	66	55	55	49	100	99	
capita/home	2,27	1	34	45	45	51	0	1	
Stock of lamps (NDLS+DLS) per home 2006		1.932.000.000	829.500.000	128.100.000	149.100.000	936.600.000	384.300.000	751.800.000	5.111.400.000
% NDLS		1.912.680.000	547.470.000	70.455.000	82.005.000	458.934.000	384.300.000	744.282.000	4.200.126.000
% DLS		19.320.000	282.030.000	57.645.000	67.095.000	477.666.000	0	7.518.000	911.274.000
Stock of lamps		1000	1000	1500	1500	3000	12000	6000	
Stock of NDLS lamps		400	400	450	450	500	700	800	
Stock of DLS lamps		772.800.000	331.800.000	38.430.000	44.730.000	156.100.000	22.417.500	100.240.000	1.466.517.500
Lamp life time (hours)									
Average operational hours (hours/year)									
Replacement Sales per year									
Forecast of stock (NDLS+DLS) in 2011		4,9	2,5	3,0	2,0	5,1	2,0	8,1	27,6
Stock of lamps		1.022.700.000	525.000.000	630.000.000	420.000.000	1.071.000.000	420.000.000	1.701.000.000	5.789.700.000
Stock of NDLS lamps		1.012.473.000	346.500.000	346.500.000	231.000.000	524.790.000	420.000.000	1.683.990.000	4.565.253.000
Stock of DLS lamps		10.227.000	178.500.000	283.500.000	189.000.000	546.210.000	0	17.010.000	1.224.447.000
Forecasted change in sales in 2007		-181.860.000	-60.900.000	100.380.000	54.180.000	26.880.000	7.140.000	252.760.000	198.580.000
Total sales 2007		590.940.000	270.900.000	138.810.000	98.910.000	182.980.000	29.557.500	353.000.000	1.665.097.500
NDLS sales 2007		585.030.600	178.794.000	76.345.500	54.400.500	89.660.200	29.557.500	349.470.000	1.363.258.300
DLS sales 2007		5.909.400	92.106.000	62.464.500	44.509.500	93.319.800	0	3.530.000	301.839.200
Forecast of stock (NDLS+DLS) 2020		3,5	2,3	4,7	2,5	5,9	2,0	10,1	31,0
Wattage weighted average (W)		54	54	40	300	30	38	13	
Lamp Wattage Factor		1	1	1	1	1,11	1,05	1,05	
Electricity consumption in 2006, TWh (total)		41,73	17,92	2,31	20,13	15,59	10,73	8,21	
Electricity consumption in 2006, TWh (NDLS)		41,31	11,83	1,27	11,07	7,84	10,73	8,13	
Electricity consumption, %		35,78%	15,36%	1,98%	17,26%	13,37%	9,20%	7,04%	
Data control for 2007		Eurostat includes both domestic and commercial customers.							
Eurostat Apparant consumption for EU27 in 2007		811.626.000	347.000.000	318.000.000		310.460.000	388.072.000	493.000.000	
Domestic 2007 Sales/Apparant consumption 2007		0,7	0,8	0,4	0,3	0,6	0,08	0,7	
Apparent EU27 consumption = Production in EU27 + Imports - Exports									
2007 sales in the non-domestic sector (calculated as the residual)		220.686.000	76.100.000	80.280.000		127.480.000	358.514.500	140.000.000	
Non-domestic sector									

In Table 2.25, data control by relation to Eurostat apparent consumption in 2007 gives reasonable results related to our expectations and Table 2.10 concerning CFLi.

Table 2.26 summarizes the domestic MEEuP data that are used in section 2.2.7 to develop MEEuP data for all sectors. These MEEuP data are used in other chapters.

*Table 2.26: Lamp data and domestic stock used in section 2.2.7 and next parts of the study*

Lamp type	Stock of Domestic lamps	DLS	Lamp life	Average operation per year	Base case wattages
	millions	%	Hours	Hours	Watt
<b>GLS-F</b>	1932	1	1000	400	54
<b>GLS-C</b>	830	34	1000	400	54
<b>HL-MV LW</b>	128	45	1500	450	40
<b>HL-MV HW</b>	149	45	1500	450	300
<b>HL-LV</b>	937	51	3000	500	30
<b>LFL</b>	384	0	12000	700	38
<b>CFLi</b>	752	1	6000	800	13

## 2.2.7 Stock and sales MEEuP data for all sectors

The lamp types identified as base-cases (part 1 concerning NDLS) in chapter 5 are used in order to investigate environmental and economic results for the domestic sector as well as “other sectors” with the assumption that lamp life, the average wattage, the lamp price and the shares of NDLS lamps are the same as in the domestic sector. Regarding CFLi, it is assumed that sales in the non-domestic sectors are negligible.

The shares of replacement sales (see definition in section 2.2.6) for the non-domestic sector are assumed to be the same as found for the domestic sector: 131 % for GLS-F, 125 % for GLS-C, 28 % for HL-MV-LW, 45 % for HL-MV-HW, and 85 % for HL-LV.

Finally is assumed that all base-cases in the non-domestic sector operated 1800 hours per year (250 working days/year with around 7 operating hours per day). The annual burning hours for all sectors are calculated in Table 2.27 based on a weighted average:

$$Operation\ hours_{All} = (Operation\ hours_{Dom} \times Sales_{Dom} + Operation\ hours_{Other} \times Sales_{Other}) / Sales_{All}$$

*Table 2.27: Calculation of average operation hours per year for all sectors*

	CLS-F	GLS-C	HL-MV-LW	HL-MV-HW	HL-LV	CFLi
Domestic sector	400	400	450	450	500	800
Non-Domestic	1800	1800	1800	1800	1800	-
All sectors	505	551	538	536	705	800

The stock of lamps for non-domestic sectors are calculated as:

$$Total\ Stock = (Lamp\ life / Operation\ hours) \times Share\ of\ Replacement\ Sales \times Total\ Sales$$

Based on the market trends described in section 2.3, a Business as Usual (BAU) forecast has been made on the stock and sales data, see Table 2.28. This BAU forecasts will be used in chapter 8 scenarios.

Table 2.28: BAU (Business as Usual) forecast of NDLS stock and sales for all sectors

	GLS-F		GLS-C		HL-MV-LW		HL-MV-HW		HL-LV		CFLi	
	Stock	Sales	Stock	Sales	Stock	Sales	Stock	Sales	Stock	Sales	Stock	Sales
2007	1.800.065.189	767.385.600	568.509.931	297.000.000	134.417.807	97.379.464	119.442.239	84.120.536	558.259.592	147.000.000	1.010.100.000	353.000.000
2008	1.580.042.277	687.946.619	523.464.062	273.114.493	193.472.689	115.167.651	151.277.051	89.792.317	571.458.374	149.258.129	1.228.500.000	353.000.000
2009	1.399.919.366	624.935.727	478.418.193	249.228.986	252.527.572	132.955.838	183.111.863	95.464.097	584.657.156	151.516.259	1.407.000.000	342.300.000
2010	1.251.296.455	573.674.336	433.372.325	225.343.479	311.582.454	150.744.025	214.946.675	101.135.878	597.855.938	153.774.388	1.554.000.000	334.600.000
2011	1.123.673.543	527.820.444	388.326.456	201.457.972	370.637.336	168.532.212	246.781.486	106.807.659	611.054.720	156.032.517	1.680.000.000	333.200.000
2012	1.038.294.179	444.839.604	384.972.443	200.832.573	394.348.142	174.770.885	253.511.891	107.623.879	622.189.495	158.214.017	1.778.700.000	322.700.000
2013	992.814.814	446.277.547	381.618.430	200.207.173	418.058.948	181.009.559	260.242.295	108.440.099	633.324.270	160.395.516	1.837.500.000	295.960.000
2014	953.635.450	434.264.989	378.264.418	199.581.774	441.769.754	187.248.232	266.972.699	109.256.319	644.459.044	162.577.015	1.890.000.000	297.500.000
2015	927.056.085	431.733.931	374.910.405	198.956.374	465.480.560	193.486.905	273.703.103	110.072.538	655.593.819	164.758.515	1.929.900.000	291.900.000
2016	900.476.721	422.965.873	371.556.392	198.330.975	489.191.366	199.725.578	280.433.507	110.888.758	666.728.594	166.940.014	1.969.800.000	297.220.000
2017	878.097.356	418.397.816	368.202.379	197.705.575	512.902.172	205.964.251	287.163.911	111.704.978	677.863.369	169.121.513	2.005.500.000	298.340.000
2018	859.917.992	415.950.758	364.848.367	197.080.175	536.612.978	212.202.924	293.894.316	112.521.198	688.998.144	171.303.012	2.037.000.000	298.900.000
2019	841.738.627	411.424.700	361.494.354	196.454.776	560.323.784	218.441.597	300.624.720	113.337.418	700.132.919	173.484.512	2.068.500.000	303.100.000
2020	823.559.263	406.898.642	358.140.341	195.829.376	584.034.590	224.680.270	307.355.124	114.153.637	711.267.694	175.666.011	2.100.000.000	307.300.000
020 distribution of stock	17%		7%		12%		6%		15%		43%	
995 distribution of stock	69%		22%		0%		1%		4%		5%	
Data in this table refers to NDLS in all base cases (see Chapter 5). The stock in 2007 is calculated based 2006 survey data in table 2.24 and 2007 Eurostat Sales data.												
The stock distribution in 1995 is calculated primary based on table 2.12												

The data in table 2.28 refer to NDLS in all base cases (see chapter 5). The stock in 2007 is calculated based on survey data from 2006 in Table 2.25 and on Eurostat Sales data from 2007. The stock distribution in 1995 is calculated based on data in Table 2.12. As mentioned in section 2.1.2 CFLi sales in 2007 might even be underestimated.

Figure 2.3 shows the forecasted yearly sales for GLS, halogen and CFLi. GLS sales is decreasing rapidly until 2012 and hereafter the decrease is slow. Use of HL increases constantly during the period (see section 2.3 for further explanation). CFLi sales is expected to peak in 2007-2008 and hereafter to decrease to a constant level around 2013 – this is a conservative forecast as the manufactures are actually inventive in order to keep the actual level of CFLi sales as described in section 2.3. Due to the gradually saturation in use of CFLi, the replacement sales goes from being 35% of the yearly CFLi sales in 2007 to 90% in 2020.

Figure 2.4 shows the forecasted distribution of the stock of GLS, halogen and CFLi. Use of GLS is decreasing rapidly in the first part of the period as both the stock of HL and CFLi is increasing fast. After 2011, the stock of CFLi is increasing slowly, but the stock of HL is still increasing and the stock of GLS is continuing to decrease.

The growth rates are related to trends and are explained in section 2.3.1. Amongst others it explains the relative high assumed HL-MV-HW stock increase between 2006 and 2011.

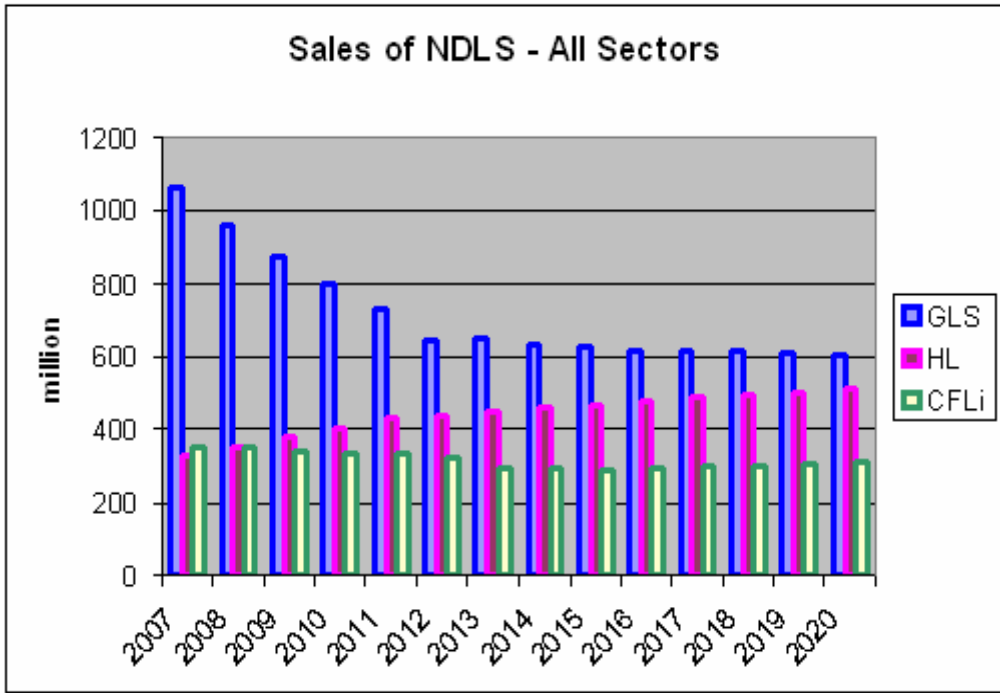


Figure 2.3: BAU (Business as Usual) forecast of NDLS sales in all sectors

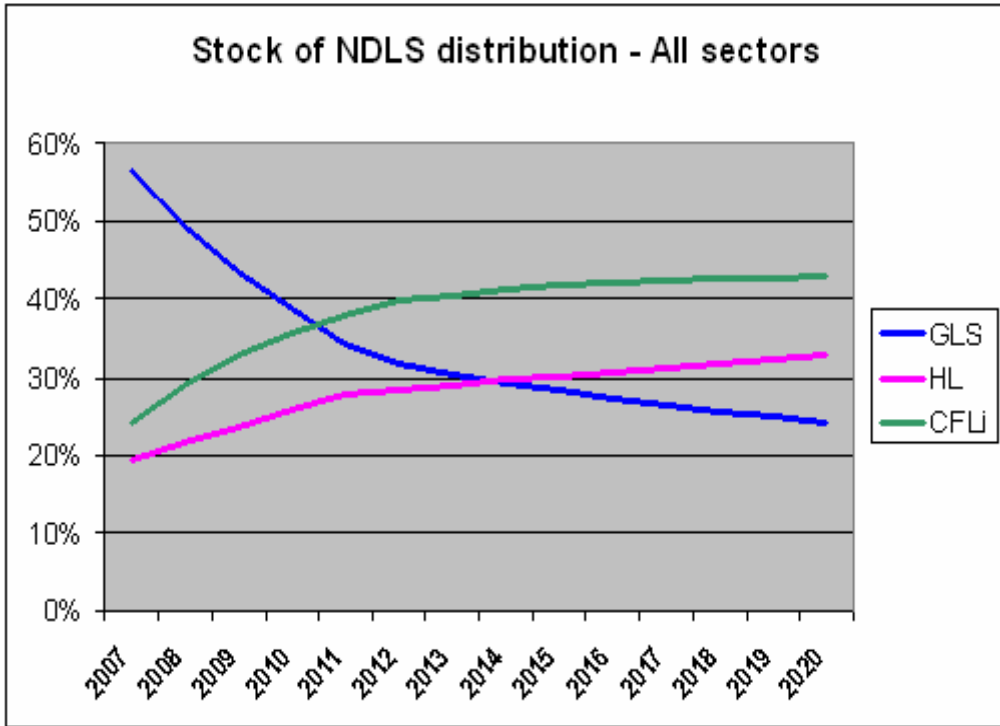


Figure 2.4: Business as Usual (BAU) forecast of the NDLS stock in all sectors

## 2.3 Market trends

### 2.3.1 General product design trends and features from marketing point of view

#### Lamps

Lamps are currently considered as replacement parts for luminaires because lamp lifetime is typically shorter than the luminaire lifetime. LED's could change this by making lamps that last as long as the luminaire. The LED technology will be considered in chapter 6.

Domestic customers are typically doing maintenance/shift of lamps themselves.

The following paragraphs give an overview of the market and production structure and identify the major players of the sector.

#### Domestic lighting purchase process

The current domestic lighting purchase process mainly takes place in the retail market. The customer buys luminaires and lighting sources in lighting shops, furniture stores, do-it-yourself shops and supermarkets. Those products are installed by the user (frequently), a home decorator or qualified electrician.

With the growing welfare, many people are installing new kitchens, bathrooms or are adding verandas. In this process, the designers and installers have a large influence by including lighting solutions. Some of those furniture and appliance manufacturers are including lighting in their products, and this market seems to be dominated by halogen down lighting (e.g. reflector lamps). This causes a shift from GLS to a multitude of halogen lamps from 1995 until 2007 as can be seen from Table 2.11 and Table 2.12. Halogen down lighting typically includes several light points. This is a first driver for more light points at home. A second driver is the growing welfare in general. This also results in an increased use of light points as can be concluded from Table 2.11 and Table 2.12, probably because the living space per capita increased (e.g. by a growing number of people living alone) or simply because more light sources were installed. One could fear that there is no natural limitation on this growth rate because the eye is able to adapt to a broad luminance range and daylight levels are by far not yet reached in domestic lighting. However, in some new installations complaints about glare and overheating of the room did already slow down this growth rate. The latter was sometimes already experienced in shop lighting or new glossy kitchens with reflector lamps. Therefore some market saturation could occur on the long run.

There is thus a clear BAU trend to replace GLS by halogen lighting. There is also a trend of market shift from HL-LV (12 volt) to HL-MV (230 V), mainly because the installation work is easier without a transformer. This is documented by ELC sales in Table 2.6 and Table 2.7 showing a larger much increase in low wattage HL-MV sales. Therefore, increases in halogen lamp sales of 9.3%/year for HL-MV-LW, 2.5%/year for HL-MV-HW and 1.4%/year for HL-LV are assumed, for the period 2007-2020.

A fast stock increase of HL-MV-HW from 2006 until 2011 for all sectors was assumed. Combination of data in Table 2.11 and Table 2.28 shows that domestic customers in Belgium, Italy and UK are already at the high 2020 HL-MV-HW stock level. Table 2.29 shows an

increase a yearly increase 6.5%/year for HL-MV 75-100W and 2.5%/year for HL-MV  $\geq$  200W. With this in mind along with the number of households is suppose to increase from 2007 to 2020 and that Central & Eastern EU might expand their use of lighting to a level similar to the rest of EU. In the domestic sector, HL-MV-HW's are used in up-lighters (floor and wall), spots in the hall/staircase/entrance, outdoor lighting and in do-it-yourself working lamps (typically 500W lamps in floodlights). Floor standing up-lighters can easily be installed. One should be aware that those lamps are also sold with luminaires at low cost and hence 'lamp' sales data lags behind. Hence, the stock estimates for other countries in previous sections might be far to low and this is compensated.

The other strong trend is to replace GLS by CFLi due to the public awareness of the climate change problems and the rising energy prices. In 2006, CFLi sales increased very fast by 77% and the growth continued in 2007, see Figure 2.1 and this might even be underestimated (see 2.1.2). A visit to the Light&building 2008 fair in Frankfurt showed that both European and Asian manufacturers are inventive and could be expected to maintain their high 2006-2007 CFLi sales, e.g. they could use the following techniques:

- Selling more shapes of CFLi.
- Promoting different colour temperatures for use in different seasons and applications.
- Selling decorative CFLi.
- Increasing the CFLi functionality (e.g. dimmable, incorporated sensors (light, presence, ..), remote control, ..).
- Reduction of product price through selling multi-packs.
- Price discounts.

Anyhow, as shown in Figure 2.3 the sales of CFLi is expected to decrease gradually after 2008 until -18% in 2015 and hereafter sales will start to increase slowly again. The explanation for this development is the large increase in use of halogen lamps (replacing GLS), the long lifetime for CFLi and the fact that some customers have a few light points left where they prefer to keep the GLS due to barriers for CFLi as explained in chapter 3 (e.g. requirements to color rendering, sparkling effect etc.) or because of the lamp has little usage such as in cellars, staircases or storage rooms and where full lighting is also needed immediately.

Table 2.24 shows that the EU-27 average number of light points per household was 24.3 in 2006 (survey data) and that the BAU (Business as Usual) stock is forecasted to increase up to 27.5 in 2011 and 31 in 2020.

### **Global lighting production market**

The global lighting-product manufacturing industry is made up of many enterprises ranging from large multinational private companies that manufacture a broad range of lighting products to small single-product firms publicly or privately owned. (IEA, 2006).

When viewed as a region, the European Union is the world's largest producer of lighting equipment in terms of value, although China is about to surpass in terms of volume (IEA, 2006). The European lighting manufacturing industry has annual revenues of about EUR 13 billion, of which EUR 5 billion (USD 6.2 billion) is from lamp manufacturers (ELC, 2005 in IEA, 2006) and EUR 8 billion from luminaires, ballasts and associated electro technical equipments (CELMA, 2005 in IEA, 2006).

Lamp manufacturers are represented by the European Lamp Companies Federation (ELC), which includes among its members<sup>14</sup> Philips Lighting, OSRAM, GE Lighting, Aura Lighting Group, BLV, Leuci, Narva and Sylvania Lighting International (SLI). The European activity of these companies employs roughly 50,000 people and produces an annual revenue of EUR 5 billion<sup>15</sup> (IEA, 2006). ELC claims to represent 95% of the total European lamp production but their part of the sales are much lower as a considerable part e.g. of the CFLi sales is covered by retailers that import directly from China.

Manufacturers of luminaires and electro-technical parts for luminaires are represented by CELMA. The 16 national member associations of CELMA represent some 1,200 companies in 11 European countries. These producers, which include many SMEs, directly employ some 100,000 people and generate EUR 8 billion annually. CELMA claims to supply more than 90% of luminaires and associated electro-technical parts for the EU market (IEA, 2006).

### **Market shares and competition**

Lamps are a globally traded commodity and there is a high degree of standardisation between international lighting markets. The lamp market is highly concentrated, with a limited amount of players and thus financial power in the marketplace, whereas the luminaire market is very fragmented.

For several decades four major multinational lamp manufacturers have dominated the international lamp market:

- Philips, based in the Netherlands
- OSRAM, based in Germany (also present in the United States as Sylvania)
- General Electric, based in the United States.
- Sylvania, based in Europe, recently renamed as Havells Sylvania.

While these companies have a strong presence in almost all global markets their strength varies in the different sectors and regions appreciably (IEA, 2006).

Shift to a higher degree of use of CFLi's will result in a large import of lighting products from China.

The forecast in Table 2.25 shows that even without any legislation, the market share and the stock of GLS-F and GLS-C are decreasing as they are increasingly replaced by halogen lamps and CFLi (see section 2.2.7 for more details about the forecast).

### **2.3.2 Duration of redesign cycle and market lifetime of the EuP**

For these aspects, domestic lighting products are discussed as consisting of two essential parts:

- the light source, in some cases including its control gear,
- the luminaire as a holder for lamp and control gear.

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<sup>14</sup> ELC, Make the switch: The ELC roadmap for deploying energy efficient lighting technology across Europe [http://www.elcfed.org/uploads/documents/-3-01elc\\_a5report\\_6\\_05.pdf](http://www.elcfed.org/uploads/documents/-3-01elc_a5report_6_05.pdf)

<sup>15</sup> <http://www.elcfed.org/index.php?mode=0>

Both parts have different redesign cycles and different market lifetimes.

### **2.3.2.1 Redesign cycle for a light source**

The duration of a redesign for a light source depends mainly on technology and it can last from several months to more than 50 years from first idea to functioning technology and working prototype. The redesign cycle will always include the long term reliability testing.

If it is only a question of amelioration of known, patent free technology, the main factor is lifetime testing: maximum number of possible burning hours per year is about 8.000. A conversion of the production lines with possible investment decisions can extend this period. Manufacturers are continuously working on ameliorating their products in that way that the new product can replace the old one, without changing luminaire or control gear.

For example the low voltage, pin based halogen lamp was introduced in the seventies of the previous century and pleased the designers and customers by its bright, small appearance. Infrared reflecting coating in lamp production was already applied in low pressure sodium lamps in the beginning of the years 1980. It took about a decade to introduce this technology in the low voltage halogen lamps production; the results in energy savings are significant (for more information see chapter 6).

A similar example is the compact fluorescent lamp with integrated ballast that was globally introduced in the early years 1980 and is still continuously ameliorated to replace a (frosted) incandescent lamp. The first lamp was fairly large and heavy with magnetic ballast and low  $R_a$ . New lamps are smaller, have lightweight electronic control gear, a colour rendering  $80 < R_a < 90$  and finger, spiral or GLS look-alike forms (see chapter 6).

The LED is an example of an important technology change. The light emitting diode was invented in 1924 but the first application only appeared on the market in 1948 as a small indicator lamp. Only in the years 1990, after the invention of the blue LED, LED's became available for different purposes (colour signalling, colour displays etc.). At last the introduction as a 'general' light source was made a few years ago.

### **2.3.2.2 Redesign cycle for a luminaire**

A luminaire for domestic lighting is mostly intended to hold the light source and its possible control gear and to embellish the 'home environment'. The redesign cycle depends on the technological changes of light sources, fashion, the creativity of the designer and the production cycle. Changing production lines, finish up available stocks of spare parts and new purchase contracts are the most influencing parameters. This cycle can be short e.g. some months after a decision or after the introduction of a new light source.

### **2.3.2.3 Market lifetime of a light source**

It is not always obvious to determine the market lifetime of a light source and its possible control gear.

A clear example of a long market lifetime is the incandescent lamp, that was invented in 1879.

After its introduction on the market (almost 140 years ago), only a few small improvements were performed: the carbon wire was replaced by a tungsten wire, the vacuous bulb was first filled with an inert gas as nitrogen and later in some cases with argon or krypton.



Also the halogen lamp is a special type of incandescent lamp where the filling gas contains halogen or xenon. The first halogen lamps came on the market in the years 1960 in the known form with R7s-cap. It was introduced for its increased lifetime and efficacy.

The smaller size low voltage halogen lamp that was introduced in the years 1970 stays on the market although a better technology, the infra-red coating, is available on the market. The end of the product life of the non-IRC halogen lamps will mainly depend on retail price and sufficient availability on the market; the fact that these new IRC-lamps are more energy-efficient doesn't seem to influence the consumers so much when the price stays high.

For CFLi's, the market lifetime is dependent on the meaning of 'product'. The first generation of compact fluorescent lamps can be considered a different product from the current CFLi's and thus the lifetime was 10-20 years. These first generation lamps have even completely disappeared from the European market due to the better quality, shape and price of the new generation. At this time, the new generation lamps are being continuously ameliorated but basically the product is not changed. It is very difficult to determine a product's market lifetime as the 'product' itself is not clearly determined.

#### **2.3.2.4 Market lifetime of a luminaire**

For the market lifetime of a luminaire, a subdivision has to be made between:

- classic or traditional luminaires like crystal luminaires, bronze luminaires etc.
- design luminaires.

For the first small category, the market lifetime does not expire; manufacturers will only change details, but the basic model almost lasts for 'eternity'. The second and largest category, that is fashion dependent, has rarely more than a maximum market lifetime of 3 years as lighting designers like to renew their products as frequent as possible to be trendy.

For some special applications such as Christmas lights, the market lifetime can even be only one season, especially nowadays that LED's are entering the market for this purpose.

As a consequence, a uniform lifetime for domestic luminaires can hardly be given. A weighted average for both categories of 3 years can be assumed.

## **2.4 Consumer expenditure data**

### **2.4.1 Product prices**

Eurostat data are not suitable for estimating product prices (luminaires, lamps, ballasts, other replacement parts). For product prices, we therefore used manufacturers' catalogues. Taking into account that the prices displayed in these catalogues are for retail trade, realistic assumptions for the prices of different lighting parts were made based on the experience of the market, e.g. consultation of small and large retailers, advertising brochures etc.

Chapter 4 (Table 4.6) gives specific retail lamp prices for products (except LFL). Examples of typical retail prices for domestically used lamps are given in Table 2.30:

Please note that product prices on CFLi can include an anti-dumping tax in EU-27. By Council Regulation (EC) 1470/2001, the EC imposed anti-dumping duties ranging from 0% to 66.1% on imports of CFLi's originating from China. By Council Regulation (EC) 866/2005 these duties were extended to the Socialist Republic of Vietnam, the Islamic Republic of Pakistan and the Republic of the Philippines. In October 2007, the Council adopted a regulation for a one year extension (Council Regulation (EC) 13040/1/07).

*Table 2.30: Typical EU-27 retail prices for lamps for domestic use*

Lamp price	Typical in €
HL-MV G9	5,5
HL-LV GY6,35	3
GLS-C 60W	0.5
GLS-F 60W	0.5
GLS-C 40W	0.7
GLS-F 40W	0.7
GLS-C-HW	2
LFL T8 18W	4,5
LFL T5 14W	8
CFLi 15W	5
CFLi 10W	4
CFLi 20W dimmable	20

Product prices can also include taxes or recycling contributions that can differ from country to country, some examples are included hereafter.

*Denmark* has a taxation on lighting sources added to the sales price:

- CFLi no tax
- GLS 3.75 DKK (= 0.5 Euro)
- Fluorescent tube 7.5 DKK (= 1 Euro)
- Halogen low voltage 0.75 DKK (0.1 Euro)
- Halogen 230V 3.75 DKK (= 0.5 Euro)
- Metalhalogen 7.5 DKK (= 1 Euro)
- Emission lamp 7.5 DKK (= 1 Euro)

The Danish taxation is basically a tax to collect state income but also an energy efficiency effort since there is no tax on CFLi's - nevertheless there is a tax for fluorescent tubes and metalhalide lamps although these lamps are very energy efficient.

According to a decree-law of April 12, 2007 *Portugal* has such an added cost or 'tax' for low energy efficiency lamps to compensate for environmental influence from this type of lighting.

The tax is calculated based on the following parameters: electric power and life cycle of the lamp compared to energy efficient lamps and the average value of CO<sub>2</sub> emission factor and cost for Portugal. The tax income will feed the Portuguese Fund for Carbon (80%) and the Energy Efficiency Fund (20%).

Several countries have an added 'disposal/recycling' contribution that is included in the sales price. For example *Belgium* has a WEEE directive specifying that a cost is added to the sales price for recycling. It is not a tax since it is not raised by the government but a contribution to take care of the recycling. The cost per lamp is at present € 0,30 and is added for CFL, LFL and other discharge lamps while there is no cost for GLS and HL. For more information on recycling schemes and costs in other EU-27 countries please consult [www.weee-forum.org](http://www.weee-forum.org).

## **2.4.2 Electricity rates**

Electricity costs account for an important part in the domestic lighting costs: according to IEA<sup>16</sup> lighting amounts up to 79% of the total cost. Electricity rates (euro/kWh) are subject to fluctuations due to recent market liberalisation.

Eurostat regularly reports on electricity prices for domestic household consumers are shown in the table below.

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<sup>16</sup> Source: IEA, 2006

Table 2.31: Electricity prices for domestic customers  
17

EU region	Country	Number of households	Electricity price for hh customers using 3500 kWh/year
		millions	€/kWh by 1/1 2007
Central and Eastern EU	Bulgaria (BL)	3,7	0,0658
	Czech Republic (CZ)	4,40	0,1067
	Cyprus (CY)	0,32	0,0796
	Estonia (EE)	0,60	0,075
	Hungary (HU)	4,10	0,1222
	Latvia (LV)	0,97	0,0686
	Lithuania (LT)	1,30	0,0777
	Malta (MT)	0,13	0,0895
	Poland (PL)	13,30	0,1184
	Rumania (RO)	8,13	0,1018
	Slovenia (SK)	2,10	0,1537
	Slovakia (SI)	0,69	0,1064
Middle EU	Austria (AT)	3,30	0,1545
	Belgium (BE)	4,30	0,1581
	France (FR)	32,20	0,1211
	Germany (DE)	39,10	0,1949
	Ireland (IE)	1,44	0,1662
	Luxembourg (LU)	0,20	0,1684
	The Netherlands (NL)	7,00	0,218
	United Kingdom (UK)	26,20	0,1323
Northern EU	Denmark (DK)	2,50	0,258
	Finland (FI)	2,50	0,116
	Sweden (SE)	4,50	0,1714
Southern EU	Greece (EL)	3,70	0,072
	Italy (IT)	22,50	0,2329
	Portugal (PT)	4,20	0,15
	Spain (ES)	17,20	0,1225
EU27 average (weighted by hh)		210,6	<b>0,1529</b>

### 2.4.3 Repair, maintenance and installation costs

Replacement and installation of lamps is practically always done by the domestic user and hence no labour cost will be taken into account.

For domestic luminaires, maintenance and installation are typically also done by the domestic user. For some ceiling and outdoor luminaires installed during construction, the replacement might be so difficult that the customer needs to hire a professional to do this; in that case the cost might be very high and is thus unpredictable.

In part 1 of this study, no installation or maintenance costs are taken into consideration. **In part 2, installation of luminaries will be considered.**

<sup>17</sup> Eurostat collects regularly data for 5 categories of domestic consumption, ranging between annual consumption 600 kWh to 20,000 kWh. Here is used “medium size household” (3,500 kWh/year) .

#### 2.4.4 Interest and inflation rate

EU-27 averages for interest rate and inflation rate are published by ECB and Eurostat:

- Interest rate = 3,9 % (source ECB<sup>18</sup>).
- The Inflation rate was 2,1 % (source Eurostat<sup>19</sup>) when this study started. Lately the inflation rate has raised to around 4 % and many economical experts forecast that the inflation will be at a higher level during the next 5 years.

Please note that these values can vary on a monthly basis and are related to currency (Euro-zone and outside Euro-zone member states).

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<sup>18</sup> ECB long-term interest rate; 10-year government bond yields, secondary market. Annual average (%), 2005

<sup>19</sup> EU27 Annual Inflation (%) in Dec 2005 Eurostat "Euro-Indicators", 7/2006 - 19 January 2006.



### **3 CONSUMER BEHAVIOUR AND LOCAL INFRASTRUCTURE**

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### **4 TECHNICAL ANALYSIS EXISTING PRODUCTS**

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### **5 DEFINITION OF BASE-CASE**

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### **6 TECHNICAL ANALYSIS BAT**

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