Household Luminaires: Recommendations for Policy Design

September 2011

1. Abstract

Consumers do not have sufficient information about household luminaires energy efficiency. European eco-design requirements and energy efficiency labels for lamps are good, but they are not enough. Household luminaires differ greatly in optical efficiency, and mandatory luminaire labelling should be aimed for in the mid-term. Successful voluntary luminaire labels exist today and can lead the way. Mandatory product information on optical efficiency is neccessary to tap the full saving potential of domestic lighting. It could be a powerful tool for initiating fast product development towards energy efficiency.

No luminaire labelling regulation has yet been agreed upon. A straight-forward test standard and classification system must be found to calculate energy efficiency. The process needs to be viable for industry. Strategies to streamline the process must be investigated to minimize bureaucracy and costs, especially for small and medium-sized enterprises.

Short-term measures could include warnings on luminaires that are not compatible with efficient lamps, and a practice that luminaires be sold with lamps of the highest efficiency class available for the socket. This would ensure energy efficient lighting is supported from the moment of the luminaire sale.

2. Background

In the EU, no energy information must be given for household luminaires. European regulations focus on lamps[1], with the energy label for non-directional lamps and the „phase-out of incandescent lamps“ (Commission Regulation 244/2009), e.g. 60 watt incandescent lamps were taken from the market this year. Complementary regulations are currently being drafted with the aim to include directional lamps and LEDs.

It is not enough though to promote efficient lamps. Household luminaires differ greatly in optical efficiency. For example, incandescent lamps might have an efficiency of 12 lm/W while CFLs are five times more efficient with 60 lm/W. Data of 16'000 luminaires[2] with fluorescent lamps and electronic control gears revealed an optical efficiency range from 5 lm/W to 100 lm/W.

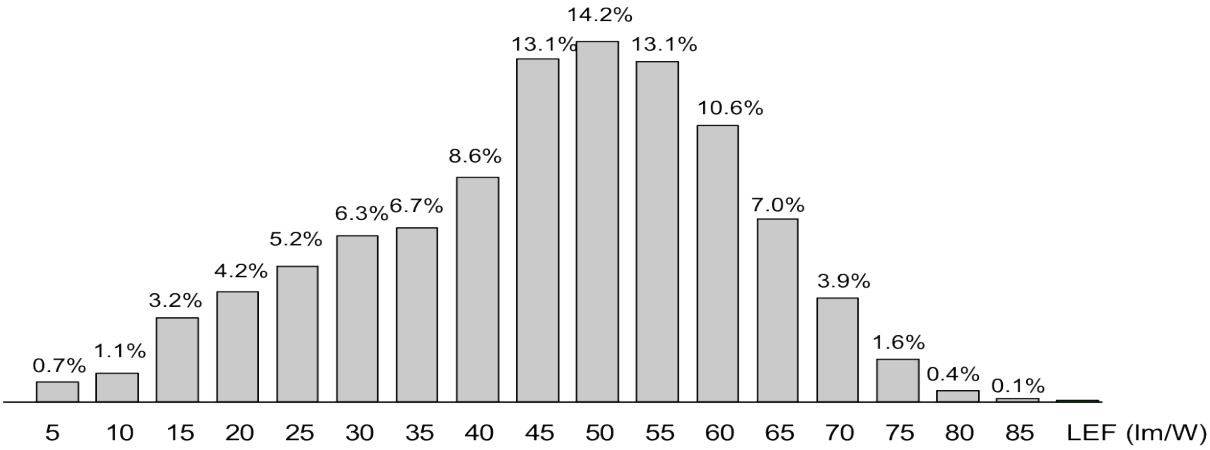

Figure 1: Frequency distribution of the luminaire efficiency factor (lm/W) of 16’000 luminaires in the relux database (only fluorescent lamps and electronic control gears)

Product information on optical efficiency is neccessary to tap the full potential of domestic lighting. Big savings are possible for households. The 2009 status report by JRC notes that „lighting represents 10,5 % of the residential electricity consumption, being the third main consumer after electricity for heating and cold appliances“.

While consumers’ choices could be directed towards energy efficient luminaires, a label would also motivate manufacturers to more thoroughly consider energy use in luminaire design. A mandatory label can be a powerful tool to initiate fast product developement towards energy efficiency. The latest example that demonstrated this is the new energy label for TVs.

Lack of product information on efficiency is not the only barrier to eco-design measures regarding luminaires. The lamp sockets in luminaires can tie consumers to inefficient lamp types. There’s a market trend to tiny halogen capsules which do not have energy efficient replacements. This so-called socket and space lock-in effect should be met with eco-design requirements for luminaires.

[1] In this article the term lamp refers to that part of a lighting apparatus that emits luminance (i.e. the bulb). Luminaire refers to the complete lighting apparatus.

[2] S.A.F.E. / Gasser 2005. See also preparatory study Lot 8: Office lighting in 2007, p. 87.

3. Aim

A mandatory European label for household luminaires is needed, in order to effectively move domestic lighting towards more energy efficiency. The efficiency classes should be based on the optical efficiency of the luminaire. This can either be the light output ratio LOR or the luminaire efficiency factor LEF.

- Light Output Ratio (LOR): Ratio of the total flux of the luminaire with its own lamps and equipment, to the sum of the individual luminous fluxes of the same lamps when operated outside the luminaire with the same equipment, measured under specified conditions.
- Luminaire Efficiency Factor (LEF): Total flux of the luminaire with its own lamps and equipment, divided by the electric power consumption, measured under specified conditions. It is measured in lumens per watt (lm/W).

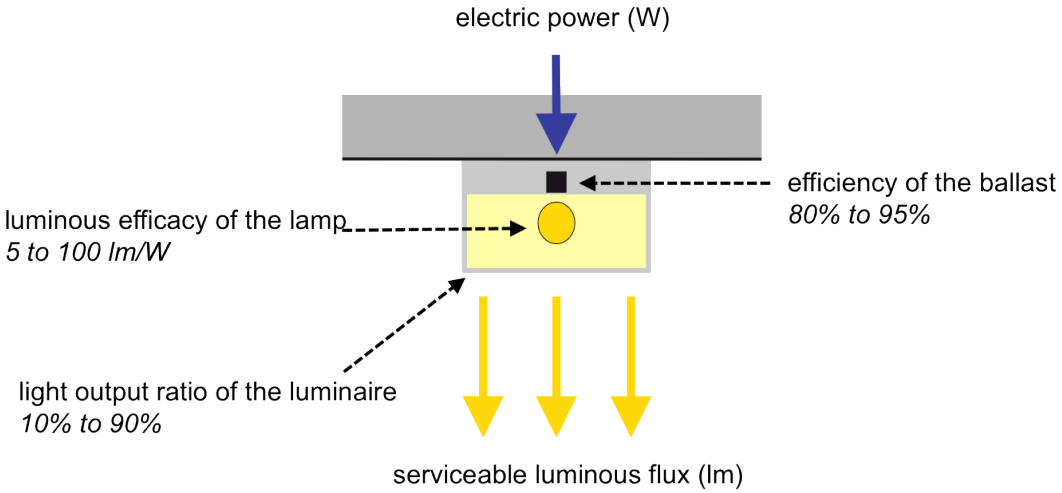

Figure 2: Illustration of LOR and LEF

The luminaire label should further contain information about energy consumption (watts in use and standby or kWh per year), glare (Unified Glare Rating UGR and maximum direct glare in Cd/m^2), light distribution (e.g. % direct light), light control functions (daylight / presence sensors, dimming).

4. Current Work by the European Commission / Eco-design Process

The European Commission is currently working on Eco-design requirements and a labelling regulation for reflector lamps to complement regulations already in force for non-directional lamps. Household luminaires are addressed as a part of these working documents, but the focus is clearly on directional lamps and LED lamps.

Already in the underlying preparatory study (part 2 of Final report Lot 19: Domestic lighting) investigations into household luminaires were limited. There is scarce data on market shares and efficiency, and technical analysis was eclipsed. This means there are still only limited insights into efficiency performance and saving potentials of household luminaires. Obstacles to eco-design measures were discussed, the most important being concerns from the industry about additional costs and administration, and negative effects on design through

requirements (see also below). The authors of the study recommend introducing “an ecolabel or other voluntary labelling for the most efficient luminaires”, which would “facilitate horizontal promotional campaigns and rebate programmes”. They would like to see further studies on “user behaviour and the possibilities to measure application parameters for domestic luminaires”. They also point out a lack of independent measurements facilities.

The working documents on directional lamps, LED lamps, halogen lighting converters and household luminaires were discussed in a consultation forum on July 5th 2011. Being discussed was a household luminaire label that would indicate „the range of classes of compatible lamps, with the possibility to superimpose an indication of the class of the lamp(s) actually included in the packaging“. Many participants in the consultation forum disapproved of this proposal. It will likely be dropped in favor of a warning on the packaging of luminaires that cannot operate lamps of efficiency class A. On September 23rd 2011 a sub-group of the consultation forum will discuss technical details of the draft regulations.

Work on office lighting by the European Commission should also be considered. There are substantial grounds for implementing eco-design requirements and labelling for professional environments. Detailed data on light distribution is readily available in the databases of light planning softwares (i.e. Relux and Dialux). Labelling benchmarks and luminaire categories were proposed in the preparatory study Lot 8: Office lighting in 2007. Despite a promising start, nothing has been implemented to this point. Optical efficiency requirements for tertiary luminaires and energy labelling were again discussed in a consultation round from July to September 2010. Legislation capping energy consumption of installed lighting was discussed as an option beyond eco-design. The discussion is ongoing. It has been suggested that lack of consensus on the categorization of luminaires has impeded progress.

Topten would welcome mandatory luminaire labels. They should be aimed for in mid-term. Successful voluntary labels could be models for progress and lead the way.

5. Examples of Voluntary Luminaire Labelling

Topten[3] functions as a label for household luminaires in Switzerland. It highlights energy saving luminaires and sets requirements for LED and desk luminaires.

A test method for domestic luminaires was developed by Topten and the University of Applied Sciences HTW Chur. Significant specifications for efficiency and quality are determined with practical and cost-effective procedures (see EEDAL paper). Two large swiss retailers as well as other retailers, specialist shops and manufacturers send their products for testing. Since the laboratory opened in 2008, over 200 luminaires have been tested.

Luminaires that fulfill the criteria defined by Topten Switzerland are promoted with the Topten logo in shops and print. They are published on www.topten.ch and articles in different media (customer magazines or trade journals) create added publicity for these efficient luminaires.

[3] Topten is a consumer-oriented online search tool, which presents the best appliances in various categories of products. The key criteria are energy efficiency, impact on the environment, health and quality. It is also a powerful instrument to influence manufacturers. Topten was launched in 2000 in Switzerland. Since then, sixteen European national Topten sites have been established with support of Intelligent Energy Europe (IEE), as well as sites for USA and China. See www.topten.eu. Household luminaires are so far presented only on the Swiss Topten site www.topten.ch, in German, French and Italian.

In Switzerland, there is also a label for professional luminaires: the Minergie label. The efficiency benchmarks are set so as to label the best 15% of products approximately. Strict requirements are set for standby power and LED light specification.

To apply for the Minergie label, manufacturers and suppliers must submit measurement protocols from an accredited optical laboratory. The luminaires that fulfill Minergie's criteria can then be labelled and published on www.toplicht.ch (in German and French). Currently, more than 580 luminaires by 24 manufacturers are labelled with Minergie.

The Minergie label thrives because its criteria are transparent and straight-forward. With 12 categories, the essential differences of professional luminaire types are taken into account:

- Light distribution:
  - Direct (>90% direct light)
  - Mixed (10-90% direct light)
  - Indirect (<10% direct light)
- Wattage and size of the light source:
  - FL, size < 600mm
  - FL, size > 600mm
  - CFL / HID / LED, wattage < 32W
  - CFL / HID / LED, wattage > 32W

Despite these succesful initiatives, there are obstacles to a European, mandatory label. They shall be discussed in the next paragraph.

6. Obstacles

Several factors impede mandatory labelling initiatives: Economic and market data are scarce, and photometric data is seldom provided for household luminaires. Providing photometric data creates additional costs and administrative work for manufacturers. This can be a heavy burden, especially for small and medium sized enterprises. There is an enormous amount of household luminaire models on the market and many new models are introduced every year.

A lighting system has several purposes: it provides light for visual tasks, security, and atmosphere. Additionally lighting systems contribute to a household's interior as a design element. The preparatory study expresses concerns that aesthetics and glare control could suffer from eco-design measures, „The right energy efficient luminaire will balance: maximum light output ratio, glare control, light distribution and amount of ornaments that absorb light."

LED luminaires have fixed in-built light sources. This means only the LEF can be measured. The LOR cannot. Most common household luminaires, on the other hand, fit lamp types ranging from efficiency classes E to A, and varying by shape, power and light distribution. Often, luminaires are sold without lamps. Standard lamp types have to be defined for the calculation of the energy efficiency index.

The energy efficiency index should consider essential differences between luminaires. An easy and straight-forward classification system has not been agreed upon yet though. A system with approximately 10 – 20 categories would be feasible.

7. Conclusions and Recommendations

Make mandatory luminaire label a goal

Mandatory labels based on optical efficiency for houshold and professional luminaires should be established as a goal. The feasablity of such labelling is being demonstrated by existing voluntary labels. Insights from these experiences can be applied to the development of a mandatory label.

To minimize bureaucracy and costs for small and medium-sized enterprises, a straight-forward test standard for household luminaires should be developed.

The process must be viable for industry. Strategies to streamline the process could include extending test results to like models in modular constructions, and excluding low wattage and limited production series.

We encourage the European Commission to take a stand for mandatory lumianire labelling in the mid-term so research and development can begin.

Short-term measures

It should be ensured that luminaires support energy efficiency. Negative lock-in effects could be tackled with a warning on the packaging: „Cannot operate with energy saving lamps“, when no efficiency class A lamps fit in the luminaire. When luminaires are sold with lamps, the provided lamps should be of the highest efficiency class available for the socket.

8. References and Links

Background

Commission Regulation (EC) No 244/2009 of 18 March 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for non-directional household lamps.

Swiss agency for efficient energy use S.A.F.E. http://www.energieeffizienz.ch

Electricity Consumption and Efficiency Trends in European Union - Status Report 2009. European Commission, Joint Research Centre, Italy, 2009.

Current Work by the European Commission / Eco-design Process

Preparatory Studies for Eco-design Requirements of EuPs - Final report Lot 19: Domestic lighting. Vito, Belgium, October 2009.

Working documents for consultation forum on 5 July 2011 (published in June 2011):
Ecodesign requirements for directional lamps, light emitting diode lamps and halogen lighting converters.
Draft energy labelling regulation with regard to energy labelling of general lighting lamps and household luminaires.
Explanatory Note to Draft energy labelling regulation.

Preparatory Studies for Eco-design Requirements of EuPs - Final report Lot 8: Office lighting. Vito, Belgium, April 2007.

Working document on possible measures targeting the energy efficiency of lighting in the tertiary sector. EC Directorate General for Energy, published on 05.07.2010.

Vito project website: Download preparatory studies lot 19 and lot 8 and other project documents:
http://www.eup4light.net/

NGO Network on EuP: Overview eco-design process, download working documents and position papers of NGOs:
http://env-ngo.eup-network.de/

Examples of Voluntary Luminaire Labelling

Test method for domestic luminaires developed by Topten and the University of Applied Sciences HTW Chur (in German):
Messung von Wohnleuchten. Messmethode von S.A.L.T. Juli 2010.
http://www.topten.ch/uploads/File/Messmethode_Wohnleuchten_081210.pdf

Testing efficient luminaires and LED retrofit lamps – experiences from Switzerland. Topten International Services, 2011. Article for EEDAL conference 2011 in Copenhagen:
http://www.topten.eu/uploads/File/056_Eva_Geilinger_final_Luminaires.pdf

Topten Switzerland website: List of energy efficient household luminaires and selection criteria (in German, French and Italian)
http://www.topten.ch

Toplicht.ch: List of all Minergie labelled luminaires (in German and French)
http://www.toplicht.ch/index.php?page=minergieleuchten

Minergie website: Regulations for Minergie luminaire label (in German, French and Italian)
http://www.minergie.ch/leuchten.html

9. Illustrations

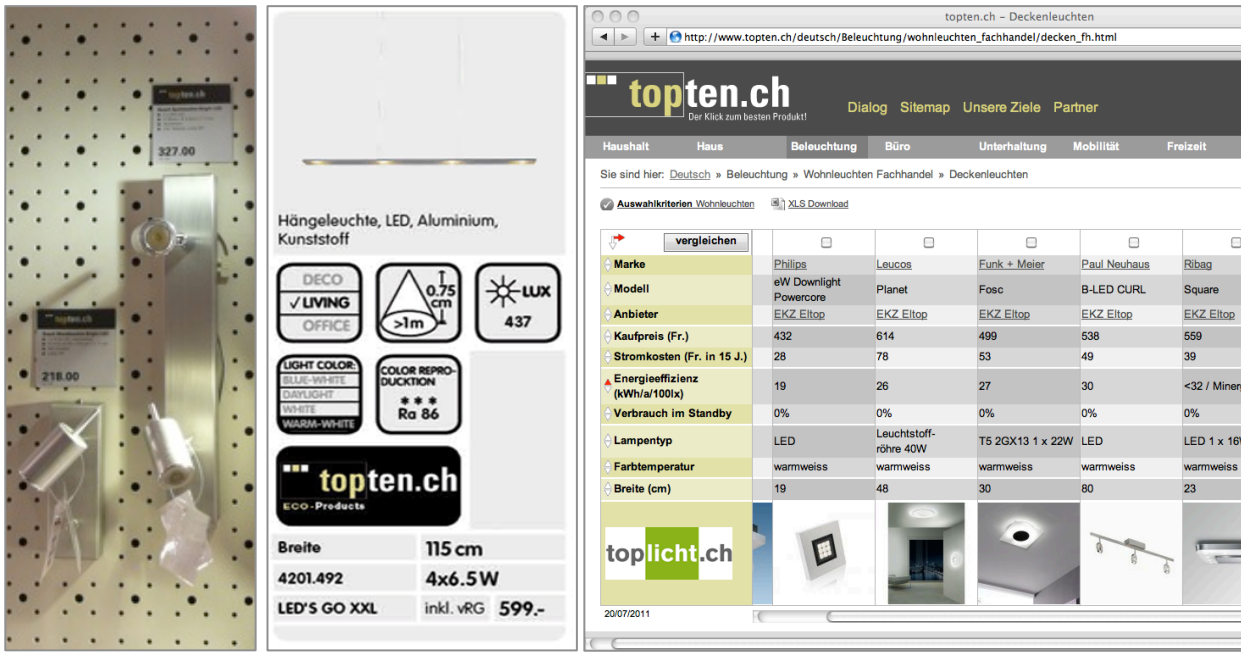

Figure 3: The Topten label promotes efficient household luminaires in displays, in printed catalogues and online on www.topten.ch.

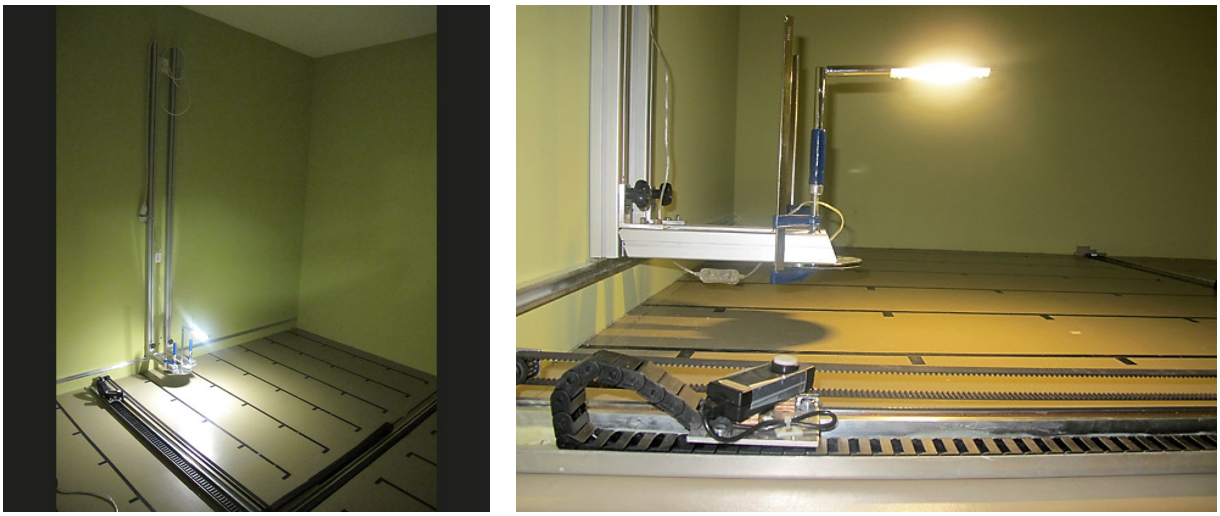

Figure 4: Standardized room for measuring household luminaires at the University of Applied Sciences HTW Chur. A robot measures the illuminance at 100 points on the ground surface. Further parameters are energy consumption (use and standby), color rendering index CRI, color temperature, direct glare and dimming (leading edge / trailing edge).