**DISCUSSION PAPER**
**ON THE OPTIONS FOR A DRAFT ECODESIGN MEASURE ON**
**DOMESTIC LIGHTING PRODUCTS**

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## Main functionalities required from "domestic lighting" lamps

From a consumer's perspective, quality and performance of lamps refer to:

- colour rendering
- lamp start and warm-up times
- lifetime
- aesthetics: bright point light sources are possible only with transparent (clear) glass lamps and are needed in certain lighting installations
- dimmability
- size for compatibility with luminaries

**Additional issues to be considered:**

Mercury content is needed for the high efficiency of Compact Fluorescent Lamps (CFLs). It is considered that the decrease of mercury emissions resulting from energy savings overweigh the need for mercury in the lamps. The mercury content in CFL lamps remains to some extent a risk factor to the user and to the environment (broken CFLs that are not properly cleaned up or disposed can cause mercury concentration affecting health).

Other alleged health effects of CFLs

The Scientific Committee on Emerging and Newly Identified Health Risks (on a mandate from the Commission services) looked into the question of health effects of Compact Fluorescent Lamps on people with certain diseases and on the general public, following up to complaints from certain patients' associations. In its report[1], the Committee concluded that for the general public, prolonged very close exposure to a bare lamp (< 20 cm) could eventually affect health by exceeding limits on UV emissions. On the other hand, the symptoms of about 250.000 people in the EU suffering from diseases accompanied by light sensitivity could be aggravated in the presence of bare CFLs (independent of distance) due to UV and blue light emissions.

Using CFLs with an outer non-breakable lamp envelope can largely solve these problems and also that of mercury pollution in case of lamp breakage, but the envelope slightly lowers (about 10%) their efficacy.

[1] http://ec.europa.eu/health/ph_risk/committees/04_scenihr/docs/scenihr_o_019.pdf

Alleged impact on European industry / jobs

Most incandescent lamps sold today in the EU are produced in the EU, whilst most lamps with integrated electronics (such as compact fluorescent lamps) are produced in third countries (due to their higher labour-intensity). Halogens are produced locally and imported in more or less equal proportions. Therefore, a shift towards lamps with integrated electronics is likely to cause a shift of production away from the EU (industry argued 10.000 out of the 50.000 people producing lamps in the EU). A closer look at the industrial sites concerned shows that the total number of workforce assigned to incandescent lamp production for European sales is in the order of 8000 people in total. However, the shift in production has already taken place to a large extent (as can be seen from the abandon of the claim by the EU manufacturers to continue imposing excise duties on imported CFL lamps). It should be noted that some halogens lamps (class C) can be made on the production lines of incandescent lamps, which would mitigate further the loss of jobs resulting from a ban of incandescent bulbs. Overall, at most 2-3000 jobs are estimated to become redundant after the incandescent lamp phase-out.

Global CFL production capacity

Some stakeholders (especially the European lamp industry) have flagged as a potentially serious problem that if the phasing out of incandescent lamps happens too fast, it could lead to global production capacity shortages of the alternatives (mainly compact fluorescent lamps) when the demand reaches its peak, and to empty shelves in European shops.
With the slow scenarios in the preparatory study, the peaks are low and/or occur late, so global production capacity should not be a problem. In the fast scenarios, the peak occurs early (2009 to 2011) and between 600 and 700 million compact fluorescent lamps may be needed a year depending on the level of ambition.
The following additional factors should be taken into account when determining to what extent this issue should influence decision making.

- Consumers are likely to stock up on incandescent lamps when the phase out will be announced, or use alternative technologies (halogens), longer life of rarely used incandescent lamps.

- It is estimated that already today out of the nearly 3 billion CFLs produced yearly in China alone (80% of total world production), about 40% (1100 billion) are up to European product requirements. The reviews preceding European anti-dumping regulations on CFLs (see Existing legislation above) have pointed out on several occasions that the Chinese market is capable of expanding rapidly to adapt to demand. It is therefore safe to say that the global CFL production capacity could meet European demand.

- Alongside the already announced initiatives, it is impossible to tell when other large countries such as India or China will decide to phase out incandescent lamps. Such decisions obviously would have substantial impact on global demand. However, in recent years we have already seen spectacular increases in compact fluorescent lamp demand in certain parts of the world, for example due to the unexpected incandescent lamp replacement programmes in Cuba and in other Latin American countries. Industry has been able to cope with the increase. On the other hand, the risk is very real of the EU becoming the dumping ground of lamps not needed elsewhere, in case large third countries are faster with their phase-out legislation.

Affordability to the consumer

The increase in purchase price is significant but affordable and it is not considered to be an obstacle to households: incandescent bulbs cost 60 cents, the price of all the alternatives varies between 2 euros up to 10 euros, and is due to lower in the future (higher competition, drop of excise duties). All the alternatives to incandescent lamps bring substantial savings over the life cycle of the product.

## Lamp types and their pros & cons

### I. Incandescent lamp (GLS)

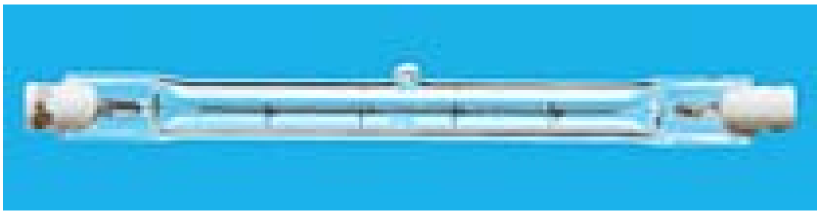
*Standard incandescent lamp*

| Advantages | Disadvantages |
|---|---|
| Bright point light source (if transparent glass) | Low efficiency (E, F or G-class) |
| Full compatibility with existing luminaires | |
| Fully dimmable on any dimmer | |
| Very good quality and performance | |
| No mercury content | |
| No presumed health issues | |
| No impact on EU industry / jobs | |

**II. Halogen lamps (Halo)**

Improved incandescent lamp technology. Much smaller lamp size, equal or slightly higher efficacy than incandescents. Their market share has been rapidly increasing in the past decade as their small size makes them more versatile for lighting design (luminaries and installations).

1.) Conventional halogen lamps (Halo conv)



*Conventional halogen lamps*

Many standard halogen lamps are low voltage lamps, which are more efficient than mains voltage (220 V) lamps. Low voltage lamps (12 V) require a transformer either in the luminaire or integrated into the lamp.

| Advantages | Disadvantages |
|---|---|
| Bright point light source | Low efficiency, no or at best 15% energy savings at mains voltage compared to incandescent lamps (D, E, or F class, low voltage: C class, 25% savings) |
| Full compatibility with existing luminaires | |
| Fully dimmable on any dimmer | |
| Very good quality and performance | |
| No mercury content | |
| No presumed health issues | |
| No impact on EU industry / jobs | |

2.) Halogen lamps with xenon gas filling (C-class)

Recent technology. With xenon gas filling, the halogen lamp will use **about 25% less** energy for the same light output compared to incandescents, even at mains voltage. There exist two versions of this halogen lamp:

- only the filling gas is replaced, the socket and the dimensions of the lamp are the same as for conventional halogens above, and therefore can only be used in luminaires with the special halogen sockets **(Halo socket C)**.

- the improved halogen capsule is placed in glass bulbs shaped like incandescent lamps with traditional socket, which makes it compatible with all luminaires using incandescent lamps (sold as retrofit "energy saver lamps") (**Halo retro C**).

*C-class pear-shaped retrofit halogen lamp*

| Advantages | Disadvantages |
|---|---|
| Bright point light source | 25% energy savings (C class) compared to incandescent lamps |
| Full compatibility with existing luminaires | |
| Fully dimmable on any dimmer | |
| Very good quality and performance | |
| No mercury content | |
| No presumed health issues | |
| Positive impact on EU industry / jobs | |

3.) Halogen lamps with infrared coating (B-class)

Recent technology. Applying an infrared coating to the wall of halogen lamp capsules considerably improves their energy efficiency, the lamp will use **about 45% less** energy for the same light output compared to incandescents (**Halogen B**). However, for technical reasons, this is only possible with low voltage lamps, so a transformer is needed, either as a separate unit, or integrated into the luminaire, or integrated into the lamp for an incandescent retrofit solution. As with the Halogen C lamps, both the halogen socket capsules and incandescent retrofit lamps are available in B class, however currently only one manufacturer is producing retrofit lamps (even though the technology is not protected by patents). Because of the heat coming from the lamp which affects the operation of the integrated transformer, their lamps are available only up to the equivalent of a 60W incandescent bulb.

*B-class pear-shaped retrofit halogen lamp with integrated transformer*

| Advantages | Disadvantages |
|---|---|
| Bright point light source | 45% energy savings (B class) compared to incandescent lamps |
| Fully dimmable on any dimmer | Its manufacturing is unlikely to replace incandescent lamp production in the EU |
| Very good quality and performance | Not compatible with many luminaires (size/socket) |
| No mercury content | No equivalent yet to GLS > 60W |
| No presumed health issues | Only one producer currently for GLS retrofit |

## III. Compact fluorescent lamps (CFLs)

It consists of fluorescent lamp tubes, for which the ballast is not sold as a separate item as for large tubes, but integrated into the lamp, which becomes a standalone retrofit solution to incandescent lamps. Its main interest lies in its long lifetime and high efficiency, the lamp will use **between 65% and 80% less** energy (from a third up to the fifth of the energy) for the same light output compared to incandescents. For mainly decorative reasons, it sometimes comes with an external envelope which hides the tubes and makes it even more similar to light bulbs (though decreasing its efficiency).

*Compact fluorescent lamps with bare tubes and with bulb-shaped outer lamp envelope*

| Advantages | Disadvantages |
|---|---|
| Up to 80% energy saving (A class or upper end of B class) compared to incandescent lamps | No bright point lighting |
| Long lifetime ( 6 times longer compared to incandescent lamps) | Often not dimmable |
| | Mediocre colour rendering |
| | Low starting and warm up time |
| | Mercury content |
| | Its manufacturing is unlikely to replace incandescent lamp production in the EU |
| | Not compatible with many luminaires (size/socket) |
| | Some alleged health issues |

*Efficiency of lamp technologies compared with incandescent lamps*

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

***Analysis of the options***

All of the policy options considered hereafter lead to a complete phasing out of incandescent lamps and conventional halogen lamps. The main questions to be answered are what kind of alternative lamps are left on the market and how fast the banning is implemented.

Option 1:

- only allow CFL lamps on the market

From a purely energy efficiency perspective, only compact fluorescent lamps (CFL) should be left on the market. This could save up to **86 TWh** of energy in 2020 compared to business as usual (equivalent to the final total electricity consumption of Finland in 2006 or of 25 million households).
However, the Ecodesign Directive (2005/32/EC) also requires to take into account functionality from the user's point of view (Article 15.5.a) and possible adverse health impacts (Article 15.5.b).
As discussed above, although health issues seem to be affecting only a restricted number of people (about 250000 in the EU), following the precautionary principle, it is advised to leave alternatives to CFLs on the market.
This would also limit the impact on the functionality of the product (detailed under Option 2).
Options hereunder are ranked following their potential for energy savings.

Option 2:
Option 2a:

- require all non-transparent (frosted) lamps to be CFLs (for applications which do not need to be bright point sources)
- allow the most efficient halogen lamps (class B) to exist if they are transparent lamps. This would offer equivalent light quality to incandescent, full dimmability, no health issues.

Energy savings could drop from 86 TWh to about **51 TWh**.
Dimmability, size/socket compatibility, performance and possible health issues are still present for non-transparent lamps.

Currently, the light output of transparent GLS retrofit lamps would be restricted to the equivalent of a 60W GLS, and they are currently produced by only one manufacturer (even though the technology is not protected by patents).
CFLs or class B halogens, due to incorporated electronics or socket incompatibility, will not fit in all luminaires. Consumers would be forced to change the affected luminaires as soon as they run out of replacement lamps. This is also an issue for European (especially Italian SMEs) luminaire producers, some of whom may have to completely change their product range.

Option 2b:

- require all non-transparent (frosted) lamps to be CFLs (for applications which do not need to be bright point sources)
- allow the most efficient halogen lamps (class B) to exist if they are transparent lamps. This would offer equivalent light quality to incandescent, full dimmability, no health issues.
- allow special socket halogens to be class C ("Halo socket C"), as it would solve the socket/luminaire incompatibility issue.

Energy savings could further drop down to about **39 TWh**.
Dimmability, size/socket compatibility, performance and possible health issues are still present for non-transparent lamps.
The light output of transparent GLS retrofit lamps would still be restricted to the equivalent of a 60W GLS, and they are currently produced only by one manufacturer (even though the technology is not protected by patents).

Option 2c:

- require all non-transparent (frosted) lamps to be CFLs (for applications which do not need to be bright point sources)
- allow all transparent lamps to be class C. This would allow C-class retrofit halogen lamps ("Halo retro C") to exist, offering equivalent light quality to incandescent, full dimmability, no health issues and no incompatibility issues. Existing GLS and halogen production lines in Europe could be at least partially converted to produce these lamps.

Energy savings could further drop down to about **33 TWh**.
Dimmability, size/socket compatibility, performance and possible health issues are still present for non-transparent lamps.

Option 3:

allow the full range (both transparent and frosted) of improved halogen lamps (class C) to exist, because they do not need integrated electronics and come in all sizes and sockets.

Energy savings may go down to **22 TWh**.

The table below provides a summary of options and associated estimated savings.

<u>The following should be considered when interpreting the table:</u>

- The remaining problems indicated with "*" and "**" relate to the particular lamp category (being either transparent or frosted) and can be solved by using a lamp of the other technology (e.g. in option 2b, mercury content issues with CFLs – which are frosted - can be solved completely by using halogen lamps - which are transparent).

- The remaining problems that are not marked with stars are applicable to both lamp categories (transparent and frosted).

- The table only lists problems and benefits that make a difference between the options. For example, compliance costs for industry are assumed to be negligible (see section 5) in all the options.

***Overview table of available options and their estimated impacts in 2020 compared to business as usual***

| op-tion | Lamps allowed | | Remaining Problems not solved by the option | EU-27 yearly energy savings in 2020 |
|---|---|---|---|---|
| | Transparent | Frosted | | |
| 1 | — | CFLs | No bright point light source available<br>Partial compatibility with existing luminaires<br>Probably no replacement to EU GLS production<br>Often not dimmable<br>Alleged health issues<br>optimal quality and performance<br>Mercury content | 86 TWh |
| 2a | Halogen B * | CFLs ** | Partial compatibility with existing luminaires<br>Probably no replacement to EU GLS production<br>* No equivalent to transparent GLS > 60W<br>* Only one producer currently for GLS retrofit<br>** Often not dimmable<br>** Alleged health issues<br>** optimal quality and performance<br>** Mercury content | 51 TWh |
| 2b | Halogen B *<br>Halo socket C | CFLs ** | Probably no replacement to EU GLS production<br>* No equivalent to transparent GLS > 60W<br>* Only one producer currently for GLS retrofit<br>** Often not dimmable<br>** Partial compatibility with existing luminaires<br>** Alleged health issues<br>** optimal quality and performance<br>** Mercury content | 39 TWh |
| 2c | Halogen B<br>Halo socket C<br>Halo retro C | CFLs ** | ** Often not dimmable<br>** Partial compatibility with existing luminaires<br>** Alleged health issues<br>** optimal quality and performance<br>** Mercury content | 33 TWh |
| 3 | Halogen B<br>Halo socket C<br>Halo retro C | CFLs<br>Halogen B<br>Halo socket C<br>Halo retro C | *This option satisfies to any possible comfort criterion, as frosted halogen lamps remain available, offering the same service as frosted incandescents.*[2] | 22 TWh |

[2] This option is the one supported by industry.

*Conclusion on the options*

In the **frosted** lamps category, the analysis has shown that it is cost-effective to only allow class A level lamps (= CFLs).
Where consumers look for a certain light quality/aesthetics or for alleged health issues, there is a need to offer alternatives to CFLs. This means leaving certain transparent halogen lamps.
The best halogens (B) can be considered as an alternative to incandescent for normal screw sockets and for wattages up to 60W.
Leaving halogens retro C would provide for wattages above 60W and the possibility to adapt the production lines currently dedicated to incandescent bulbs.
If the special socket halogen lamps were banned in the short term, people would be forced to change their luminaires when they run out of replacement lamps. The impact on luminaire manufacturers (in particular Italian SMEs) would also be significant.
However, special socket halogens in class C should be removed from the market in the longer term as more efficient alternatives exist with different lamp caps. It could be considered to phase out compatible luminaires in a second step that would deal with luminaires and reflector lamps.
**Overall, following the assessment of impacts, Option 2b seems to strike the appropriate balance between optimising energy savings and minimising negative economical, social and environmental impacts.**

*Timing*

Staged introduction of requirements (in particular banning incandescent bulbs in 2 stages) would affect accumulated savings up to 2020 but mitigate impacts on industry and should avoid risk of supply shortage; the annual savings as from 2020 would remain more or less unchanged. The lamp industry has been lately supporting an implementation of the measure in 5 years rather than 9 years.
A possible scenario could be as follows for a given option (considering adoption of the measure in March 2009):

| Stage | Date | Main result |
|---|---|---|
| Stage 1 | October 2009 | Start of incandescent lamp phase-out (for lamps of 100W, 75W and 60W) |
| Stage 2 | October 2011 | Complete incandescent lamp phase-out (lamps of 25W and 40W) |
| Stage 3 | October 2013 | Raising the level of the requirements to the maximum planned under the given option |

The saving estimates in the overview table are based on this timing.

The following table explains which lamp energy class according to Directive 98/11/EC is meant by the formulae used to set minimum efficacy requirements in Annex III.1 of the Working document.

| **Application date** | **Energy class equivalents (according to Directive 98/11/EC) of the formulae used in the Working document** | |
|---|---|---|
| | **Clear lamps** | **Non-clear lamps** |
| **Stage 1** | Energy class C | Energy class A |
| **Stage 2** | Energy class C | Energy class A |
| **Stage 3** | Energy class B | Energy class A |

| **Exceptions** | |
|---|---|
| **Scope of the exception** | **Maximum rated power (W)** |
| All lamps 200 lm ≤ Φ ≤ 450 lm in Stage 1 | Energy class E |
| Clear lamps with G9 or R7s cap in Stage 3 | Energy class C |