Texte zu den geplanten neuen EU-Regelungen zur umweltgerechten Produktgestaltung und zur Energieverbrauchskennzeichnung in der Beleuchtung – Zusammenstellung * des Umweltbundesamtes (UBA), Deutschland

Entwürfe der EU-Kommission vom 6. November 2015

Stellungnahme der Organisation CLASP ** vom 1. Februar 2016

– Vorstudie | Anforderungen an die umweltgerechte Produktegestaltung | Energieverbrauchskennzeichnung –

Hinweis: Bitte beachten Sie, daß der angehängte Text nur in Englisch verfaßt ist.

EN: Information on the coming EU Lighting Regulations – Ecodesign and Energy Labelling – Compilation * of the Federal Environment Agency (UBA), Germany

The EU Commission's drafts of 6 November 2015

Comments by CLASP ** as of 1 February 2016

– Preparatory study | Ecodesign | Energy Labelling –

FR: Informations sur les futures réglementations de l'UE concernant l'éclairage – l'écoconception et l'étiquetage énergétique – Compilation * de l'Agence Fédérale de l'Environnement (UBA), Allemagne

Les projets de la Commission Européenne du 6 novembre 2015

Commentaires de l'organisation CLASP ** du 1 février 2016

– Étude préparatoire | Écoconception | Étiquetage énergétique –

Indication: Veuillez noter que le présent texte n'est disponible qu'en anglais.

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* http://www.eup-network.de/de/eup-netzwerk-deutschland/offenes-forum-eu-regelungen-beleuchtung/dokumente/texte/

** CLASP = Collaborative Labeling and Appliance Standards Program; http://www.clasp.ngo

Es folgt ein unveränderter Originaltext.

EN: The following is an unmodified original text.

FR: Ce qui suit est un texte original.

To: **Ruben Kubiak, DG Energy**

From: **Michael Scholand, CLASP Europe**

Cc: **Robert Nuij, DG Energy**
René Kemna, VHK
Leo Wierda, VHK
Marie Baton, CLASP Europe
Eric Gibbs, CLASP

Date: **1 February 2016**

Subject: Comments on the final drafts of the review study of lighting products and on the preliminary drafts of implementing measures for ecodesign and energy labelling of lighting products

Thank you for the opportunity to review and comment on the final versions of the review study on lighting products and on the preliminary drafts of the implementing measures on ecodesign and energy labelling of lighting products.

Overall, we have deep concerns about the material presented to the Consultation Forum as it appears that it could result in a significant loss of energy savings, and undo important progress that the Commission has facilitated in the European lighting market through the current lighting regulations. We do believe, however that the objective of a simplification of the requirements is achievable through careful tailoring and gradual simplification of the lighting regulations over time. This approach will eliminate loop holes, reduce confusion about coverage and requirements, and progressively move the lighting market toward LED technology.

Our three major concerns with the material presented to the Consultation Forum are given below:

1) The review study is an impressive undertaking with extensive research and reporting, and a detailed market model for running scenarios; however there were two areas where we felt more information would have been helpful for policymakers. First, we would suggest including some quantification in the modelling for the situation where some end-use applications where the new efficacy level is lower than the previous one could 'back-slide' and re-introduce inefficient lighting technologies. Secondly, the analysis (and model) could have benefitted from considering incremental increases to the efficacy levels of existing regulations where possible such as in fluorescent lamps and high-intensity discharge lamps.

2) The ecodesign regulation, while we recognise is a preliminary draft, appears to present a policy scenario that will not increase energy savings between 2018 and 2024. The new single equation approach, with the apparent lack of ambition, translates into a significant reduction in the efficacy requirements for many covered lighting products, particularly in the tertiary sector which constitutes the majority of energy consumption for lighting. In addition, we found issues with the definitions (i.e., omissions and lack of clarity), and structural issues with terms and

requirements, which makes it difficult to assess the potential market impacts.

3) The energy labelling proposal, for which we applaud as a return to the A to G scale, would benefit from the addition of more categories at the low-efficiency end of the EEI scale and fewer at the high end. In addition, we also recommend considering lower categories that use an equation where efficacy varies with light output (i.e., designed for the traditional light sources), and higher categories where the efficacy does not vary with light output (i.e., designed for LED light sources).

In these comments, we provide our rationale for the above concerns and our recommendations for your consideration. In addition, CLASP would also like to offer to conduct a study that would cover topics of relevance and interest which need further study, including for example:

- Lighting controls – industry says they need a higher power allowance, but what does the data say? Are we losing features and potential savings opportunities due to a strict requirement on standby power?
- Mercury content – the allowed levels are currently 5 mg, but could they be reduced further (e.g., Philips has a 1.7 mg T8 lamp today)? Is there an opportunity for Ecodesign to take over RoHS for lighting products under the resource efficiency authority?
- Tolerances – should the same 10% tolerance be applied to all lighting products, or are there more appropriate tolerances depending on the metric and actual variabilities measured? (this would involve consultations with market surveillance authorities in several European countries)
- Exemptions – can we develop precise definitions that could be drafted that could prevent the formation of loop-holes and ensure special purpose lamps are excluded?
- Incremental improvement – what are the life-cycle cost benefits of small incremental increases to the ambition of the tertiary lighting products (i.e., fluorescent tubes and high-intensity discharge)?

And there may be additional topics that arise during your review of the stakeholder comments, which we could discuss. If you think this kind of a fast-track research study would be helpful, please let us know and we will start immediately recognizing that this would need to be done within the next 1-2 months. The report we prepare would be placed in the public domain, as an evidence contribution to the Consultation Forum.

Thank you again for this opportunity to comment and we hope it will be possible to convene a second Consultation Forum meeting for this important product group with a revised proposal for lighting products.

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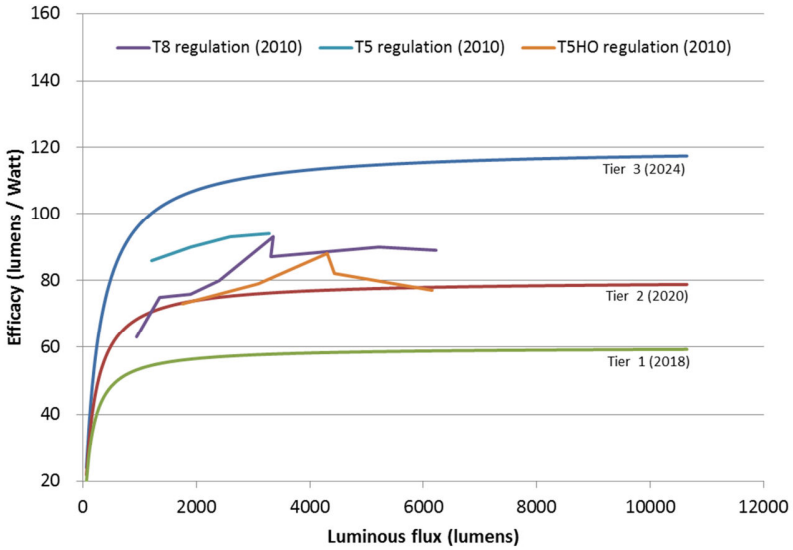
1 Issues with the Review Study

The review study is an impressive undertaking with extensive research and reporting, and a detailed market model for running scenarios; however there were two areas where we felt more information would have been helpful for policymakers. First, we would suggest including some quantification in the modelling for the situation where some end-use applications where the new efficacy level is lower than the previous one could 'back-slide' and re-introduce inefficient lighting technologies. Secondly, the analysis (and model) could have benefitted from considering incremental increases to the efficacy levels of existing regulations where possible such as in fluorescent lamps and high-intensity discharge lamps.

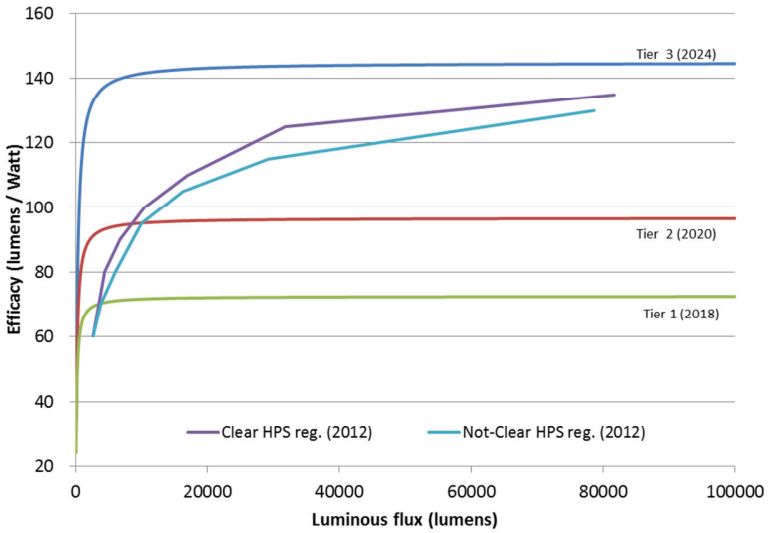
1.1 Modelling backsliding in energy savings impacts

As shown in the figures below, the levels of tiers proposed in the draft regulation are substantially lower than the requirements currently in place, which were adopted in regulations EC No 244/2009, EC No 245/2009 and EU No 1194/2012. As a result of this, we can expect that some users will migrate back to the old technologies that had been previously phased-out, increasing energy consumption (or decreasing light output and light quality) in these applications.



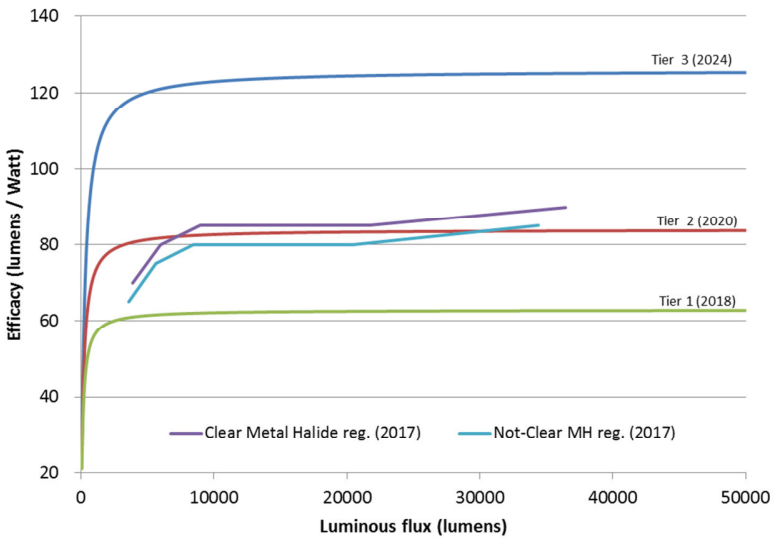
- Linear fluorescent T5 and T8 are the primary fluorescent light sources in Europe.
- The ambition of the draft proposed Tier 1 (2018) and Tier 2 (2020) are both less ambitious than the existing requirements from 245/2009.
- Only at Tier 3 (2024) do the requirements exceed the levels established by 245/2009.

Figure 1. Existing Linear Fluorescent Regulations and Proposal in Draft Working Document



- High pressure sodium is a popular street light with poor colour-rendering.
- The ambition of the draft proposed Tier 1 (2018) is less ambitious than the existing requirements from 245/2009.
- The ambition of the draft proposed Tier 2 (2020) is less ambitious for most light output levels, except for wattages of 75W and below.

Figure 2. Existing High Pressure Sodium Regulations and Proposal in Draft Working Document



- Metal halide is a popular street light and indoor high/low bay technology with good colour-rendering.
- The ambition of the draft proposed Tier 1 (2018) is less ambitious than the existing 2017 requirements from 245/2009.
- The ambition of the draft proposed Tier 2 (2020) is approximately the same as the 2017 requirements from 245/2009.

Figure 3. Existing Metal Halide Regulations and Proposal in Draft Working Document

These are a few examples of some of the high volume / popular lamps that would experience back-sliding in minimum efficiency requirements. Due to the high proportion of energy associated with these lamp types – 35% of lighting electricity for fluorescent lamps and 17% for HID lamps – it would seem important to capture the potential increase in electricity consumption that could result from removal of the existing regulations. Without this information, policy-makers are unable to properly assess potential outcomes in terms of energy impacts.

1.2 Energy savings scenarios omitted

The European regulations on fluorescent lamps were adopted in 2009 and took effect in 2010. In the intervening six years since adoption, industry has invested and made incremental improvements in phosphors and other fluorescent lamp components to advance the efficacy of the products sold. Consequently, many models offered on the market today exceed the minimum requirements set out in the original regulation. The potential policy scenario analysis, however, does not take into consideration the possibility of improving the efficiency of the existing regulations, which would ensure energy savings are realised in Europe. In other words, advancing the energy efficiency requirements of the existing products such as was recently done by the United States Department of Energy, which adopted new efficacy requirements for linear fluorescent lamps that take effect in 2018. The table below shows that in their analysis, the two categories which experienced increase in the efficacy were the T8 (4-foot medium bipin) and the T5 (4-ft miniature bipin) lamps.

Table 1. Efficiency Standards for General Service Fluorescent Lamps – USA – take effect in 2018

Lamp type	Covered wattages	Colour Temperature	Efficacy Requirement	Increase over previous regs.
4-foot medium bipin	≥ 25W	≤4500K | >4500K - ≤7000K	92.4 | 88.7	3.8% | 0.8%
2-foot U-shaped	≥ 25W	≤4500K | >4500K - ≤7000K	85.0 | 83.3	1.2% | 2.8%
8-foot slimline	≥ 49W	≤4500K | >4500K - ≤7000K	97.0 | 93.0	0% | 0%
8-foot recessed DCHO	All	≤4500K | >4500K - ≤7000K	92.0 | 88.0	0% | 0%
4-ft miniature bipin	≥ 25W	≤4500K | >4500K - ≤7000K	95.0 | 89.3	10.5% | 10.2%
4-ft mini. bipin HO	≥ 44W	≤4500K | >4500K - ≤7000K	82.7 | 76.9	8.8% | 6.8%

And this potential to capture incremental savings from this lamp type exists here in Europe as well. The figures below show a scatter plot of available products compared to the minimum requirements. An increase in ambition for these lamps yield tangible energy savings and continue to support the transition the market toward LED replacements for these products.

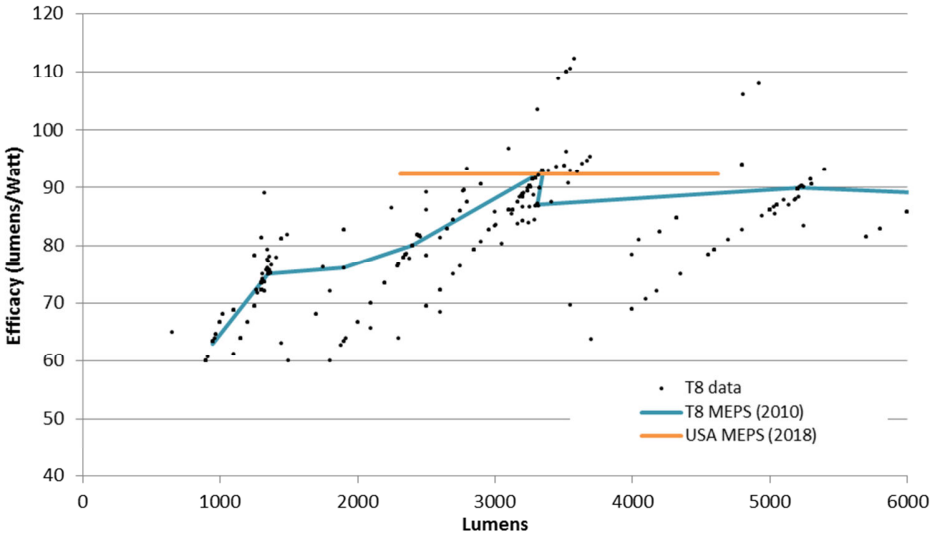


Figure 4. Scatter Plot of Australian T8 Lamp Data with EU and US Regulations

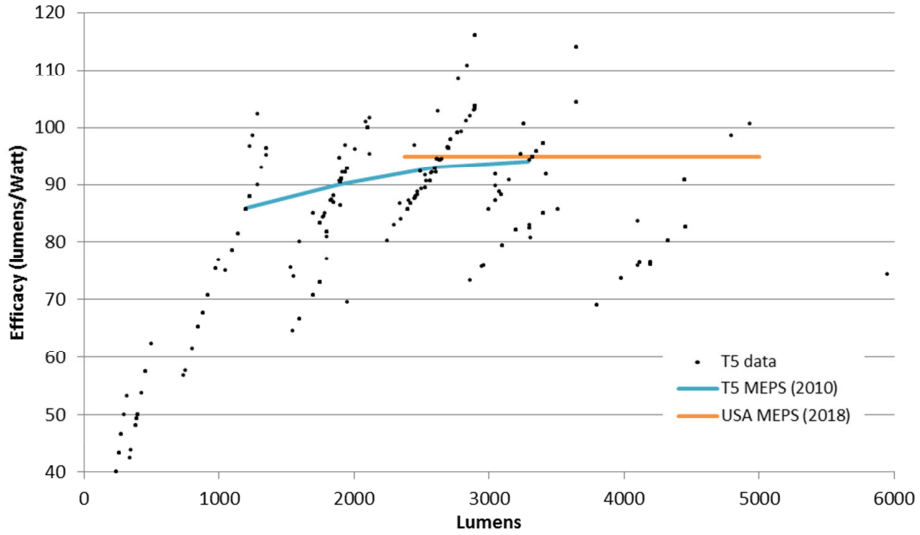


Figure 5. Scatter Plot of Australian T5 Lamp Data with EU and US Regulations

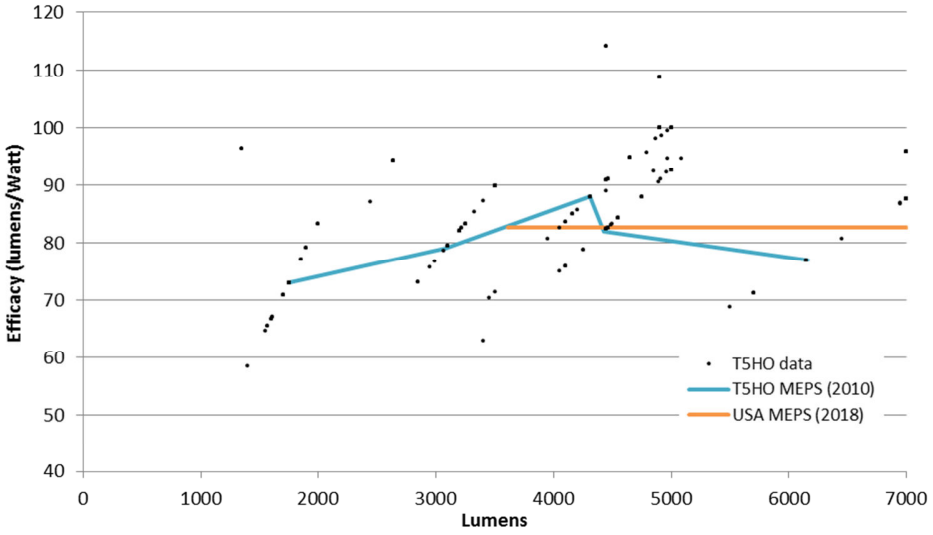


Figure 6. Scatter Plot of Australian T5HO Lamp Data with EU and US Regulations

In all three figures, it is clear that there are new products available on the market that are more efficacious than the minimum requirements and therefore an opportunity for energy savings that would apply across this group of products. Consideration of incremental improvements to the existing ecodesign requirements was not included in the review study analysis, although the opportunity to capture some savings with this policy measure is demonstrated by these figures.

2 Issues with the draft Ecodesign Implementing Measure

The paragraph below, copied from the European Commission's website, states the intent of Ecodesign and energy labelling:

> *"The EU legislation on Ecodesign and energy labelling is an effective tool for improving the energy efficiency of products. It helps eliminate the least performing products from the market, significantly contributing to the EU's 2020 energy efficiency objective. At the same time, it supports industrial competitiveness and innovation by promoting the better environmental performance of products throughout the Internal Market."*
>
> - European Commission, link

In that paragraph are four key phrases which capture the essence of Ecodesign:

- "improving the energy efficiency of products"
- "eliminate the least performing products from the market"
- "contributing to the EU's 2020 energy efficiency objective"
- "supports industrial competitiveness and innovation"

Unfortunately, the measure being proposed by the Commission will not achieve these four intended outcomes of Ecodesign across the majority of covered lighting products. Instead, the ambition of the requirements seem to convey a step-approach that is focused on non-directional household lamps, matching the phase-out of mains-voltage halogen in 2018 (Tier 1, which is already required by the delayed Stage 6 of EC No 244/2009), and then the phase-out of integrally ballasted CFLs in 2020 (Tier 2).

In both Tier 1 and Tier 2, the subsequent requirements that are then applied to linear fluorescent lamps and HID lamps – which together represent 52% of Europe's electricity consumption for lighting – would have lower requirements than they have today. Only in Tier 3 (scheduled for 2024, 8 years from now), does the Commission advance the efficacy of these products relative to their requirements today (some of which became effective in 2010).

From our point of view therefore, the Commission's proposal does not capture the full potential of energy savings at Tier 1 and Tier 2. However, we believe we have a solution that could work, not only avoiding back-sliding, but making small advances in efficacy, simplifying the requirements and migrating gradually toward one equation for all products. The following text attempts to present an approach that the Commission could adopt which would be workable and would also accomplish abovementioned key aspects of Ecodesign.

2.1 Energy-efficiency proposal overview

We are proposing a pragmatic approach to the revision for lighting regulations which would allow for gains in performance across the group of covered products, and over time, a gradual migration in the regulatory framework toward the Commission's objective of having a single simple/elegant equation for all lighting products. The figure below illustrates this pragmatic approach, which is based on three-tiers introduced in two-year increments followed by a review in 2023.

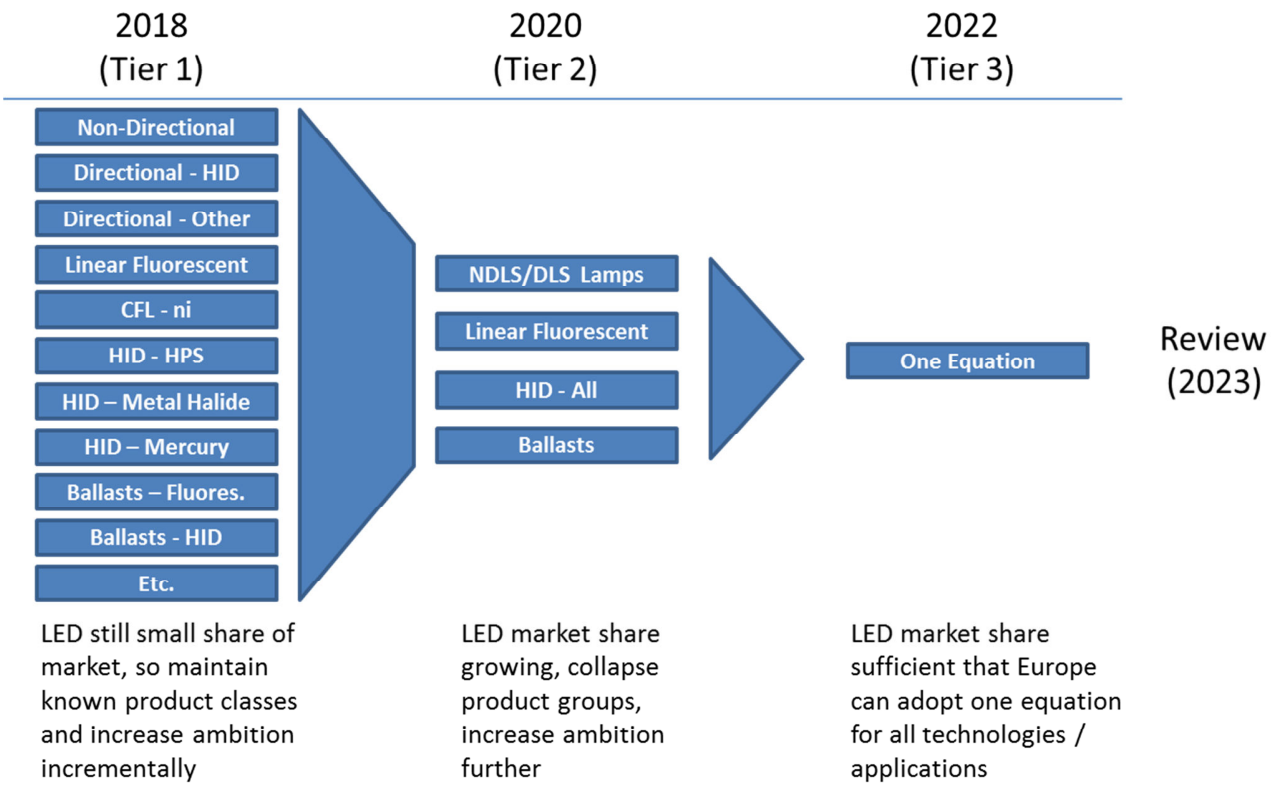


Figure 7. Flow diagram showing suggested product classes and requirements at the three tiers

Tier 1 (2018) - maintain current regulatory structure and coverage, including all product classes in all regulations – EC No 244/2009, EC No 245/2009 and EU No 1194/2012. Incrementally increase those requirements where it is cost-justified and appropriate, enabling Europe to save energy at Tier 1 and keep advancing the market toward LED technology. While this first step would have a lot of definitions and tables, it is the same as the current regulatory structure which everyone in the industry and in market surveillance knows and uses today. It is, therefore, effective[1] and clear and would help Europe reach its objectives promoting energy-efficiency.

Tier 2 (2020) – in this stage, the regulation would combine some of the product classes, to reduce the complexity and have regulatory requirements that apply to more products. For example, fluorescent lamps, whether linear or bent, would all be covered by one equation, but it would be different from those of other classes such as HID lamps, because it would still be important to take into account the underlying conventional technology at Tier 2. Through the use of a smaller number of equations at this stage applying across the product classes, the degree of regulatory complexity would be reduced. At the same time, requirements are being established that would advancing efficiency and avoid (or minimise) any back-sliding in ambition.

[1] Note: It is understood that there are problems with some definitions and requirements; these would be addressed in the re-casting of the existing regulations at Tier 1.

Tier 3 (2022) – in this stage, the regulation would move to one equation applying to all light sources, achieving the goal of broad-base simplification of the lighting regulation. As we discussed in the December Consultation Forum meeting, one equation for all light sources is based on the presumption that all light sources are using the same underlying technology – light emitting diodes (LED). And it is presumed that by 2022, LED-derived technologies would constitute the majority of sales across these applications in Europe. Tier 3 would therefore establish the removal of mercury-based lighting from the European market, while maintaining ambition by advancing the requirements to efficacy levels that are achieved by LED technology (which at that time will be >200 lm/W at the device level).

A review would be held in 2023 to assess the market and develop new (simple, single-equation) requirements for 2025 and onwards. Placing the review *after* Tier 3 is intentional, as it would send a clear message from the outset of this regulation of the future target efficacy value, enabling the lighting industry to make the necessary investments and plan their production lines to be ready for the complete transition to LED in 2022.

2.2 Terminology and definitions

In the draft Ecodesign Implementing Measure, there are some issues with how the products are defined that could well lead to confusion and uncertainty in the marketplace. CLASP would suggest that where possible and appropriate, the Commission take advantage of using definitions of terms and products that are derived from the extensive set of lighting and lighting product definitions published by CEN/CENELEC in the European harmonised standards. This approach would make it easier for market surveillance authorities who often use the European standards when measuring the performance of covered products, enabling absolute transparency in terms of what is covered.

Some terms are used in the regulatory text – and therefore should be defined – however, it appears they may have been overlooked. For example, the terms “off mode”, “stand-by mode” and “full load mode” are not defined in the draft implementing measure. Definitions for these terms need to be developed to ensure clarity of the applicable modes and associated requirements used in the regulation.

The draft implementing measure establishes a set of products that are not subject to the regulation as long as they are specified to operate exclusively in a series of applications. However, some of these applications such as “pieces of art” and “nuclear installations” will encompass sockets and wattages that are commonly found in the European household and commercial office. If that is the case, then the regulation could be establishing a significant loop-hole which a handful of unscrupulous companies have already demonstrated they are prepared to exploit in order to sell non-compliant lamps to the public. Consider for example the following photograph taken in North London in December 2013 which shows how a simple package label was being used to by-pass EC No 244/2009 and sell incandescent lamps which had been banned from 1 September 2009 in a grocery store.

Figure 8. Flow diagram showing suggested product classes and requirements at the three tiers

Given the track record of companies like the one depicted in the photograph, we believe that the exemptions offered by the Commission for lighting products must be very tightly defined, giving detailed specifics on unique physical aspects that would avoid a interpretative misapplication of the exemption. As has been done regulatory measures for other product and equipment Lots, the Commission could establish a set of carefully defined exemptions by specifying things such as the lamp shape, the base type, the emission spectrum and pattern, the lifetime, the filament configuration, and so-on. The more specific the exemption, the better, as it would prevent any confusion by manufacturers and importers as to whether something is subject to the regulation or not.

2.3 Uneven treatment of products

CLASP is also concerned that – in our understanding of the existing proposed structure - new LED luminaires that have a LED light source which is not removable would be subject to the regulation and those that have removable LED lighting modules are not. This could set up for a very uneven market, where by the directly competing (very similar) luminaires with integral LED and non-integral LED are competing with each other, but one is subject to regulatory requirements and the other is not. This type of approach could result in a significant market distortion and move the market away from non-removable LED luminaires – which, if designed properly for long life – can last for the full refurbishment cycle of an indoor space, e.g., 10-15 years – which would be 40-60 thousand hours of service at 10 hours/day. CLASP therefore recommends that the Commission try and ensure that both luminaires containing integral (i.e., non-removable) LEDs and luminaires that contain removable LEDs are regulated in a consistent and fair way.

3 Assessment of Savings Potential in Ecodesign Implementing Measure

This section is a summary of the analysis presented in Annex A of these comments. In the following sections and subsections, we present our suggested approach for reducing complexity in the ecodesign regulations that apply to the existing covered products. By adopting equations instead of tables at Tier 1, the Commission will already start to simply the regulations by removing numerous tables and confusion over what to do with wattages that fall between or outside of the tables of requirements.

3.1 Requirements in EC No 245/2009

This section provides the summary equations we recommend for the products covered under EC No 245/2009. Please see Annex A for information on the derivation.

3.1.1 Double capped fluorescent lamps of 16mm (T5) and 26mm (T8) diameter

The equations below for these lamp types are as follows, where Φ is the lumens of initial light output at 25°C for T8 and 35°C for T5 are presented in the table below.

Table 2. Double capped fluorescent lamps of 16mm (T5) and 26mm (T8) diameter

Product Groups from 245/2009 Table 1	Tier 1 Equation that Applies to All
• Double-capped fluorescent lamps 26mm in diameter (T8) • All other fluorescent lamp diameters, other than T5 and T5HO below	$Efficacy_{T8} = 90 \times \tanh(0.18 + 0.00075\Phi)$
• Double-capped fluorescent lamps 16mm in diameter (T5)	$Efficacy_{T5} = 100 \times \tanh(0.30 + 0.00075\Phi)$
• Double-capped fluorescent lamps 16mm in diameter (T5), High Output (HO)	$Efficacy_{T5HO} = 89 \times \tanh(0.18 + 0.00075\Phi)$

Note that, according to Stage 2 of EC No 245/2009, the requirements applicable to double-capped fluorescent lamps 26mm in diameter (T8) during the first stage shall apply to all double capped fluorescent lamps of other diameters than those covered in the first stage. Therefore, apart from the T5 and T5HO requirements, all other fluorescent tubes must meet the requirements of the curve presented above as $Efficacy_{T8}$.

3.1.2 Single capped Compact Fluorescent Lamps

The table below shows the common curve fits that were identified, and the fact that the six product groups presented in Tables 2 and 3 of 245/2009 can be reduced to three equations at Stage 1 of the new lighting regulation. This allows for some simplification at the outset and will not compromise energy savings or introduce any market distortions.

Table 3. Equations for Single-Ended CFLs, Tables 2 and 3 of EC No 245/2009

Product Groups from 245/2009 Table 2 and Table 3	Tier 1 Equation that Applies to All
• Small single parallel tube, lamp cap G23 (2 pin) or 2G7 (4 pin)	$Efficacy_{G23,2G7} = 88 \times \tanh(0.35 + 0.001\Phi)$
• Double parallel tubes, lamp cap G24d (2 pin) or G24q (4 pin) • Triple parallel tubes, lamp cap GX24d (2 pin) or GX24q (4 pin) • Four parallel tubes, lamp cap GX24q (4 pin)	$Efficacy_{G24d,G24q,GX24d,GX24q} = 70 \times \tanh(0.7 + 0.0007\Phi)$
• Long single parallel tube, lamp cap 2G11 (4 pin) • 4 legs in one plane, lamp cap 2G10 (4 pin)	$Efficacy_{2G11,2G10} = 75 \times \tanh(0.7 + 0.0007\Phi)$

Similar analysis could be performed on Table 4 and Table 5, and a set of equations developed that approximate the existing efficacy tables.

3.1.3 High-Intensity Discharge Lamps

High pressure sodium lamps were covered in Stage 2 of 245/2009 at Stage 2. The requirements vary with whether the lamp has a clear or not-clear envelope. There was no increase in ambition for high pressure sodium, so these are the levels that we curve fit in this section.

Metal halide lamps were covered in Stage 2 of 245/2009 and again in Stage 3. There is also a variance in the efficacy requirements for the clear vs. non-clear lamps. We provide a curve-fit of the requirements in Stage 3, as that will be the level that has taken effect (April 2017) when this new regulation comes into effect (September 2018).

Mercury vapour lamps were covered in Stage 2 under 'other high intensity discharge lamps'. However, given that the efficacy requirements are so low for this application, and there are substitute lamps that have been made which are more efficacious than mercury vapour, we recommend phasing out mercury vapour in September 2018 when establishing the new efficacy requirements for HID lamps. We therefore recommend holding all mercury vapour lamps and metal halide lamps to the same requirement, which can only be achieved by metal halide technology.

Table 4. Equations for High-Intensity Discharge Lamps

Product Groups from 245/2009	Tier 1 Equation that Applies to All
• High Pressure Sodium Lamps	$Efficacy_{HPS} = 121 \times \tanh(0.5 + 0.00004\Phi)$
• Mercury Vapour Lamps – all types • Metal Halide Lamps	$Efficacy_{MV,MH} = 100 \times \tanh(0.8 + 0.00004\Phi)$

3.1.4 Other Requirements of 245/2009

In addition to the above efficacy requirements for these important lamp types covered under EC No 245/2009, there are also a series of other requirements relating to the ballasts – including ballasts for both fluorescent lamps and HID lamps. There are also performance and quality requirements in terms of technical documentation, lumen maintenance factors, colour rendering index and so-on. While these cannot be simplified down to an equation, we would recommend continuing to retain these requirements in place, either as they are today or increasing some of them slightly to reflect trends in the market (e.g., a higher ballast efficiency requirement, higher CRI level, a better lumen maintenance requirement, etc.).

3.2 Requirements in EC No 244/2009

This section provides the summary equations we recommend for non-directional household lamps products covered under EC No 244/2009. For these lamps, they already have an equation that applies, which is a function of the light output. The table below is a screen capture from Table 1 in the Annex of the regulation, EC No 244/2009.

Table 1

Application date	Maximum rated power (P_{max}) for a given rated luminous flux (Φ) (W)	
	Clear lamps	Non-clear lamps
Stages 1 to 5	0,8 * (0,88√Φ+0,049Φ)	0,24√Φ+0,0103Φ
Stage 6	0,6 * (0,88√Φ+0,049Φ)	0,24√Φ+0,0103Φ

Stage 6 was delayed to take effect on 1 September 2018, and that will phase-out the mains-voltage halogen products, moving the whole non-directional household lamp market toward CFL and LED replacements. This requirement, which has already been agreed, should remain in place, however in 2020, CFLs can easily be phased out in favour of a reasonably high level of ambition of non-directional LED lamps, for which there exists today a wide range of efficacies.

The figure below presents the draft requirements published by the IEA 4E SSL Annex on 17 December 2015 for non-directional household lamps. The Annex uses a flat line when setting the requirement LED lamps because the efficacy does not vary by light output – it remains relatively constant, and thus the performance levels are presented as flat efficacy requirements over a wide range of flux levels. The economic analysis in Task 6 of the Commission Contractor's Review Study states that: "If the LED 2020 option would already be available, with the projected characteristics of 175 lm/W and 7.5 euros/klm, it would have a payback time of less than 1 year." Thus, it would appear that much higher efficacy values are possible at Tier 2 (2020) than what was proposed by the Commission in Tier 2.

Perhaps some additional analysis needs to be done, but it would appear both from the scatter plot of model data available in 2014/2015 and the payback period of less than 1 year in 2020 from shifting to LED, that the IEA 4E SSL Annex Tier 2 of 100 lm/W would be entirely reasonable.

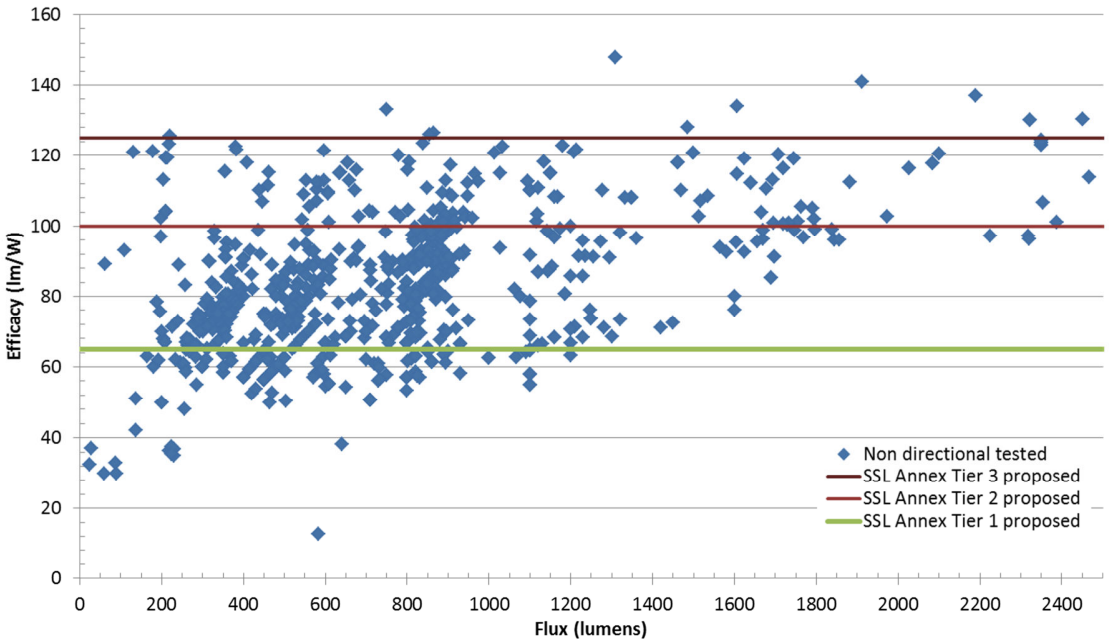


Figure 9. Draft Performance Tiers from the IEA 4E SSL Annex for Non-Directional Household Lamps

The figure below presents the proposed Tier 1 and Tier 2 for Non-Directional Household Lamps. Note that the first tier is a curve because of CFL technology, but that the second tier is a flat line due to the fact that it is solely about LED technology.

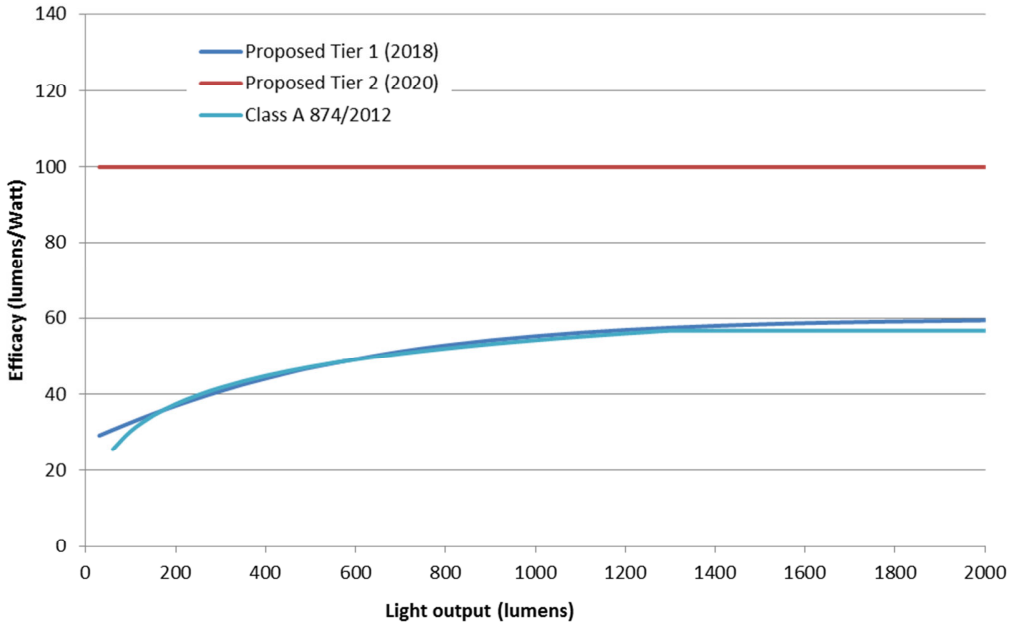


Figure 10. Potential curves for Non-Directional Household Lamps at Tier 1 (2018) and Tier 2 (2020)

Table 5. Equations for Non-Directional Household Lamps

Product Groups from 245/2009	Equation that Applies to All
• Non-Directional Household Lamps – **Tier 1** Level (2018)	$Efficacy_{NDLS} = 60 \times \tanh(0.5 + 0.0011\Phi)$
• Non-Directional Household Lamps – **Tier 2** Level (2020)	$Efficacy_{NDLS} = 100$

3.2.1 Other Requirements of 244/2009

In addition to the above efficacy requirements for non-directional lamps covered under EC No 244/2009, there are also a series of other performance and functionality requirements relating to these lamps, as well as information requirements, etc. While these cannot be simplified down to an equation, we would recommend continuing to retain these requirements in place, either as they are today or increasing some of them slightly to reflect trends in the market.

3.3 Requirements in EC No 1194/2012

This section provides the summary equations we recommend for directional lamps, which are covered under EC No 1194/2012.

3.3.1 Efficacy Requirements of 1194/2012

In the market today, low-voltage halogen lamps already have many LED replacement alternatives available, therefore in a manner consistent the Commission's decision to phase-out mains-voltage filament lamps in September 2016, so should the low-voltage halogen be phased out in September 2018. In this way, we already have a simplification to the table, such that both types of filament lamps can be rolled into the performance requirement of the high-intensity discharge lamps. In addition, as shown in the figure below, LED lamps which are required to have an EEI of 0.20 can easily accommodate a modest increase in their efficacy in 2018, to follow the trend in the market and the switch to LED that takes place in September 2016.

The following figure presents a number of data points for directional LED lamps, along with the three draft performance tiers from the IEA 4E SSL Annex (published 17 December 2015) and with the existing Stage 3 requirements of HID lamps and LED lamps from 1194/2012. It is interesting to see that the orange line, which are the Stage 3 requirements for LED lamps, is very close to the SSL Annex Tier 1 requirement, although it has less ambition at the very low flux levels.

Directional HID lamps are a technology that is phasing out and being replaced by LED lamps which offer better performance, light quality and control, and a longer operating life. Therefore at Stage 1, CLASP proposes two equations for directional lamps which cover the HID lamps (and two filament lamp) product classes as one group and the LED lamps as a second one. And then at Stage 2, all directional lamps could be accommodated under one equation.

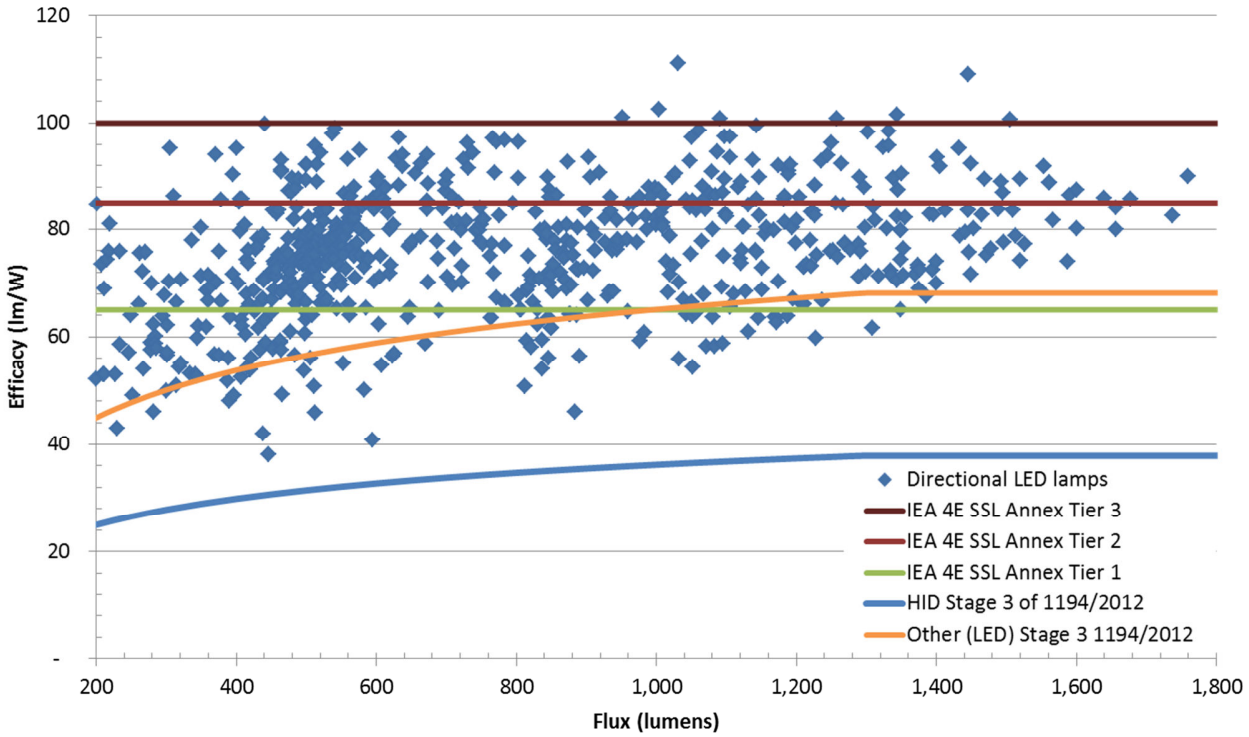


Figure 11. Stage 3 of 1194/2012 requirements for Directional Household Lamps, IEA 4E SSL Annex Draft Performance Tiers and Data

Table 6. Equations for Non-Directional Household Lamps

Product Groups from 245/2009	Equation that Applies to All
Tier 1 (2018) • High-intensity discharge directional lamps • Mains-voltage filament lamps • Other filament lamps	$Efficacy_{HID,filament} = 40 \times \tanh(0.5 + 0.0011\Phi)$
Tier 1 (2018) • LED Lamps	$Efficacy_{NDLS} = 65$
Tier 2 (2020) • All Directional Lamps	$Efficacy_{NDLS} = 85$

One of the other aspects unique to Europe is the definition of 'useful lumens' which is defined as the part of the luminous flux of a lamp falling within the cone used for calculating the lamp's energy efficiency and the requirements above. CLASP does not believe this 'useful lumen' concept is worth continuing in the regulation when it is re-issued. There are a number of reasons:

1) It requires manufacturers who sell to a global market to carry duplicative information on their packaging about performance in Europe and performance in other economies;

2) Useful lumens are the lumens projected forward and used in the living space. General illumination with a number of directional lamps in the ceiling is very common in both domestic and some commercial settings (e.g., restaurants) – and in these applications, all forward lumens are relevant.
3) CLASP has been told by one market surveillance authority that the definition of useful lumens is an expensive and burdensome issue for them. It requires extra time and lots of additional measurements in order to get the correct level of flux.
4) It is an added requirement is not present or required for any other covered light source in Ecodesign, and thus is in conflict with the concept of merging requirements into one equation.

For all of these reasons, CLASP suggests that the Commission consider abandoning useful lumens for directional lamps when it issues the new requirements that would take effect in 2018.

3.3.2 Other Requirements of 1194/2009

In addition to the efficacy requirements for directional lamps covered under EU No 1194/2012, there are also a series of functionality requirements performance and quality requirements relating to these lamps, as well as information requirements, etc. And in this regulation, there are requirements for both directional and non-directional LED lamps. While all these requirements cannot be simplified down to an equation, we would recommend continuing to retain these requirements in place, either as they are today or increasing some of them slightly to reflect trends in the market.

3.4 Completing the Simplification

As discussed in Chapter 2, CLASP is proposing that the requirements for these lamps be converted into equations instead of tables, and that where possible – and as demonstrated in the few examples presented in Chapter 3 – these requirements can be merged and simplified to start moving the total regulated lighting market toward one equation in 2022.

The purpose of this chapter was primarily to illustrate the approach the Commission should follow, and in that approach, there would need to be analysis of the economic justification of these steps, as well as a calculation of energy savings that would result. Importantly, the CLASP proposal avoids any backsliding, while at the same time, advances efficacy requirements incrementally while simplifying product classes and abandoning technologies like low-voltage halogen and mercury vapour which are no longer needed.

At Tier 3 – which we recommend for 2022 rather than the Commission's proposal of 2024 because that is too long into the future and we think that the Commission should try and avoid holding a review prior to Tier 3 due to the fact that industry needs certainty to plan. CLASP would, at that time, expect to see a very high degree of ambition at Tier 3, similar to that in the high tiers presented in the SSL Annex work, such as 150 lumens per watt.

4 Issues with the draft Energy Labelling Implementing Measure

The energy labelling proposal, for which we applaud as a return to the A to G scale, would benefit from the addition of more categories at the low-efficiency end of the EEI scale and fewer at the high end. In addition, we also recommend considering lower categories that use an equation where efficacy varies with light output (i.e., designed for the traditional light sources), and higher categories where the efficacy does not vary with light output (i.e., designed for LED light sources).

4.1 A one-time rescaling

Although this represents a significant re-shuffle of the energy label classes, we hope that it would be acceptable to industry because it essentially represents a one-time rescaling of the label classes. Once the A-class level has been reached, there is not much need to differentiate between energy classes anymore because the absolute watts of power saved above 200 lumens/Watt will be marginal, and at that point, manufacturers will most likely be concentrating on light quality and other features.

4.2 More differentiation at the higher efficacy levels, adjust threshold values

One of the new approaches that CLASP is recommending the Commission consider for labelling of lighting products is to establish the equations for the label class thresholds based on the technologies that underpin them. This has two advantages: (1) it enables greater precision with regard to the application of the label class to the market since it takes into account the incumbent technologies that are most widely in use and (2) it allows for better alignment between the ecodesign requirements and the energy label classes – (although not perfectly because our proposal is to have more than one equation at Tiers 1 and 2, and only migrate to a single equation from Tier 3).

The approach presented in the draft Energy Labelling measure used straight-forward incremental steps of 25 lumens/Watt between the label classes. We support the Commission's proposal from the stand-point of having flat efficacy lines across a range of lumen values. This is a better representation of the performance of LED products over a range of lumen values than a curve that has diminishing efficacy requirements at the low end of the range and higher ones at the high end.

However, in our assessment, we were not comfortable with the decision to simply use 25 lm/W steps between all the energy label class thresholds. In our view, this approach would not allow for adequate differentiation between the traditional lighting technologies such as fluorescent lamps and high-intensity discharge lamps, and had too much differentiation at the high-end of the scale, which would be all LED technology. This approach meant that there were diminishing returns on energy savings with increasing energy label classes - as shown in the table below, with the savings going from Class B to Class A of about half a Watt for a 1000-lumen lamp.

Table 7. Commission Proposal for Label Classes in draft Implementing Measure

Label Class	Efficacy	Watts to produce 1000 lumens	Watts Savings per Label Class
A	210	4.76	0.64
B	185	5.41	0.84
C	160	6.25	1.16
D	135	7.41	1.68
E	110	9.09	2.67
F	85	11.76	11.76
G	<85		

We therefore looked at a label class structure that sought to keep equal amounts of energy savings in each label class step. This approach was applied over the same range of efficacies, and it was found that there were lots of label classes at the low-end of the scale and very few at the high end. Please see the table below which depicts this – energy focused – approach.

Table 8. Potential Label Classes if Watts of savings between classes is held constant

Label Class	Efficacy	Watts to produce 1000 lumens	Watts Savings per Label Class
A	200	5.0	2.50
B	133	7.5	2.50
C	100	10.0	2.50
D	80	12.5	2.50
E	67	15.0	2.50
F	57	17.5	2.50
G	50	20.0	

Therefore, we thought it might be prudent to combine these two approaches, giving 50% weighting to each approach (i.e., equal efficacy steps, equal wattage steps) and arrived at the following set of suggested energy label class thresholds.

Table 9. Potential Label Classes if Watts of savings between classes is held constant

Label Class	Efficacy	Watts to produce 1000 lumens	Watts Savings per Label Class
A	200	5.0	1.49
B	154	6.5	1.51
C	125	8.0	1.76
D	103	9.8	2.24
E	83	12.0	3.14
F	66	15.1	---
G	---	---	---

And graphically, the label classes in our proposal appear as shown below.

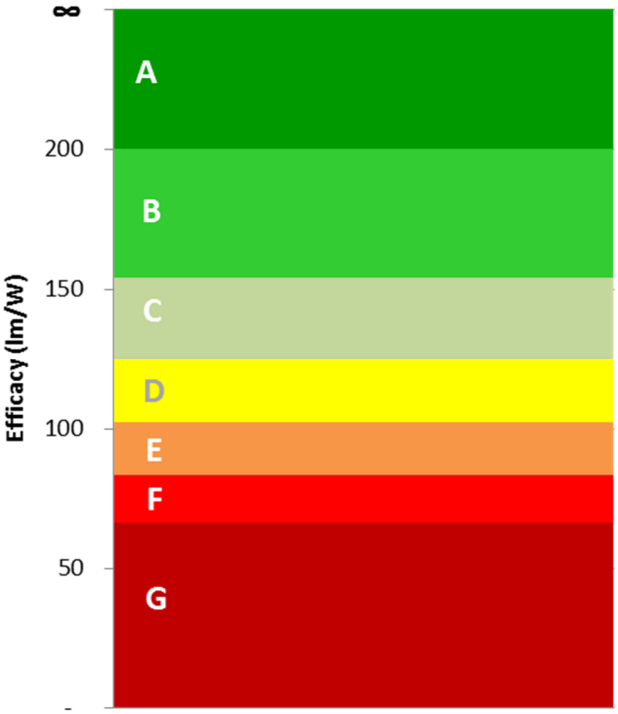


Figure 12. CLASP's Proposed Energy Label Thresholds Plotted by Efficacy

Annex A. Plots used to determine curve-fit equations

A.1 Double-Capped Fluorescent Lamps

Citation:

- EC No 245/2009, Annex III. Ecodesign requirements for fluorescent and high intensity discharge lamps and ballasts and luminaires able to operate such lamps. Section 1.1, A. Table 1.

Requirements:

- Minimum efficacy requirements for T8, T5 and T5 High Output lamps, defined at 25C. Requirements are presented in Table 1 and in a paragraph of text. Requirements took effect on 13 April 2010, one year after entry into force of EC No 245/2009.
- In case the nominal wattages are different from those listed in Table 1, lamps must reach the luminous efficacy of the nearest equivalent in terms of wattage, except T8 lamps above 50 W, which must reach a luminous efficacy of 83 lm/W. If the nominal wattage is at equal distance from the two nearest wattages in the table, it shall conform to the higher efficacy of the two. If the nominal wattage is higher than the highest wattage in the table, it shall conform to the efficacy of that highest wattage.

Table 1

Rated minimum efficacy values for T8 and T5 lamps

T8 (26 mm Ø)		T5 (16 mm Ø) High Efficiency		T5 (16 mm Ø) High Output	
Nominal wattage (W)	Rated luminous efficacy (lm/W), 100 h initial value	Nominal wattage (W)	Rated luminous efficacy (lm/W), 100 h initial value	Nominal wattage (W)	Rated luminous efficacy (lm/W), 100 h initial value
15	63	14	86	24	73
18	75	21	90	39	79
25	76	28	93	49	88
30	80	35	94	54	82
36	93			80	77
38	87				
58	90				
70	89				

In the following section, we present the graphs that plot the Commission's three proposed tier levels, the requirements of the existing regulation (above), some actual model data and a 'curve fit' equation for each product class that avoids backsliding, reduces complexity, and will help to save energy. The equations below for these lamp types are as follows, where Φ is the lumens of initial light output at 25°C for T8 and 35°C for T5:

$$Efficacy_{T8} = 90 \times \tanh(0.18 + 0.00075\Phi)$$
$$Efficacy_{T5} = 100 \times \tanh(0.30 + 0.00075\Phi)$$
$$Efficacy_{T5HO} = 89 \times \tanh(0.18 + 0.00075\Phi)$$

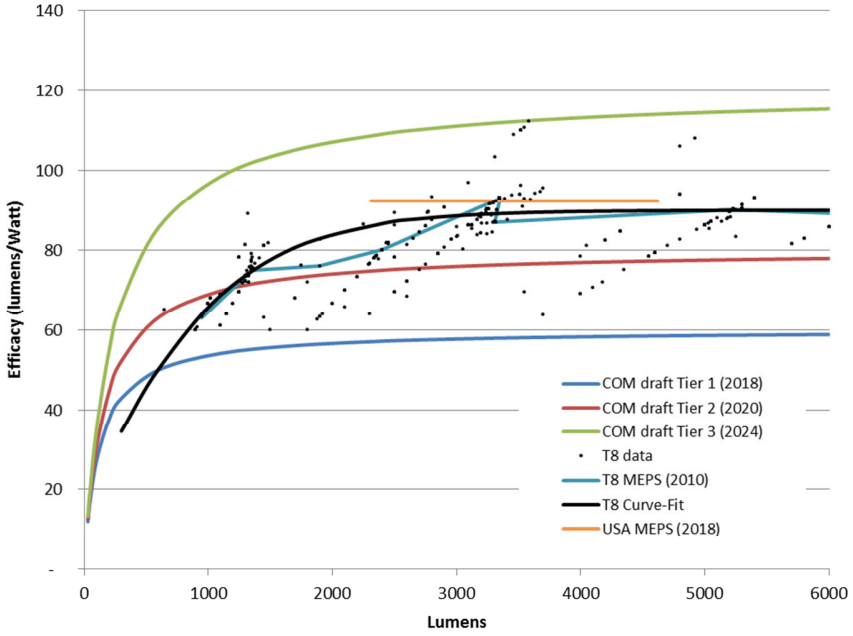


Figure A.13. Efficacy vs. lumen plot for T8 linear fluorescent lamps

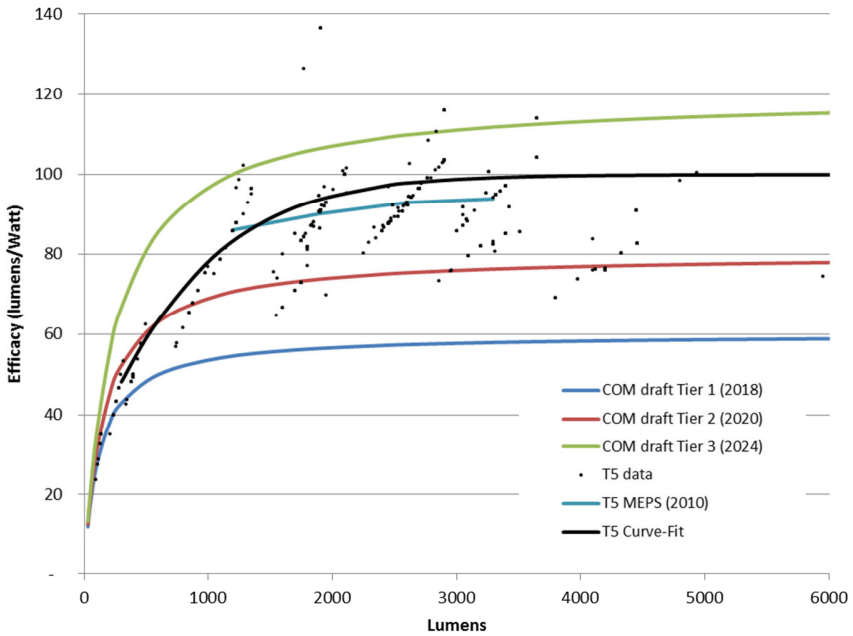


Figure A.14. Efficacy vs. lumen plot for T5 linear fluorescent lamps

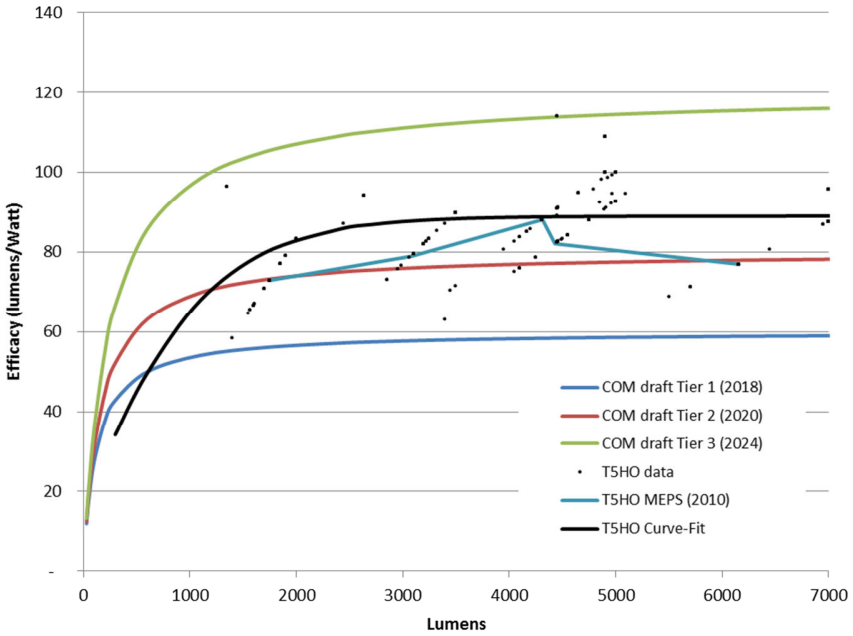


Figure A.15. Efficacy vs. lumen plot for T5HO linear fluorescent lamps

A.2 Single-Capped Fluorescent Lamps

Citation:

- EC No 245/2009, Annex III. Ecodesign requirements for fluorescent and high intensity discharge lamps and ballasts and luminaires able to operate such lamps. Section 1.1, A. Tables 2, 3, 4, 5.

Requirements:

- Minimum efficacy requirements for several types of single-capped fluorescent lamps, all of similar construction and with different base types and wattages. In the regulation, the types listed include:
  - Small single parallel tube, lamp cap G23 (2 pin) or 2G7 (4 pin)
  - Double parallel tubes, lamp cap G24d (2 pin) or G24q (4 pin)
  - Triple parallel tubes, lamp cap GX24d (2 pin) or GX24q (4 pin)
  - Four parallel tubes, lamp cap GX24q (4 pin)
  - Long single parallel tube, lamp cap 2G11 (4 pin)
  - 4 legs in one plane, lamp cap 2G10 (4 pin)
  - Single flat plane tube, lamp cap GR8 (2pin), GR10q (4pin) or GRY10q3 (4 pin)
  - Four or three parallel T5 tubes, lamp cap 2G8 (4 pin)
  - T9 circular, tube diameter 29mm with base G10q
  - T5 cicular, tube diameter 16mm with base 2GX13
- The following screen captures present the requirements as they are presented in 245/2009:
  -

Table 2

Rated minimum efficacy values for single capped fluorescent lamps working on electromagnetic and electronic ballast

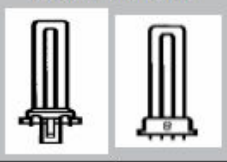
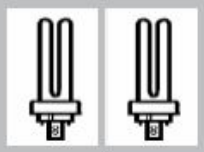
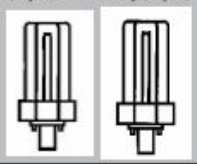
Small single parallel tube, lamp cap G23 (2 pin) or 2G7 (4 pin) 		Double parallel tubes, lamp cap G24d (2 pin) or G24q (4 pin) 		Triple parallel tubes, lamp cap GX24d (2 pin) or GX24q (4 pin) 	
Nominal wattage (W)	Rated luminous efficacy (lm/W), 100 h initial value	Nominal wattage (W)	Rated luminous efficacy (lm/W), 100 h initial value	Nominal wattage (W)	Rated luminous efficacy (lm/W), 100 h initial value
5	50	10	60	13	69
7	57	13	69	18	67
9	67	18	67	26	66
11	82	26	66	32	75
				42	76
				57	75
				70	74

Table 3

Rated minimum efficacy values for single capped fluorescent lamps, working only on electronic ballast

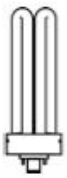
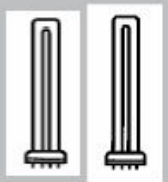
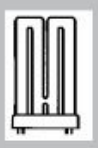
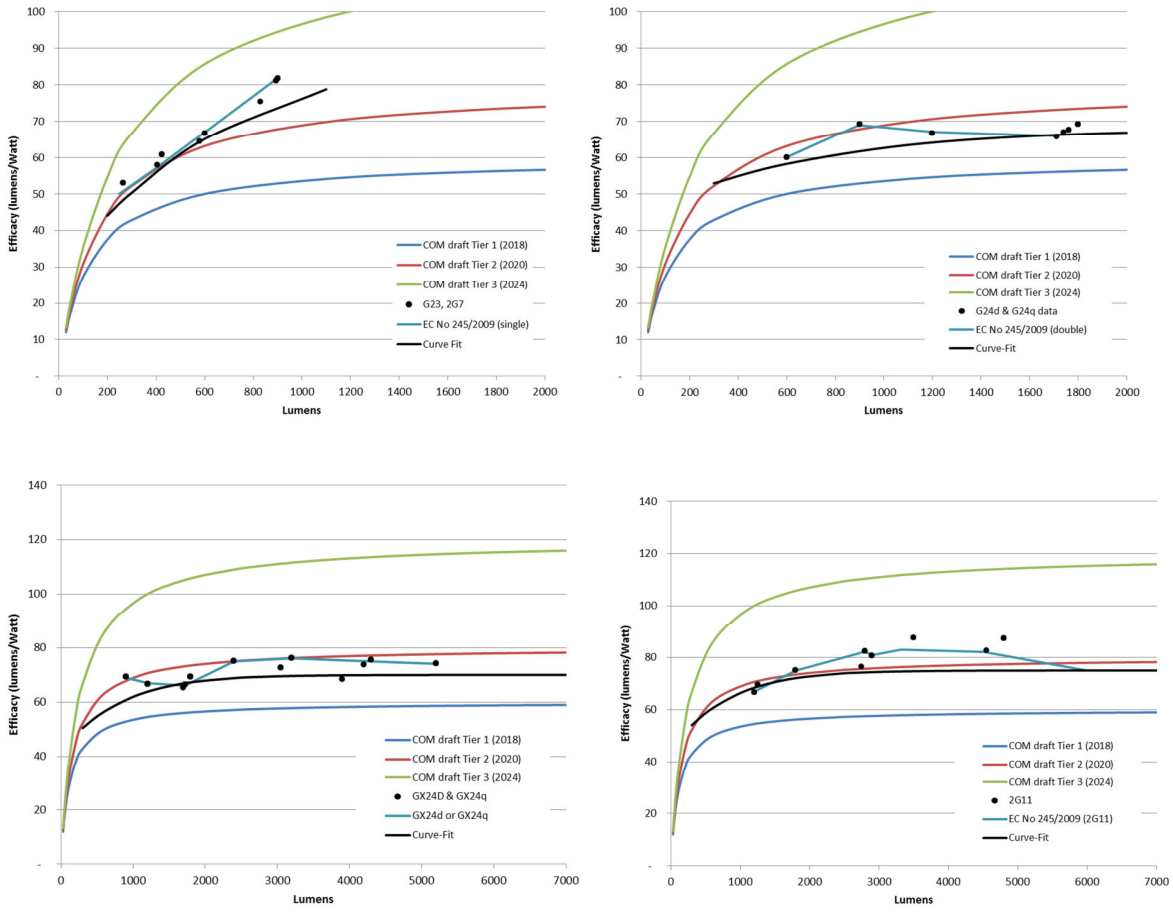
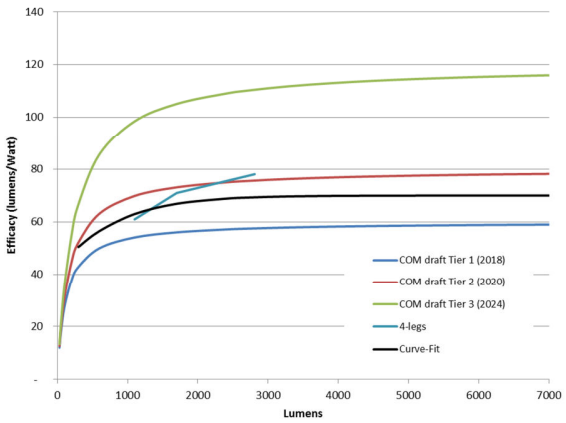
Four parallel tubes, lamp cap GX24q (4 pin) 		Long single parallel tube, lamp cap 2G11 (4 pin) 		4 legs in one plane, lamp cap 2G10 (4 pin) 	
Nominal wattage (W)	Rated luminous efficacy (lm/W), 100 h initial value	Nominal wattage (W)	Rated luminous efficacy (lm/W), 100 h initial value	Nominal wattage (W)	Rated luminous efficacy (lm/W), 100 h initial value
57	75	18	67	18	61
70	74	24	75	24	71
		34	82	36	78
		36	81		
		40	83		
		55	82		
		80	75		

Table 2 and 3 provide requirements for single-capped fluorescent lamps. These are non-ballasted, and tend to be used in commercial applications such as downlights and wall-washers. In the figures below, we have plotted market data but found that the products essentially match the requirements, and there has not been innovation that has moved the efficacy levels higher. We developed a series of curve fits to approximate these requirements with an equation, and in the process found some of them to be similar enough that they could be combined. Although the curves may appear to be slightly lower than the existing tables, these differences are not great enough to allow the re-introduction of halophosphors and it is very unlikely that any manufacturer would introduce new models that have a lower efficacy due to these small gaps between the existing requirements and the curve fits.

Figure A.16. Five Curve-Fit Plots for Pin-Based Single-ended Tubes





The table below shows the common curve fits that were identified, and the fact that the six product groups presented in Tables 2 and 3 of 245/2009 can be reduced to three equations at Stage 1 of the new lighting regulation. This allows for some simplification at the outset and will not compromise energy savings or introduce any market distortions.

Table A.10. Equations for Single-Ended CFLs, Tables 2 and 3 of EC No 245/2009

Product Groups from 245/2009	Equation that Applies to All
• Small single parallel tube, lamp cap G23 (2 pin) or 2G7 (4 pin)	$Efficacy_{G23,2G7} = 88 \times \tanh(0.35 + 0.001\Phi)$
• Double parallel tubes, lamp cap G24d (2 pin) or G24q (4 pin) • Triple parallel tubes, lamp cap GX24d (2 pin) or GX24q (4 pin) • Four parallel tubes, lamp cap GX24q (4 pin)	$Efficacy_{G24d,G24q,GX24d,GX24q} = 70 \times \tanh(0.7 + 0.0007\Phi)$
• Long single parallel tube, lamp cap 2G11 (4 pin) • 4 legs in one plane, lamp cap 2G10 (4 pin)	$Efficacy_{2G11,2G10} = 75 \times \tanh(0.7 + 0.0007\Phi)$

A.3 High Intensity Discharge Lamps

High pressure sodium lamps were covered in Stage 2 of 245/2009 at Stage 2. The requirements vary with whether the lamp has a clear or not-clear envelope. There was no increase in ambition for high pressure sodium, so these are the levels that we curve fit in this section.

Metal halide lamps were covered in Stage 2 of 245/2009 and again in Stage 3. There is also a variance in the efficacy requirements for the clear vs. non-clear lamps. We provide a curve-fit of the requirements in Stage 3, as that will be the level that has taken effect (April 2017) when this new regulation comes into effect (September 2018).

Mercury vapour lamps were covered in Stage 2 under 'other high intensity discharge lamps'. However, given that the efficacy requirements are so low for this application, and there are substitute lamps that have been made which are more efficacious than mercury vapour, we recommend phasing out mercury vapour in September 2018 when establishing the new efficacy requirements for HID lamps. We therefore recommend holding all mercury vapour lamps and metal halide lamps to the same requirement, which can only be achieved by metal halide technology.

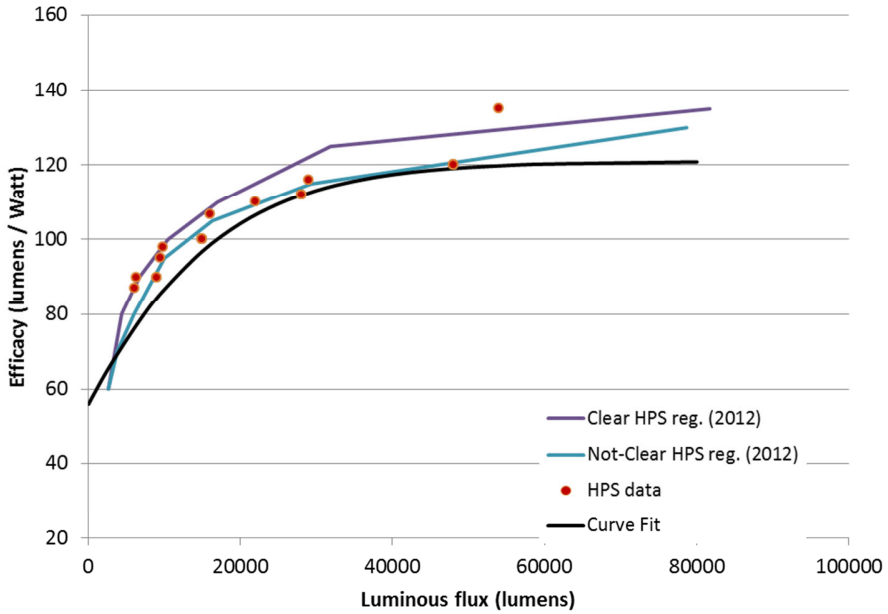


Figure A.17. Curve-Fit Plot for High Pressure Sodium Lamps

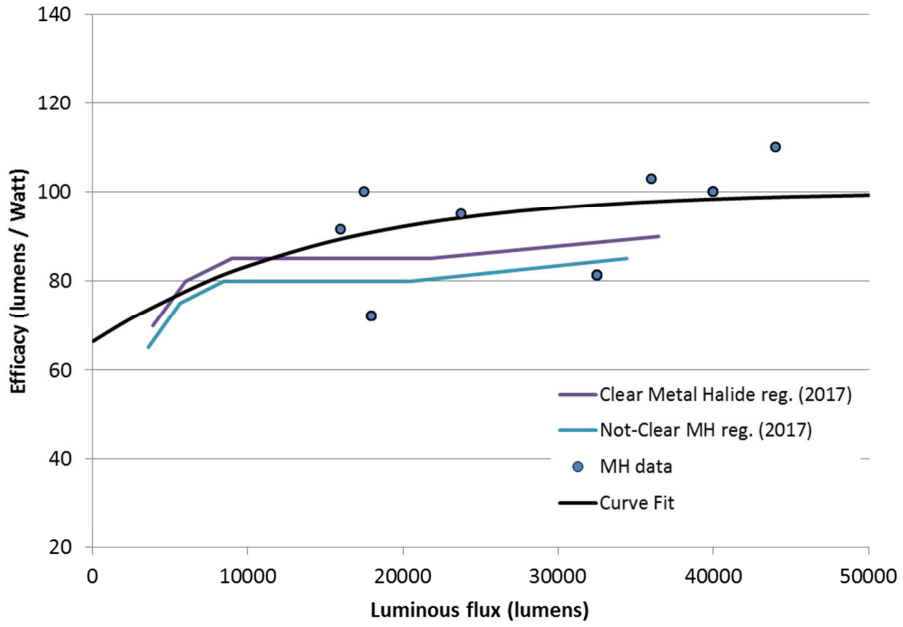


Figure A.18. Curve-Fit Plot for Metal Halide Lamps

Table A.11. Equations for High-Intensity Discharge Lamps

Product Groups from 245/2009	Equation that Applies to All
• High Pressure Sodium Lamps	$Efficacy_{HPS} = 121 \times \tanh(0.5 + 0.00004\Phi)$
• Mercury Vapour Lamps – all types • Metal Halide Lamps	$Efficacy_{MV,MH} = 100 \times \tanh(0.8 + 0.00004\Phi)$