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LIGHTINGEUROPE
THE VOICE OF THE LIGHTING INDUSTRY

# LightingEurope Feedback to the Oeko Clarification Questionnaire Regarding applications for Exemption No. 39a (renewal requests)

## Questions:

*1. Najing request a renewal of the request with its current formulation, benefitting the use of Cd QD in display applications only, but without limiting the configuration (on-surface, on-edge, on-chip). OSRAM propose a change to the formulation, limiting Ex. 39(a) to use of Cd QD in on-chip applications in which the CdQD are "directly deposited on LED chips". Please confirm that you agree that on-edge and on-surface Cd QD configurations could be excluded from future RoHS exemptions for quantum dot applications, or explain why not.*

As far as LightingEurope is aware, for the OSRAM target applications, solely on-chip configuration is required.

On-edge and on-surface are currently in use for TV or computer displays. LightingEurope is not aware of a member company being involved in this technology.

Therefore, LightingEurope cannot judge the necessity of these films or tubes with respect to display applications. The Najing request is not available to us.

*2. In parallel to these requests, LightingEurope has requested a new exemption for "Cadmium in luminescent material for on-chip application on LED semiconductor chips (lighting)".*

*a. Please explain the difference between this technology and the technology for which OSRAM seek a separate exemption.*

The basic technology of Quantum Dots (herein QD) as wavelength converter to generate green or red light from the blue LED light is the same in both.

However, the different applications require a completely different architecture of the LED system and are therefore not really comparable.

In lighting, the mixture of conventional phosphors and Quantum Dot wavelength converters will generate (spectrally broad) high-quality white light. Only red QDs are

required to enhance the emission spectrum of red phosphors (especially if high CRI is required). For lighting applications today only on-chip configuration seem to be a realistic approach, since remote phosphor configurations (on-surface or on-edge) proved impractical for lighting, both from a material cost and an aesthetics point of view.

In contrast, for display applications, spectrally narrow green and red light is needed for a high efficiency (especially in combination with the color filters of the display) and high color gamut.

Since for displays, both red and green light is generated by Quantum Dots and does not contain conventional phosphors, the Cadmium (herein Cd) content must be higher than for a lighting LED with only red light from Quantum Dots. In addition, to fulfill the demanding optical requirements for an innovative compact display system, the phosphor layer is typically much thinner and thus requires a very high concentration (wt-%) of Cd in that layer, compared to the relatively low concentration used in the thick layers in lighting applications. However, the total content of Cd per LED is of similar order of magnitude in all these applications.

Displays with on-edge and on-surface configurations are in use, whilst on-chip configurations are to our knowledge not yet in use, but requested by our member company OSRAM, in order to introduce innovative applications that are highly efficient and in addition need less cadmium.

*b. In this respect, please clarify how the two technologies compare in terms of use of Cd, energy consumption, colour properties (application specific) etc.*

LightingEurope understands that for general lighting a higher efficiency of up to +20% is expected at comparable CCT and CRI values, compared to best available phosphor-based converter materials.

For display backlighting, efficiency and colour gamut will be the same compared to "on-surface", however, the amount of Cadmium could be reduced as soon as on-chip configuration is available for the market. This is expected to be the case in 1-2 years.

For certain new innovative applications, the only possible realizable solutions need the use of Cd containing quantum dots in on-chip configuration.

Regarding to the use of Cd, see above (answer to question 2a).

*c. Please specify if the two technologies could be addressed under one exemption and if so propose a suitable formulation (an exemption with two items, however with a common title is also an option in this respect), also referring to respective exemption durations.*

LightingEurope supports the proposal received from OSRAM in order to address the requests under one exemption, split into the different applications. As the display and projection application is not yet finally ready for the market, the current exemption for Cd in QD LED could also be included into the wording, depending on the argumentation of the renewal request mentioned in question 1, which is not known to us.

The exemptions could read:

*Cadmium in downshifting semiconductor nanocrystal quantum dots*

- *directly deposited on LED semiconductor chips for use in display and projection applications (< 5 µg Cd per mm² of light emitting LED chip surface)*
- *directly deposited on LED semiconductor chips for use in in lighting applications of at least CRI 80 (< 1.000 ppm in the luminescent material)*
- *not directly deposited on LED semiconductor chips for use in display and projection applications (< 0,2 µg Cd per mm² of display screen area) **

*All for a maximum validity period of 5 years (Expires for all categories on 31 October 2024)*

[* As far as is known to LightingEurope, member companies currently do not work on such configurations.]

A duration of 5 years is required in order to allow the users of this new technology to develop, validate and market products based on the electronic components we are preparing. A shorter period would be extremely negative for the acceptance and rollout of the technology by our customers. It would lead to legal uncertainty as to whether the effort they need to spend for products and applications leads to success. It would hamper the availability of innovative products that offer advantages in terms of energy efficiency and support the EU's energy savings and climate change agenda.

*3. As regards lighting applications, please explain which conventional lighting technologies still on the market (discharge lamps of different types) the technologies, for which OSRAM and LightingEurope request exemptions, shall substitute. In this respect, please provide comparisons of conventional technologies with the LE CD technologies to allow understanding the advantages in terms of energy consumption, light quality and colour, etc.*

Display: Hg-containing discharge lamps are no longer in use for displays for quite some years. They are only required as spare parts for special industrial, commercial or medical displays.

Solid State Lighting: LED packages are electronic components used in LED lamps and LED luminaires and other equipment. So the LED package alone cannot replace a lamp or a luminaire, but it can be used in lamps and luminaires replacing phosphor-based LED packages. The technology offers advantages in terms of energy efficiency and as such is a technological advancement that supports the EU's energy savings and climate change agenda.

*4. Please provide information on the relevant parameters for comparisons of the Cd QD on-chip technologies with other technologies applied in general and special lighting applications and for display lighting application on the system level. For each parameter, please also provide detail as to the industry wide accepted standards and benchmarks for quantifying the performance of various technologies in relation to each of the specified parameters.*

<u>General Lighting:</u>

Currently no Cd QD LED are in use in general lighting. According to OSRAM, products with RoHS compliant Cd QD (On-chip, <100ppm Cd) will be released soon. Other configurations are not realistic for general lighting. LED used today in lighting applications are using almost exclusively phosphor-based converter materials or RGB packages. Cd QD LED are completely equivalent to conventional LED with respect to parameters like colour rendering. Colour gamut is not relevant for lighting.

The only relevant difference is enhanced luminous efficiency at a given CRI and CCT.

In addition, this can lead to increased material efficiency as less LED packages are required in a comparable light source (e.g. a lamp equivalent to a 60W GLS).

<u>For Display:</u>

Currently only on-surface and on-edge solutions are available. Compared to these technologies Cd QD on-chip solutions would offer:

- Lower Cd amounts per display area
- New innovative applications
- Miniaturization of equipment

Compared to today's displays not using QDs:

- Significant higher luminous efficiency
- Increase of gamut Rec 2020 coverage
- New innovative applications
- Miniaturization of equipment

# Contact

For further information on this topic, please contact:

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*LightingEurope is the industry association that represents the lighting industry in Europe. We are the voice of more than 1,000 lighting companies that employ more than 100,000 Europeans and create an annual European turnover of over € 20 billion. Our daily mission is to advocate and defend the lighting industry in Brussels, while reconciling it with ongoing EU policy aims. In doing so, we are dedicated to promoting efficient lighting practices for the benefit of the global environment, human comfort, and the health and safety of consumers. More information is available on: www.lightingeurope.org.*