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Mr. Karney:

I have reviewed the [Draft ENERGY STAR Requirements for SSL Luminaires](#) and have the following comments on the standard, as it appears on the web (1) on January 18, 2007:

**Critique of current draft standard:**

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The draft standard makes no mention of the toxicity of LED bulbs and fixtures, and the possible energy expenditures required to mitigate this toxicity when bulbs and fixtures reach the end of their useful life. Nor does the standard require that manufacturers of LED and related devices explicitly list all chemical dopant compounds used in the manufacture of these devices.

If LED bulbs and fixtures must be recycled as toxics when they reach the end of their useful life, disposal may require the transport or packaging & shipment of spent devices to specialized handlers, as is true for spent fluorescent bulbs.

**Proposed changes to standard:**

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I suggest the ENERGY STAR cost & energy efficiency analysis of LED's provide an allowance for any expenditures of energy and time needed to meet special disposal requirements (similar to those required for fluorescent bulbs).

I also suggest that the new SSL Luminaires standard *at least recommend* -- if not require -- that manufacturers of LED materials and dyes make available explicit lists all dopants applied to their products, in order to receive ENERGY STAR certification. This would be a prudent requirement, since future studies of such materials may justify further special handling at the product's end-of-life.

**Rationale:**

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Certain LED bulbs use arsenic and indium-based materials in their construction, such as Gallium Aluminum Arsenide or Indium Gallium Aluminum Phosphide. These materials may be highly toxic (2). Furthermore, some LED materials are "doped" with other extremely toxic compounds, such as Beryllium, although the dopants are not always listed by the manufacturer as being part of the LED semiconductor material (3).

Until more is known about the toxicity of the components used to manufacture LED's, it would be conservative to assume that specialized recycling of spent LED bulbs may be required, as it is presently required for fluorescent bulbs. Since such specialized recycling requirements impact the energy expenditure required over the life of the product, such expenditures could be an appropriate factor to include in the ENERGY STAR energy efficiency rating standard for SSL devices.

The lack of mercury content may make LED's far more environmentally friendly than fluorescent bulbs. My two suggestions, above, are intended to be manufacturer-friendly, so as to not impede the adoption of LED devices. At the same time, my suggestions are meant to underscore the possible risks and future mitigation steps needed to address toxicity as future studies shed more light on the subject.

Please submit this comment into the record, and thank you for your consideration.

- (1) Reviewed 1/18/2007 from the web link at <http://www.netl.doe.gov/ssl/PDFs/ENERGY%20STAR%20SSL%20Draft%2012%2020.pdf>
- (2) [http://en.wikipedia.org/wiki/Aluminium\\_gallium\\_indium\\_phosphide#Safety\\_and\\_toxicity\\_aspects](http://en.wikipedia.org/wiki/Aluminium_gallium_indium_phosphide#Safety_and_toxicity_aspects)  
[http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list\\_uids=15276420&dopt=Abstract](http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=15276420&dopt=Abstract)
- (3) <http://www.marktechopto.com/Engineering-Services/Technical%20Articles/leds-alphabet-soup.cfm>