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Blue light issues in a nut shell

Recently the American Medical Association published a position paper on the effects of LED lighting on humans. There has been much back and forth over the issue since this paper was written. In order to clarify the issues in a concise way this paper will attempt to abbreviate the topic and list in bullet format the central point's being made on each side. Sternberg does not wish to take sides on this issue as we are not a scientific organization with research that will support either position. We will however try to capture for convenience sake both sides of the argument. The reader will be left to form their own opinions and decide for themselves which side if any to support.

The issue: Is Blue light bad for people? If so how much is bad and at what exposure rate? What effects does it have on human beings?

AMA position:

"Despite the energy efficiency benefits, some LED lights are harmful when used as street lighting," AMA Board Member Maya A. Babu, M.D., M.B.A. "The new AMA guidance encourages proper attention to optimal design and engineering features when converting to LED lighting that minimize detrimental health and environmental effects."

- White (Blue) wavelengths create nighttime glare
- Discomfort and disability created by glare reduces visual acuity
- Blue-rich LED sources produce wavelengths that suppress melatonin production in the human body
- Bright white sources in residential areas reduce sleep times producing fatigue and impaired daytime function as well as contributing to obesity
- Has a disorienting effect on birds, insects, turtles and fish species

Recommended actions:

- Minimize and control blue-rich lighting by using sources with minimal blue wavelengths to reduce glare
- Employ proper shielding to minimize glare and to minimize effects on humans, wildlife and the environment
- Use the ability of LED to be dimmed for off peak periods

Original document link: http://www.ama-assn.org/ama/pub/news/news/2016/2016-06-14-community-guidance-street-lighting.page

Illuminating Enginering Society of North America (IESNA) response:

The IES is aligned with the AMA in support of the proper conversion of outdoor area and roadway lighting to LED light sources to reduce energy consumption, with proper optics and shielding to reduce glare and light trespass. The IES further supports the AMA recommendation to consider the ability to reduce light levels during off-peak periods.
IES disagrees with AMA polies H-135.927 related to Spectral content for outdoor and roadway lighting sighting more evidence is needed before claims of actual negative health effects can be substantiated. They also disagree on the basis that Correlated Color Temperature (CCT) is inadequate for the purpose of evaluating possible health outcomes.
They call for more research and a collaborative effort with AMA to help research and define the issues going forward.

Original document link: www.ies.org/policy/position-statements/ies-board-position-on-ama-csaph-report-2-a-16-human-and-environmental-effects-of-light-emitting-diode-led-community-lighting/

U.S. Department of Energy (DOE) response:

As explained in the DOE Fact Sheet True Colors, there's nothing inherently different about the blue light emitted by LEDs; that is, at the same power and wavelength, electromagnetic energy is the same, regardless of source type. And as the potential for undesirable effects from exposure to light at night emerges from evolving research, the implications apply to all light sources — including, but by no means limited to, LEDs. Further, these research results are often also relevant to

light we receive from televisions, phones, computer displays, and other such devices.

- The same prudence taken with traditional light sources should be used with new LED technologies
- LED's have advantages over older sources in that they are dimmable offering control of intensity for the varying needs of roadways with respect to traffic density and time of day/night
- LED's are highly controllable in terms of distribution and light patterns on the road surface applying light only to the areas of need rather than allowing up-light and stray light
- LED sources or inherently more energy efficient with roughly 50% wattage needed to do the same lighting job
- LED spectral content can be mix and/or changed to emit more or less light in a given part of the color spectrum
- There isn't anything special about blue light from LED's. In fact the same blue part of the spectrum is present in almost all light sources
- LED's with lower CCT values are easy to find but are slightly less efficient than the higher CCT versions
- Lower CCT's lower visual acuity. Although lower CCT's may reduce environmental impact they can increase lighting effectiveness with a possible need to increase lumens in the design to compensate

Recommended actions:

- Match lighting products, sources and performance to the application
- Consider the right amount of light, the right spectral characteristics and directional aspects of lighting products when selecting for a project

Original document link: http://energy.gov/sites/prod/files/2016/06/f32/postings_06-21-16.pdf

Rensselaer Polytechnic Institute (LRC--RPI) response:

Recently the AMA has produced a document cautioning the public about In-Ga-N based LEDs used as sources of illumination both indoors and outdoors. These In-Ga-N LED sources generate short wavelength radiation from a solid state die. Some of that radiation is absorbed by a phosphor that, in turn, reemits long wavelength radiation. Together, the light emitted by the die and the light reemitted by the phosphor appear white to the human eye. Depending upon the relative emissions from the LED package, both the die and the phosphor, the white illumination can appear to have a "warm" tint (yellowish-white) or "cool" tint (bluish-white) or can appear neutral. This solid state lighting technology has, or soon will, displace most other commercially available light sources used for general illumination because they are more energy efficient, have longer life and are more cost effective to own and operate than most other sources of illumination. The concern expressed by the AMA in their report is focused specifically on the short-wavelength emission from these In-Ga-N LED sources as that spectral region might negatively affect, through several modes, human health.

- Predictions of health consequences from light exposure depend upon an accurate characterization of the physical stimulus as well as the biological response to that stimulus. Without fully defining both the stimulus and the response, nothing meaningful can be stated about the health effects of any light source.
- Notwithstanding certain sub-populations that deserve special attention, blue light hazard from In-Ga-N LEDs is probably not a concern to the majority of the population in most lighting applications due to human's natural photophobic response.
- In-Ga-N LED sources dominated by short wavelengths can cause relatively greater discomfort than sources dominated by long wavelengths, including "warm" In-Ga-N LED sources, at the same photopic illuminance at the cornea. As with disability glare, however, discomfort glare is mostly determined by the amount and distribution of light entering the eye, not its spectral content
- In-Ga-N LED sources dominated by short wavelengths have greater potential for suppressing the hormone melatonin at night than sodium-based sources commonly used outdoors. However, the amount and the duration of exposure need to be specified before it can be stated that In-Ga-N LED sources affect melatonin suppression at night.
- Until more is known about the effects of long-wavelength light exposure (amount, spectrum, duration) on circadian disruption, it is inappropriate to single out short- wavelength radiation from In-Ga-N LED sources as a causative factor in modern maladies.

Original document link: http://www.lrc.rpi.edu/resources/newsroom/AMA.pdf

Recommended actions;

- There must be an attempt at rational discussion on this subject not emotional reaction
- Social benefits as well as social costs must be evaluated
- Single metrics such as CCT and its effect on biological response should be avoided at all cost. A holistic approach is needed

Municipal Solid-State Street Lighting Consortium (MSSLC) response;

DOE's Solid-State Lighting Program issued an SSL Postings within a few days of the AMA's release. This notes the importance of matching the characteristics of the product with the specific application, underscoring the AMA's call for the use of appropriate products. Since then a number of other organizations have also weighed in with very useful perspectives.

- Spectral power distribution is a good indicator of melanopic (non-visual) content but there is overlap between CCT's. CCT is not a good indicator of whether a light source will produce an effect over another source
- Results of a particular response on health is not fully understood by the medical community
- No respect to Dimming is given by the AMA. The idea being that if any source that produces a given melanopic output will decrease that output with dimming giving a potential positive result to total effect on the human body

Recommended actions;

- No actions suggested

Original document link; http://energy.gov/sites/prod/files/2016/07/f33/msslc_enews_jul2016.pdf

National Electrical Manufacturers Association (NEMA) response:

The National Electrical Manufacturers Association (NEMA) is a long-time proponent of good quality lighting design and application with technical standards and guidance for manufacturers and their end-use customers. The American Medical Association's community guidance on LED outdoor lighting is aligned with lighting manufacturers' long-standing recommendations on how to design safe and efficient light for night.

- Spectral content should be one factor in effective lighting for the outdoor environment
- A single solution is not appropriate for all situations
- The complexity of lighting designs is not well served by implying that CCT or correlated color temperature be the only metric used to design projects
- Sites DOE response regarding CCT and the limitations of using sources of 3000k or lower

Original document link; http://www.nema.org/news/Pages/NEMA-Comments-on-American-Medical-Association-Community-Guidance-Advocating-and-Support-for-Light-Pollution-Control-Efforts.aspx

Recommended actions;

- NEMA welcomes the opportunity to work with AMA to further research in this area

References:

AMA on-line report
"Human and Environmental effects of LED Light emitting Diode lighting" June 14, 2016

Lighting Research Center (LRC—RPI) response to AMA
Authors Mark S. Rea, PHD and Mariana G, Figuero, PHD June 30th, 2016

U.S. Department of Energy (DOE) SSL postings
"LED Street Lighting"
Author Jim Brodrick June 21st, 2016

National Electrical Manufacturers Association (NEMA) response to AMA
"NEMA Comments on American Medical Association Community Guidance: Advocating and Support for Light Pollution Control Efforts and Glare Reduction for both Public Safety and Energy Savings"
On-line report
Author; Tracy Cullen June 24th, 2016

Municipal Solid-State Street Lighting Consortium (MSSLC)
Article in "The Light Post" newsletter
Author; Bruce Kinzey, MSSLC Director July 2016

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