



Department of Energy
Washington, DC 20585

December 18, 2009

Mr. Robert Parks, Director
IDA Government Affairs & Public Safety
717 D Street, N.W., Suite 300
Washington, D.C. 20004

Subject: US Department of Energy Response to the International Dark-Sky Association's (IDA) Draft Position Statement, "Blue-White Light and the Night Environment" (DPS)

Dear Mr. Parks:

The mission of the Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) is to strengthen America's energy security, environmental quality, and economic vitality through public-private partnerships that bring clean, reliable and affordable energy technologies to the marketplace. The DOE and its partners are working to accelerate advances in solid-state lighting because there is no other lighting technology that offers as much potential to save energy, thus contributing the most to our nation's energy and climate change solutions.

DOE is primarily interested in promoting the most energy efficient technologies and methods that meet standards set by recognized authorities. The recognized authority in lighting is the IESNA, and the latest published documents pertinent to the spectral content of outdoor lighting are IESNA TM-12-06 and IESNA TM-18-08, published in 2006 and 2008, respectively.

I would like to thank IDA for the opportunity to provide input to the above referenced DPS. I have limited my review to those portions that are directed toward solid-state lighting, and in so doing, I find three flaws in the DPS as currently written. The following issues concern the DPS recommendations to limit the blue content of light sources for outdoor lighting applications:

1. Energy Efficiency: It is factually incorrect to state that "Outdoor lighting efficiency for visual tasks involving cognitive and foveal vision (primarily driving) is not increased using bluish-white light sources" when discussing LEDs. This is because LEDs with higher CCT (more blue content) tend to be substantially more *photopically* efficacious than LEDs with lower CCT.

For instance, a 6000K LED today is 30% more photopically efficacious than a 3000K version. While LED luminaires can often outperform their less optically efficient HID counterparts, much of the potential for energy savings is lost if CCT is limited to 3000K. On a national level, we estimate that the lost annual energy savings from limiting the blue content in outdoor lighting applications would be equivalent to the annual energy consumption of 3.7 million residential households, and the annual greenhouse gas

reductions would be 28 MMT of CO₂, 117,000 short tons of SO₂, and 43,000 short tons of NO_x. These represent significant energy savings and emissions reductions that would have a positive effect on the environment. Note that this example does not rely on any scotopic or mesopic modification factors.

2. Human Visual Impacts: The DPS position claiming possible negative visual effects from bluish-white light is not consistent with the IESNA Technical Memoranda noted above. For instance, while it is true that neither of the DPS references [1] and [2] from the IESNA are conclusive in formulating methods for using light sources with relatively more blue in the spectrum, these documents do conclude that there are potential visual benefits for off-axis detection and brightness perception. The DPS conclusion that “negative human visual impacts that would result” from widespread replacement of existing outdoor lighting with sources emitting bluish-white light is unsubstantiated in the DPS.

We constantly monitor research to assess whether there are potential pitfalls that might adversely affect the development of solid-state lighting. For outdoor lighting, most research indicates that broad-spectrum bluish-white lighting results in equal foveal vision and may aid vision through better color discrimination, color contrast, brightness perception, alertness, and off-axis detection. Research into possible negative glare effects from bluish-white light sources in outdoor luminaires is lacking, and the DPS implication that LED broad-spectrum lighting results in a net negative effect on human vision is unsupported. If the IDA has found conclusive evidence that such a net negative visual effect exists in outdoor applications, we invite you to submit it for our review.

3. LED Effect on Circadian Rhythms: It is misleading to include a diagram of a bluish-white LED light source and conclude that it “may disrupt normal day/night cycles” without addressing the relative significance of other variables like retinal illuminance and duration of exposure. Given the available research findings at this time, it is not clear that the relatively low intensity levels and short duration of outdoor lighting exposures could pose any threat to human health. Additionally, polychromatic (broad spectrum) white light sources have been shown to be weaker stimuli to the circadian system than would be assumed from the additive sum of the effects produced by their individual spectral components. This phenomenon, presumed to be a result of spectral opponency, must be considered in any discussion on the non-visual impacts of high CCT, white light sources. Taking all of this into consideration, it does not appear likely that limited exposure to broad spectrum LEDs outdoors will prove to be of greater concern than typical indoor lighting exposures experienced at night.

Given the above, the IDA’s recommendations of curtailing emissions of light wavelengths shorter than 500 nanometers over the complete life of the lamp and minimizing the use of light sources with a CCT above 3000 Kelvin are unsubstantiated, and are contrary to the Department of Energy’s mission to improve energy efficiency and environmental quality. High CCT lighting for outdoor applications should be neither mandated nor prohibited at a national level; qualified designers should be free to determine the relative importance of color and efficacy for any given project.

As you know, I have suggested that the National Institutes of Health and/or the Federal Highway Administration are agencies that are more appropriate for funding much of the research that IDA

has proposed over the last few months. DOE will continue to monitor research on the performance and potential pitfalls of LED outdoor lighting solutions. I appreciate the opportunity to comment on behalf of the U.S. Department of Energy.

Sincerely,

James R. Brodrick