Mesopic Street Lighting System Conserves Energy

The human vision system has two types of receptors in the retina, cones and rods, to transmit visual signals to the brain. The current system of photometry is based on how the eye's cones respond to different wavelengths. Cones are the dominant visual receptor under photopic (daylight) lighting conditions. Rods function primarily under very dim (scotopic) conditions. With the current system of photometry, it remains unclear which luminous efficacy function should be used for nighttime applications where electric lighting is used and both rods and cones contribute to vision (mesopic conditions).

Induction lamps replaced high-pressure sodium lighting on Meridian Street in Groton, Conn. A remaining HPS lamp lights the parking area on the right in this photo.

The LRC's proposed Unified System of Photometry was designed to characterize light at any level including mesopic levels, bridging the photopic and scotopic luminous efficacy functions. LRC researchers developed a mesopic street lighting system designed to reduce energy use while maintaining or improving perceptions of visibility, safety, and security. The LRC team demonstrated the new mesopic system in the City of Groton, Connecticut.

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A researcher takes illuminance readings under CMH lighting

Field test evaluation

High-pressure sodium (HPS) lights at two locations were replaced with white light sources (induction and ceramic metal halide), which better optimize human vision under mesopic conditions.

The new mesopic street lighting system:

- Met all utility requirements;
- Operated in both cold and hot climates without dramatic degradation of light output;
- Used 30 – 50% less energy than the HPS systems;
- Demonstrated that using less wattage, thereby lowering illuminance levels, reduces the light reflected from the road surface, a major contributor to light pollution (sky glow).

The overall results verified that the mesopic street lighting system can conserve energy in rural and suburban areas.

There are approximately 13 million streetlights in America. LRC experts estimate that about half of these have the opportunity to take advantage of mesopic lighting strategies. Assuming a 30% energy reduction per streetlight, this would translate to an annual savings of 1 billion kWh, and a reduction in power plant CO_2 emissions of 546,000 tons per year.

Survey results

Responses to surveys conducted before and after the installation of the new light sources revealed that area residents perceived higher levels of visibility, safety, security, brightness, and color rendering as both drivers and pedestrians with the new lighting systems than with the standard HPS systems.

The findings in Groton concur with similar research conducted by the LRC in Easthampton, Massachusetts and in Austin, Texas.

A full report detailing energy use, consumer acceptance and perceptions, visibility, and light levels is available online at:

www.lrc.rpi.edu/researchAreas/pdf/GrotonFinalReport.pdf

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View LRC Project Sheets at
www.lrc.rpi.edu/resources/newsroom/projectsheets.asp

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