

How can our society use artificial light at night in a way that is sustainable, healthy, and socially acceptable? The European Union's Cooperation in Science and Technology (COST) Action ES1204 has brought together experts from such fields as lighting engineering, biology, ecology, health, city planning, law, physics, astronomy and statistics to answer this question. The Action is now beginning the third of its four years. After intensive study of current lighting practice and scientific literature, our group presents what we view as the current scientific consensus regarding best practices for night lighting.

There is now a large body of evidence demonstrating unintended negative consequences of artificial light at night. The most alarming problems are (1) the impact on the human circadian system, which is linked to significant adverse consequences on sleep, performance and health, and (2) the disruption of ecosystems through illumination with different temporal patterns and much higher levels than existed when life evolved.

Recommendation 1: Reduction of upward directed light

Overhead lamps intended for public or private outdoor area lighting should never emit light directly above the horizontal and should emit as little light as possible at shallow downward angles. Upward light provides no benefit and light at shallow angles causes glare that reduces visibility.

This could be accomplished by restricting allowed area lighting using a luminous intensity classification method similar to that defined in the European Standard EN 13201-2, but with a general requirement of no direct "uplight" (i.e. ULOR=0 for all classes).

Recommendation 2: Avoidance of blue light in outdoor lighting

There are several reasons to avoid blue light in outdoor lighting. (1) The circadian system of mammals is most sensitive to blue light. (2) Blue light is more glaring, especially for older individuals. (3) On clear nights, blue photons are more likely to be scattered by the atmosphere and returned to Earth as skyglow. For these reasons, it is our view that lamps used for outdoor area lighting should have a correlated colour temperature of 3000 K or lower. Exposure to bright light –and particularly light below a wavelength of 500nm (blue) – should be avoided to the greatest practical degree during the evening and night.

Recommendation 3: Evaluation of lighting levels

We recommend that the illuminance levels in standards like the European Standard EN 13201 and the ANSI/IES RP-8 be re-evaluated and that a scientific justification be provided for each of the recommended lighting levels.

Much of the lighting infrastructure in Europe provides an illuminance that is considerably below that recommended by EN 13201. Indeed, there are longstanding examples of European cities that intentionally use street lighting levels substantially below those specified in the standard but that nevertheless successfully address public safety. Furthermore, the energy and CO₂ emissions associated with outdoor lighting would increase dramatically if even the minimum limits recommended by the standard were adopted in all European countries.

Conclusion

There is a tremendous potential to improve the sustainability of exterior lighting systems in Europe. Improved lighting design with reduced glare will also improve visibility for drivers and pedestrians. The combination of reductions in wasted light and lowering of average illuminances will reduce costs as well as environmental and biological impacts. It will also help to achieve the European goal set out in the European Energy Efficiency Directive (2012/27/EU) to reduce energy consumption by 20% by 2020 and to target a 30% reduction by 2030 (EU COM(2014)520 final).

The ES1204 Action will continue its interdisciplinary investigation into artificial light at night and will provide more detailed recommendations as the end of the Action approaches.