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International Commission on Illumination
Commission Internationale de l'Eclairage
Internationale Beleuchtungskommission

POSITION STATEMENT

CIE Position Statement on Obtrusive Light and Light Pollution

1st Edition (November 2025)

CIE PS 003:2025

THE INTERNATIONAL COMMISSION ON ILLUMINATION

The International Commission on Illumination (CIE) is an organization devoted to international co-operation and exchange of information among its member countries on all matters relating to the art and science of lighting. Its membership consists of the National Committees in about 40 countries.

The objectives of the CIE are:

1. To provide an international forum for the discussion of all matters relating to the science, technology and art in the fields of light and lighting and for the interchange of information in these fields between countries.
2. To develop basic standards and procedures of metrology in the fields of light and lighting.
3. To provide guidance in the application of principles and procedures in the development of international and national standards in the fields of light and lighting.
4. To prepare and publish standards, reports and other publications concerned with all matters relating to the science, technology and art in the fields of light and lighting.
5. To maintain liaison and technical interaction with other international organizations concerned with matters related to the science, technology, standardization and art in the fields of light and lighting.

The work of the CIE is carried out by Technical Committees, organized in six Divisions. This work covers subjects ranging from fundamental matters to all types of lighting applications. The standards and technical reports developed by these international Divisions of the CIE are accepted throughout the world.
A plenary session is held every four years at which the work of the Divisions and Technical Committees is reported and reviewed, and plans are made for the future. The CIE is recognized as the authority on all aspects of light and lighting. As such it occupies an important position among international organizations.

LA COMMISSION INTERNATIONALE DE L'ECLAIRAGE

La Commission Internationale de l'Eclairage (CIE) est une organisation qui se donne pour but la coopération internationale et l'échange d'informations entre les Pays membres sur toutes les questions relatives à l'art et à la science de l'éclairage. Elle est composée de Comités Nationaux représentant environ 40 pays.

Les objectifs de la CIE sont :

1. De constituer un centre d'étude international pour toute matière relevant de la science, de la technologie et de l'art de la lumière et de l'éclairage et pour l'échange entre pays d'informations dans ces domaines.
2. D'élaborer des normes et des méthodes de base pour la métrologie dans les domaines de la lumière et de l'éclairage.
3. De donner des directives pour l'application des principes et des méthodes d'élaboration de normes internationales et nationales dans les domaines de la lumière et de l'éclairage.
4. De préparer et publier des normes, rapports et autres textes, concernant toutes matières relatives à la science, la technologie et l'art dans les domaines de la lumière et de l'éclairage.
5. De maintenir une liaison et une collaboration technique avec les autres organisations internationales concernées par des sujets relatifs à la science, la technologie, la normalisation et l'art dans les domaines de la lumière et de l'éclairage.

Les travaux de la CIE sont effectués par Comités Techniques, organisés en six Divisions. Les sujets d'études s'étendent des questions fondamentales, à tous les types d'applications de l'éclairage. Les normes et les rapports techniques élaborés par ces Divisions Internationales de la CIE sont reconnus dans le monde entier.
Tous les quatre ans, une Session plénière passe en revue le travail des Divisions et des Comités Techniques, en fait rapport et établit les projets de travaux pour l'avenir. La CIE est reconnue comme la plus haute autorité en ce qui concerne tous les aspects de la lumière et de l'éclairage. Elle occupe comme telle une position importante parmi les organisations internationales.

DIE INTERNATIONALE BELEUCHTUNGSKOMMISSION

Die Internationale Beleuchtungskommission (CIE) ist eine Organisation, die sich der internationalen Zusammenarbeit und dem Austausch von Informationen zwischen ihren Mitgliedsländern bezüglich der Kunst und Wissenschaft der Lichttechnik widmet. Die Mitgliedschaft besteht aus den Nationalen Komitees in rund 40 Ländern.

Die Ziele der CIE sind:

1. Ein internationales Forum für Diskussionen aller Fragen auf dem Gebiet der Wissenschaft, Technik und Kunst der Lichttechnik und für den Informationsaustausch auf diesen Gebieten zwischen den einzelnen Ländern zu sein.
2. Grundnormen und Verfahren der Messtechnik auf dem Gebiet der Lichttechnik zu entwickeln.
3. Richtlinien für die Anwendung von Prinzipien und Vorgängen in der Entwicklung internationaler und nationaler Normen auf dem Gebiet der Lichttechnik zu erstellen.
4. Normen, Berichte und andere Publikationen zu erstellen und zu veröffentlichen, die alle Fragen auf dem Gebiet der Wissenschaft, Technik und Kunst der Lichttechnik betreffen.
5. Liaison und technische Zusammenarbeit mit anderen internationalen Organisationen zu unterhalten, die mit Fragen der Wissenschaft, Technik, Normung und Kunst auf dem Gebiet der Lichttechnik zu tun haben.

Die Arbeit der CIE wird durch Technische Komitees geleistet, die in sechs Divisionen organisiert sind. Diese Arbeit betrifft Gebiete mit grundlegendem Inhalt bis zu allen Arten der Lichtanwendung. Die Normen und Technischen Berichte, die von diesen international zusammengesetzten Divisionen ausgearbeitet werden, sind auf der ganzen Welt anerkannt.
Alle vier Jahre findet eine Session statt, in der die Arbeiten der Divisionen berichtet und überprüft werden, sowie neue Pläne für die Zukunft ausgearbeitet werden. Die CIE wird als höchste Autorität für alle Aspekte des Lichtes und der Beleuchtung angesehen. Auf diese Weise unterhält sie eine bedeutende Stellung unter den internationalen Organisationen.

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November 5, 2025

Introduction

The purpose of lighting at night is to improve visual amenity and safety. However, in the design and setting-up of lighting installations one should avoid disproportionate unwanted effects. For instance,

- lighting requires energy use, and inefficient lighting wastes energy;
- bright patches of light frustrate visual adaptation;
- flashing, moving and high luminance light can cause annoyance;
- unwanted light can misdirect health-related body functions and disrupt the environment.

Obtrusive light is defined as *"spill light which, because of quantitative or directional attributes, gives rise to annoyance, discomfort, distraction, or a reduction in ability to see essential information such as transport signals"* (CIE 2020, 17-29-181; https://cie.co.at/eilvterm/17-29-181). The definition of light pollution (CIE 2020, 17-29-177; https://cie.co.at/eilvterm/17-29-177) differs in that it is less prescriptive and encompasses all adverse effects of anthropogenic light, and therefore would also include sleep and circadian rhythm disruption.

Although it is easy to focus on how this affects us personally, as when nearby lighting comes into our homes, there is a much wider range of effects that needs to be considered, including

- ecological effects;
- astronomical observations, both professional (astronomers) and amateur (our ability to see the stars on a clear night);
- health effects.

The lighting industry offers solutions that can mitigate obtrusive light. However, as much as finding ways to restrict it to specific times, illumination levels and places, it may often be necessary to consider placing less reliance on outdoor light. The wider picture, when we try to preserve what we value about the night, requires everybody to play a part, including ourselves at home, local authorities and businesses, and mitigation measures should be applied to buildings, outdoor spaces, infrastructure, activities and travel at night. At every part of the design process, the balance between the benefits of nighttime lighting on one hand and its costs and disbenefits on the other hand needs to be carefully considered. This is because anthropogenic light at night is usually a combination of multiple light sources, and its ecological impact can spread over large areas far removed from the original lighting.

Anthropogenic light at night

Anthropogenic light at night is light at night that is human generated as opposed to naturally occurring light such as moonlight. While the term “artificial light at night” has been used historically and remains common, “anthropogenic light at night” is the scientifically more precise term, as it avoids implying that human-generated photons differ from those produced by natural sources.

Obtrusive light can be from exterior lighting, such as that used for public area lighting, commercial lighting, sports lighting, road lighting, security lighting and from private properties, or it can be interior lighting that is transmitted through windows, rooflights/skylights and other openings in the building envelope. Although this is predominantly electric lighting, it could also be from other sources such as gas lamps, kerosene lamps, gas flares from oil refineries, etc. Hereafter in this Position Statement we refer to all of these anthropogenic sources simply as “light” or “lighting”.

In this Position Statement, the term “night” is intended to mean the period shortly following sunset on one day to shortly before sunrise the next day[1], which varies with latitude and time of year.

Benefits of light at night

The presence of road lighting is associated with a reduction in the risk of road traffic collision at night, in particular those collisions resulting in serious or fatal injuries for vulnerable road users such as pedestrians and cyclists, and to some extent the risk further decreases with higher luminance (CIE 1992).

The presence of road and public area lighting is also associated with an increase in reassurance that it is safe to walk through or be in a space, and to some extent the reassurance further increases with higher luminance (CIE 2019). The improved reassurance from lighting can reduce the fear of danger expressed often especially by women, and can reduce social isolation of the elderly or those with limited visual or physical capabilities by making it more feasible to be out after dark. Lighting (whether road lighting or the illumination of building facades and landmarks) can make a space more inviting, encouraging the use of and social interactions within an area.

Thus, road and public area lighting contributes to improved public health (UN Sustainable Development Goal (SDG) 3), as well as to reduced inequalities (SDG 5, SDG 10), and supports sustainable cities and communities (SDG 11)[2].

However, while there are benefits to society of light at night, CIE understands that there are also adverse effects and supports necessary and proper means of mitigation.

Adverse effects of light at night

This Position Statement describes how light at the wrong time and in the wrong place leads to adverse health effects, extending the advice given in the CIE Position Statement on Integrative Lighting (CIE 2024). In an appropriate design, illumination levels directly near road and public area lighting are intended to support human activities, but the resulting illumination penetrating into domestic interior spaces through windows should not have a level that suppresses melatonin production. It is important to note that in addition to melatonin suppression, the nuisance from

[1] More precisely, it is from the end of civil twilight one evening to the start of civil twilight the morning after.

[2] See https://sdgs.un.org/goals for details on the UN Sustainable Development Goals.

glare, motion, saturated colours and changing illumination levels can also be disruptive to sleep. Adverse effects can be particularly significant when the light is dynamic, such as some advertising panels.

Laboratory and field studies have shown that light exposure at night at moderately high levels has adverse effects on human physiology, including disruption to sleep and circadian rhythms through suppression of the hormone melatonin. If these effects are chronic, then they are well understood to be risk factors for poor health (Martinsons et al. 2024). There are reported associations between outdoor light levels assessed from satellite images of geographic areas and the incidence of disease, including cancer, in those locations (e.g. Palomar-Cros et al. 2024). However, it is unclear whether obtrusive light from exterior lighting has a potent influence on occupant physiology (Gibbons et al. 2022). Broadly speaking, the current strength of evidence for a given causal health-related effect of light at night is often lesser for long-term effects, partly because of weaknesses in the individual light exposure assessment and due to the fact that many diseases are multifactorial. Furthermore, generalizing to different groups of people, ages or with certain illnesses is often not possible (ISO/CIE 2022).

A recent expert review made recommendations for the appropriate amount of light exposure on healthy, day-active adults, including limits for evening and nighttime exposures (Brown et al. 2022, CIE 2023). When trying to sleep, the illuminance at the eye from all sources of light should be kept to below 1 lx of melanopic equivalent daylight illuminance (melanopic EDI)[3], which corresponds to a photopic illuminance of around 1 lx to 3 lx (depending on the light spectrum).

Standard lighting metrics are based on human visual perception and the human eye's response curves. These metrics for humans are not meaningful for ecological assessments, as most species interact with light differently from humans. The light levels used on roads and other external spaces, and the direct or reflected spill light from these, can exceed tolerable limits for species and ecosystems, both locally and over wider areas, since migrating species can also be affected. Therefore, light has to be used responsibly and with caution to minimize harm to the natural environment.

Ecosystems function as interconnected networks, making it challenging to protect species in isolation. If the food chain and ecological system that sustains a given species are negatively affected, that species can be detrimentally affected despite protective measures. Effects on one species can affect others: for example, changes in insect behaviour can alter food availability for others. Migrating species exposed to anthropogenic light at night can show consequences ranging from disrupted breeding patterns to altered migration routes and increased mortality (Jägerbrand & Spoelstra 2023). Pollinators active at night are especially vulnerable as anthropogenic light can disrupt their natural behaviour (Jägerbrand & Spoelstra 2023). Disrupted pollination, in turn, disrupts fruit production and the plant life cycle. Aquatic species can also be affected by light pollution, as many marine and freshwater species rely on natural light cycles for critical behaviours such as reproduction, feeding and navigation.

[3] The quantity called melanopic equivalent daylight illuminance (melanopic EDI) is expressed in lux (symbol lx), which is also the unit of the general quantity illuminance. It is generally agreed that correlated colour temperature (CCT) is not a reliable quantity for evaluation of melanopic spectral sensitivity, i.e. we cannot definitively state that a source with a higher CCT has a higher effect on melatonin suppression compared with a source with a lower CCT without specific evaluation of the melanopic response. See (Brown et al. 2022, CIE 2023) for more details. Note that melanopic spectral sensitivity does not apply to all animal species or to plants.

Sky glow resulting from excessive spill light at a distance can also adversely affect species. This scattered light pollution can extend far beyond the original light sources, allowing anthropogenic light at night to penetrate protected areas and nature reserves, thereby undermining conservation efforts that depend on maintaining natural darkness.

Although many species are particularly sensitive to shorter wavelength radiation (blue and UV), numerous species—including fireflies and other bioluminescent beetles, bats, freshwater fish and passerine birds—have a photoreceptor sensitivity extending beyond the visible spectrum into longer wavelengths for critical behaviour such as mating and foraging (Longcore 2023). Additionally, even species with lower sensitivity to longer wavelengths can still detect these wavelengths when light levels are sufficiently high.

Shorter wavelength radiation scatters more readily in the atmosphere and is therefore a bigger problem than longer wavelength radiation for sky glow and astronomical observations. Therefore, while the use of light sources with lower S/P ratios[4] often helps to reduce ecological impacts and skyglow in environmentally sensitive areas, it is recommended that lighting solutions be tailored to address the specific sensitivities of local species of concern, and spectral tuning should be considered as an additional tool to be used in concert with other mitigation measures, as there is no simple solution to mitigating the effects of anthropogenic light at night on all species.

Lighting of building facades and monuments is often mounted at ground level and directed upwards. This can result in significant spill light directly into the sky. Such lighting should therefore be implemented carefully to mitigate the environmental and ecological impacts.

Mitigation of the adverse effects of light at night

Adverse effects of light at night can be mitigated (whilst not entirely removed) by careful design using suitable products. It is important to understand what light is needed and when. Spaces have a rhythm: daily, weekly, throughout the seasons and throughout the years. A good approach is to light according to the rhythm of use and not simply to light the space without considering how it is used[5].

Lighting design should be undertaken with respect to the capabilities of the human visual system. When the illumination is non-uniform, the observer's adaptation level is raised in areas of relatively high light levels, making it harder to see details in the dark patch(es) beyond. When the illumination is very uniform, the adaptation level is (more or less) maintained as an observer passes through. Therefore, a good-quality lighting design is more likely to achieve its intended outcomes, possibly at lower overall average illumination levels.

Whilst standards should not be considered as the end point in design, observing recommendations within standards is important. When read correctly, standards usually give guidance on when it is possible to reduce lighting. It is common practice to ascertain the worst-

[4] S/P ratio is the ratio of the luminous output of a source evaluated according to the CIE scotopic spectral luminous efficiency, $V'(\lambda)$, to the luminous output evaluated according to the CIE photopic spectral luminous efficiency, $V(\lambda)$ (CIE 2020, 17-21-113; https://cie.co.at/eilvterm/17-21-113) . The S/P ratio is a better indicator of the amount of shorter wavelength or longer wavelength light for a given light source than the correlated colour temperature.

[5] In other words, if you just light the space you are lighting surfaces within the space without context. A better approach is to light a space according to the activities and use of the space as much as the specific lighting needs at any time.

case-expected scenario that requires the most illumination and light for a given situation on the assumption that requirements for all other tasks within a space will be satisfied by this, albeit potentially over-illuminated. Using adaptive lighting to match the lighting to the needs of the occupants at that time, e.g. by dimming or switching off the lighting, reduces environmental impacts. This is the basis of a wider meaning for adaptive lighting, moving beyond purely human concerns and providing lighting that adjusts to address the needs within the space, both human and ecological.

A multi-dimensional design approach is needed to provide lighting for human activities whilst respecting the surrounding environment. Local knowledge is required to understand what should be or is needed to be lit. Local authorities generally have oversight of outdoor lighting and should also have an understanding of what lighting is necessary, based upon local needs and ecological considerations.

New technologies offer possibilities for improving outdoor lighting. LEDs offer a unique capability in terms of choice of spectral distribution, control of spatial distribution and adaptability of light levels at different times.

Anthropogenic light at night cannot be avoided if external spaces are required to be safe and inviting, but it should be limited to the proper light at the proper place at the proper time while minimizing adverse effects.

Roadmap to future guidance

The CIE Research Strategy (CIE 2025) Topical Theme 2.3 “Ecologically respectful, high-quality exterior lighting” describes six areas in which researchers could focus to provide a scientific basis for improved recommendations that balance competing interests. Research in this area would also help to address eight out of the 17 UN Sustainable Development Goals.

Priorities include:

- effectively reducing ecological effects of anthropogenic light at night on affected species and ecosystems, particularly conservation-priority species and migratory species;
- understanding long-term effects of light at night on human health;
- determining measurement methods for obtrusive light and sky glow;
- reducing impacts on astronomical observations and research, as much as on cultural heritage of dark skies;
- making comprehensive, multi-disciplinary observations of whole systems to understand effective mitigation methods.

CIE can assist research by writing letters of support for research funding applications: See the CIE Research Strategy section of the CIE website (https://cie.co.at/research-strategy).

CIE already has work programmes in progress working on many of the issues covered in this Position Statement. For more information, please see https://cie.co.at/technical-work/jtcs to find out what we are working on and to get involved.

What can policy makers do now?

As compared to other difficult environmental problems, the adverse effects of anthropogenic light at night can have relatively straightforward mitigations. Finding the right solutions for specific places would best be done with a collaborative approach and open communication about needs, wants, goals, costs and benefits. Local authorities with jurisdiction should review their local lighting policies together with community members and suitable experts to evaluate whether they have struck the appropriate balance between the diverse needs of residents, drivers, pedestrians, cyclists, stargazers and ecosystems. They should review their practices and technology choices to assess whether there are opportunities to introduce energy-saving and adaptive lighting that could also mitigate some of the adverse effects of obtrusive light and light pollution. This work should be iterative, with updates occurring as new standards, recommendations and technologies become available.

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About the CIE and its Position Statements

The International Commission on Illumination – also known as the CIE from its French title, Commission Internationale de l´Eclairage – is devoted to worldwide cooperation and the exchange of information on all matters relating to the science and art of light and lighting, colour and vision, photobiology and image technology. The CIE publishes internationally recognized standards, reports and other publications concerned with all matters related to science, technology, and standardization in the fields of light and lighting.

CIE Position Statements are approved by the CIE's Governing Board and Technical Management Board.

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