LIGHTINGEUROPE
THE VOICE OF THE LIGHTING INDUSTRY

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How to create Better Lighting?

No renovation in Europe without an upgrade of the lighting installations

LightingEurope strongly supports the call made in the EU Renovation Wave Initiative to at least double renovation rates across Europe in the next ten years. This represents a unique opportunity to achieve the needed energy efficiency of buildings and to address the well-being of occupants through a better indoor environmental quality, both of which lighting contributes to.

Modernised lighting can significantly contribute to the energy savings in buildings. Lighting accounts for around 20 % of the total cost-effective electrical energy savings potential in non-residential buildings: with LED-based lighting systems, an additional 29 TWh/y can be saved by 2030 (up to 56 TWh/y in 2050).[1]

The World Health Organisation reports that people are spending on average 90% of their time indoors, and the Covid-19 pandemic has highlighted the importance of indoor comfort and wellbeing. High quality, energy efficient lighting products and technologies are already available and ready to install. By leveraging the impact of these products and technologies to create both energy efficient buildings and buildings with high indoor environmental quality (IEQ) – so-called Healthy Buildings - we can also improve the well-being and productivity of building occupants.

Although traditional electric lighting does wonders in terms of the visual, it simply lacks the non-visual benefits of natural light, created by dynamics in intensity and colour of the light throughout the day. This is where Human Centric Lighting (HCL) comes in. Using daylight as the baseline for quality lighting, HCL brings the benefits of natural light inside. More specifically, HCL supports the well-being and performance of humans by combining the visual, biological and emotional benefits of light[2].

HCL provides the right light, at the right place and the right time for the various activities we carry out every day. A wide range of users can benefit from HCL, including patients, residents, and staff in hospitals and nursing homes; students and teachers in schools; employees in offices; workers in manufacturing sites; and residents in their private homes.

We call upon EU policymakers to ensure there is no renovation without an upgrade of lighting installations and no new construction without better lighting.

[1] VITO et al. (commissioned by the European Commission), Preparatory study on lighting systems 'ENER Lot 37' (Brussels, 15 December 2016).
[2] https://www.lightingeurope.org/images/publications/position-papers/LightingEurope_and_IALD_Position_Paper_on_Human_Centric_Lighting_-_February_2017-modified_version-v2.pdf

To grasp the full benefits of better lighting, we recommend:

- the **introduction of mandatory minimum requirements** on Indoor Environment Quality (IEQ). Instructions for lighting can be found in EN 12464-1.
- that **access to public financing is subject to the fulfilment of certain conditions**. An obligation to include lighting renovation to obtain full subsidy should be introduced. One of the conditions to be fulfilled: Lighting should comply with EN 12464-1.
- **to include indoor environmental quality requirements in Green Public Procurement**. A reference to Indoor Environmental Quality should be included in Green Public Procurement guidelines and should be a prerequisite for bids on the renovation of public buildings, administrations, hospitals and schools.
- **to add new requirements in the Workplace Directive. The current legislation (89/654/EEC)** only consider health within the framework of injury prevention. The Directive should be revised to include new requirements that move beyond pure risk prevention and promote workplace well-being.

The main characteristics of better lighting

Within the IEQ design process, lighting should address the core issues of safety, task requirements and occupant needs in a coherent and integrated manner.

Better Lighting is adjustable in light levels

Traditional lighting design within a space involves metrics such as lux levels on a task plane, uniformity and discomfort glare. While these metrics are important in adequately lighting a space for people to work or perform their everyday visual tasks safely, they will not necessarily help to promote well-being or the biological and emotional performance of an individual. To do this, other factors must be considered.

A range of lighting levels required by occupants with a range of visual capabilities (e.g. age related) are most commonly considered on a horizontal surface at floor or working plane but the vertical illuminance within a space is also important, as this is the plane eyes are generally looking in. The variation in illuminance is important, ceiling to wall, to accents of light. Glare should be considered and techniques such as washing the walls or ceiling with light may reduce discomfort glare. Areas of relative darkness are as important as light brighter areas to provide visual interest and a more natural lit appearance. In the natural world shadows are cast from the sun, they help reveal an objects solid form. With that in mind, daylight is an important factor to consider and not just the spectrum it produces but also the quantity, directionality and its ever-changing nature. In general, more light during the day is better, although when wrongly implemented, higher light levels can cause discomfort due to glare or contrast issues. It is also important to consider the usage of the space, for example display screen equipment requires special consideration. The ratio between screen brightness and the background will affect glare and visual comfort to the user, poor application of this can cause headaches and fatigue. Lighting controls can be used to provide a dynamic lit appearance which can increase visual interest and specific lighting levels for a particular user. To provide a truly Human Centric lighting scheme we must consider that individuals have preferences, in lighting this may be illuminance levels and personal controls to dim or boost the illuminance levels should be used.

Better Lighting uses quality light sources

The quality of the light generated by the light source(s) and the luminaire in which the light source(s) are installed will impact the quality of light output from an electric lighting installation.

The development of LED lighting has revolutionised the lighting sector and opened the door to many new HCL-related opportunities not possible with previous technologies. Intelligent Lighting Systems make indoor environments more attractive and functional, allowing users to control light and dynamically adapt it to their specific needs, for instance by dimming. Several different distributions of light output are possible, and the spectral output from LEDs can be varied across a very wide range of colour temperatures. Adjustment of LED light fixtures between 2700K and 6500K to suit occupant needs are common today, whereas traditional light sources are much more limited in these aspects.

Colour rendering (CRI) is a measure of how similar the colours of objects appear when illuminated by the light source as compared to illumination by a reference light source of the same colour appearance. Colour rendering is not a measure for consumer preference. Colour Rendering can be derived from the spectral power distribution. Recently, a new measure for non-visual performance is also derived from the spectrum: Melanopic Equivalent Daylight Illuminance (MEDI). This MEDI (combining illuminance levels and spectral composition) indicates the effect that the light source may have on human circadian rhythms.

The absence of annoying factors such as flicker or stroboscopic effect are also seen as part of light source quality.

Better lighting is tunable or tuned for the application

Better lighting has a tunable spectrum or is tuned to support a specific activity in the application. It is also possible to control simultaneously and automatically both the spectrum and light intensity of a lighting installation. This functionality may be valuable for aesthetic reasons, by introducing dynamism and drama to the space, or it may be used to improve visual acuity for certain tasks benefitting from different light levels or spectral composition. Tunable and dynamic lighting also allows the intensity and colour temperature of the electric light inside a space to be aligned with those of the daylight or sunlight outside, helping create the effect of ‘bringing the outside in’.

Better lighting is personalised through controls

Several factors, such as the personal preferences, visual acuity of a person, the type of activities carried out in a certain space at a certain time or prevailing weather conditions, can affect the quantities, distributions and spectral qualities of light that are required. Lighting design tends to implement a minimum scenario as described in the Application Standard (e.g. EN 12464-1 for indoor workplaces). The misinterpretation of the Standard frequently led to visually uninteresting lighting designs, limited visual comfort and for a significant number of individuals too low lighting levels. For this reason, the 2021 revision of EN 12464-1 includes for the first time the concept of *Modified* light levels, which adjust upwards the illuminances for situations where higher levels are required.

The personalisation and optimisation that is achieved by using lighting controls will both save energy and help ensure that the occupants of a building are provided with the right light, at the right time, in the right place and in the right quantity for the various tasks they carry out every day. Pre-programmed settings can allow for light levels to be automatically changed. The current daylight conditions or a manual override by the inhabitants of the building based on their preferences or needs at that particular time can also activate certain settings.

Daylight

Daylight in indoor workspaces has been shown to improve worker satisfaction and productivity. Furthermore, high levels of daylight during the day are reported to improve sleep quality during the night with consequent additional productivity improvements. In addition to the occupant benefits achievable by optimising daylight utilisation in a space, the 'harvesting' of daylight allows the electric lighting installation to be 'dialled-down', greatly reducing its daytime energy consumption.

Daylight is a high-quality light source. However, impacts such as disability glare from the sun, overheating due to excessive solar thermal gains and subsequent increased cooling energy costs may need to be addressed, for example by using automated solar shading[3].

Each application requires its own lighting design

There is no one-size-fits-all solution for providing better lighting. It very much depends on the application, which means that better lighting in an office, for example, differs from better lighting in a school:

- **At the office**: During the working day, lighting supports employees in their work. The visual, biological and emotional effects of lighting should be considered. Modern lighting concepts make working easier: Human Centric Lighting increases concentration, reduces fatigue and is bright enough for all visual tasks, including tasks performed by aging employees. The minimum value for brightness at eye level should be met by a sufficient vertical lighting level of the required spectrum. Higher lighting levels and the right spectral composition help to maintain the performance for a longer period of time. Furthermore, personalization through controls is of utmost importance. The right amount and spectral distribution of light vary according to each individual's personal needs and the needs of the task they are performing as well as according to the time of day and prevailing weather conditions. A study by CBRE[4] in offices showed an improvement of 12% in task performance with Human Centric Lighting.

- **At school**: The beginning of classes, during both summer and winter, can be supported by bright light. For biological tasks the lighting spectrum should reflect the prevailing daylight conditions. Vertical illuminance at eye level deserves additional attention in the lighting design. The right light supports students in their learning: concentration is increased, studying together is easier and fun. Compared to adults, a teenage girl's internal clock is generally delayed by one hour, and a boy's is generally delayed by up to two. That is why students, especially during winter, need extra amounts of short wave-length light early in the morning to wake them up and better synchronize their rhythms with the working day.

For more examples of better lighting in different applications, please check our dedicated website.

For visual tasks, lighting must at least comply with the requirements defined in the European standard EN 12464-1 but these only constitute a minimum. Standards are based

[3] JRC Technical Reports – Level(s) Indicator 4.3 Lighting and Visual Comfort – User manual, instructions and guidance, December 2020
[4] https://www.cbre.nl/en/healthy-offices-research/juiste-verlichting

on established good-practice, but inherently lag behind latest knowledge and developments – often by many years. LightingEurope therefore recommends going beyond the minimum requirements set in these standards.

Contact

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About LightingEurope

LightingEurope is the voice of the lighting industry, based in Brussels and representing 30 companies and national associations. Together these members account for over 1,000 European companies, a majority of which are small or medium-sized. They represent a total European workforce of over 100,000 people and an annual turnover exceeding 20 billion euro. LightingEurope is committed to promoting efficient lighting that benefits human comfort, safety and well-being, and the environment. LightingEurope advocates a positive business and regulatory environment to foster fair competition and growth for the European lighting industry. More information is available at www.lightingeurope.org.