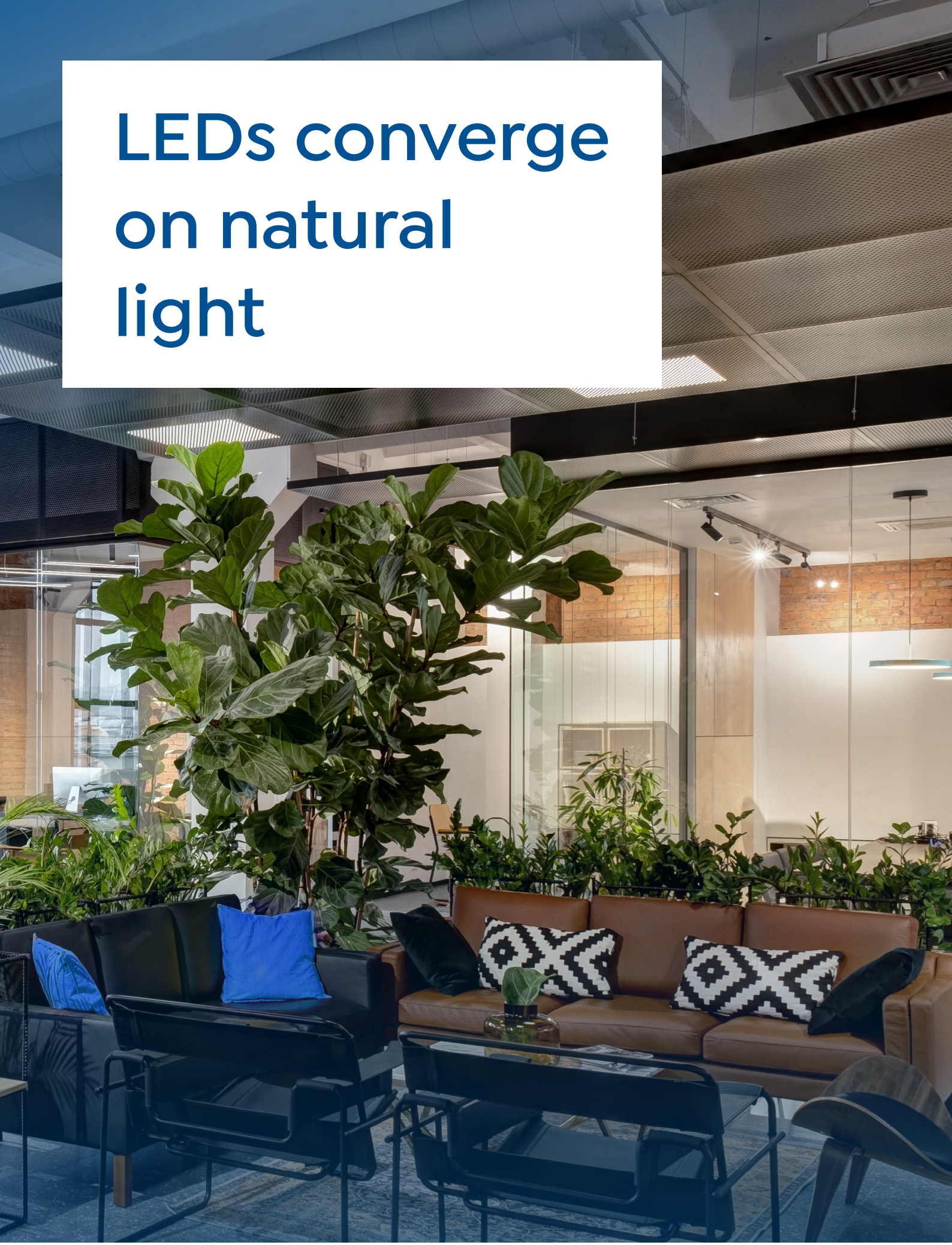
LEDs converge on natural light



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LEDs converge on natural light

Over recent years, we have all become used to high quality LEDs, which provide energy efficient lighting in our homes and offices. Today, LED manufacturers are increasingly concentrating on the quality of light their products emit. This is part of a wider shift towards human-centric lighting (HCL), which aims to prioritise how lighting affects the well-being, comfort, and health of people.

In this article, we'll look at what we mean by the quality of LED light, and how this can be objectively measured. We'll also discuss how high-quality light can be achieved by design engineers, by working with efficient, easy-to-use LED modules.

Lighting for humans

As part of an HCL approach, the colour of the light produced is hugely important. By choosing a suitable LED, homeowners and building managers can select the right light that meets the needs of residents and workers.

For offices, light with a higher blue component can enable staff to feel active and energised. Conversely, a warmer coloured light, with less blue, can feel relaxed and comfortable at home. This is in part due to the human body's circadian rhythms, and its response to ambient light, with higher levels of blue light suppressing the production of the hormone melatonin, and therefore leading to increased productivity.

The quality of light produced by LEDs can be subjective, and the lighting industry has worked to develop quantified standards that can be used to compare different LEDs and the illumination they produce. As our vision system has evolved in response to natural sunlight, it makes sense to compare artificial light with natural daylight – and there is a general consensus that we should usually aim to get as close as possible to matching natural light with a lighting system.

Perhaps the best-known metric is Colour Rendering Index (CRI), which is determined by comparing natural daylight to the spectrum of different wavelengths produced by a light source. CRI has its critics, particularly as it does not predict the appearance of colours as well as other standards such as TM-30. Overall, though, CRI provides an easily understood and useful metric, and it has been widely adopted.

The highest possible value of CRI would be 100 and would only be achieved if the spectrum is identical to natural light. White LEDs usually have a CRI of 80 or more, with CRI of 90 and above becoming increasingly common, and figures as high as 98 being quoted by some LED manufacturers.

How is 'natural' measured?

Looking beyond CRI, there is a need for other metrics that objectively address how closely a light source matches natural light. To meet this requirement, Bridgelux has developed Average Spectral Difference (ASD), a new way to make comparisons of naturalness between light sources[1].

The ASD figure for a particular light source is calculated by comparing the radiant power (which corresponds to brightness) of the source and of natural light. This is done for many different wavelengths of light in the visible spectrum, from 425nm to 690nm. These multiple values are then averaged to give a single value for ASD (with lower figures being better).

Figure 1 shows the spectra of several different light sources, and how much light they produce at each wavelength. The black dashed line shows daylight, while the coloured lines show how closely four different LEDs match up with this natural light. You can see that the closest fit is Bridgelux's Thrive™, which has an ASD figure of 8%.

Three other LEDs are shown, with their CRI and ASD metrics, and you can see they deviate further away from natural light than the Thrive light source. In particular, they each have a peak between around 440nm and 480nm, which represents higher emissions of blue light.

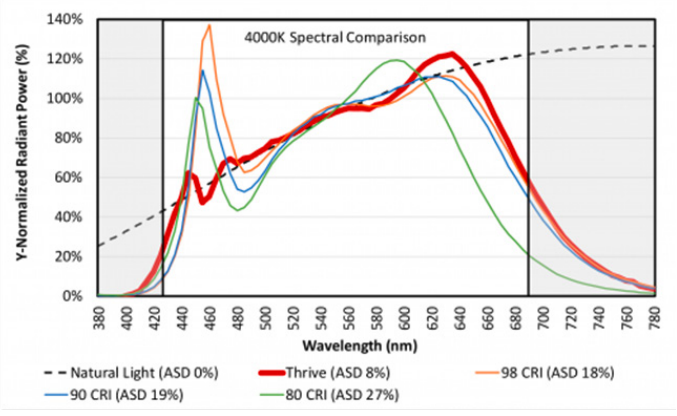

Figure 1: **Spectra of light sources compared, using ASD and CRI metrics** (source: https://www.bridgelux.com/products/thrive)

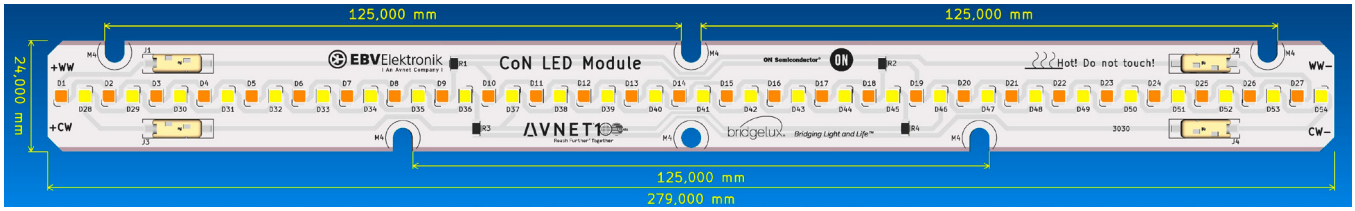

Figure 2: **CoN LED module** (source: https://www.avnet.com/wps/portal/ebv/solutions/markets/light-home-and-building/con-led-module/)

High quality light from LED module

To help engineers achieve high quality illumination that approximates natural light, EBV Elektronik has designed the CoN LED Module[2].

This is a tuneable white LED module, which is compliant with the Zhaga[3] LED interface standards, and which provides improved lighting quality without sacrificing energy efficiency. It comprises 2 channels, each of 27 LEDs. Each channel consists of 3 x 9 strings of respectively 2700K LEDs and 6500K LEDs. The CoN LED Module is based on an aluminium-core PCB, and is equipped with Linda optics from LEDiL, offering excellent thermal management and colour mixing[4].

The module is intended as a companion LED module to onsemi's Connected Lighting Platform[5], and in particular the LIGHTING-1-GEVK kit. This platform is a modular development kit that combines an AC/DC power supply, an LED driver board and a wireless sensing and connectivity board. For Power Over Ethernet (PoE) connectivity up to 90 watts, a PoE module is available separately.

The onsemi platform provides high-power lighting, up to two strings of 16 LEDs, with high efficiency power conversion of greater than 90% at full load. It offers wireless connectivity with Bluetooth Low Energy (BLE) and is compliant with multiple industry standards. Battery-less applications can also be developed using an energy harvesting BLE switch.

Module available

The module is based on the Bridgelux Thrive SMD 3030 LEDs. As discussed earlier in this article, Bridgelux Thrive technology is optimised to provide the closest match to natural light with an Average Spectral Difference (ASD) of only 8%. In comparison, typical CRI 98 LEDs have a much greater ASD of 18%.

Conclusions

LED manufacturers have been hugely successful in developing reliable, affordable lighting solutions with outstanding power efficiency. Recently, the industry has shifted its focus to the quality of the light produced by LEDs, and how this affects people's physical and emotional health.

The best solution is often considered to be matching natural light as closely as possible. While the well-established CRI metric is still valuable, a new measurement, called ASD, aims to better define how closely a light source emulates natural daylight.

To deliver the high-quality light that people want, design engineers can turn to LED modules available from EBV Elektronik. These provide efficient, integrated platforms that are easy to work with, and combine performance, features and power efficiency.

[1] https://bridgelux.com/sites/default/files/resource_media/Bridgelux%20White%20Paper%20-%20Average%20Spectral%20Difference%20051420.pdf

[2] https://www.avnet.com/wps/portal/ebv/solutions/markets/light-home-and-building/con-led-module/

[3] https://www.zhagastandard.org

[4] https://www.ledil.com/product-landing/linear/LINDA/#start

[5] https://www.avnet.com/wps/portal/ebv/products/new-products/npi/2020/onsemi-lighting-1-gevk-platform

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