



A GOOD NIGHT'S SLEEP

A white paper
on the impact of LED street lighting
on sleeping patterns from Schröder

INTRODUCTION

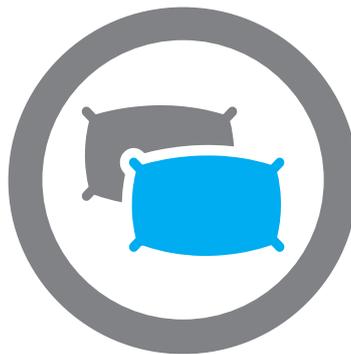
The benefits of a good night's sleep are well known. Yet the Centres for Disease Control and Prevention (CDC) have categorised insufficient sleep as a public health problem and believe it may be at epidemic proportions.

Many reasons have been given for the lack of sleep that people are experiencing, including longer working days, access to technology and the 24-hour working environment of the digital age. However, The American Medical Association (AMA) recently suggested another potential reason when it adopted guidelines to reduce harm from LED streetlighting.

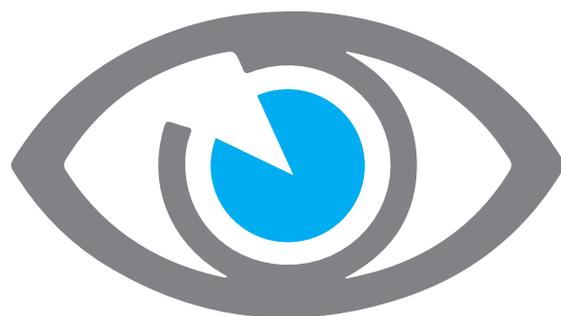
Whilst this might initially seem unconnected to the issue of people not sleeping enough, the AMA guidelines included a paragraph that comments: "blue-rich LED streetlights operate at a wavelength that most adversely suppresses melatonin during night. It is estimated that white LED lamps have five times greater impact on circadian sleep rhythms than conventional street lamps. Recent large surveys found that brighter residential night time lighting is associated with reduced sleep times,

dissatisfaction with sleep quality, excessive sleepiness, impaired daytime functioning and obesity".

This White Paper aims to address the issues raised by the AMA, categorise Schröder's response to these assertions and demonstrate some of the many measures taken by the company to ensure that LED streetlights do not cause harm.



BLUE LIGHT



ABOUT BLUE LIGHT

All light is part of the electromagnetic spectrum which ranges from radio waves to gamma rays. The lighting spectrum visible to humans moves from blue, through the rainbows of colours to red. Light at the blue end has a shorter wavelength and light at the red end has a longer wavelength. It has long been known that short wavelength light focussed on the retina for extended time has the potential to cause damage to the retina of the eye. This is why people are advised to (for example) wear sunglasses or goggles when the sun is reflected off water or snow.

There are many natural sources of blue light including the sun. Other sources include digital screens, such as TVs, computers, laptops, smart phones and tablets, other electronic devices, and fluorescent and LED lighting.

LED street lighting can be made up of lighting from across a spectrum of lighting colours. However, one of the main drivers for moving to an LED street lighting solution is to reduce energy consumption and

cost. Historically, the most cost-efficient LED lighting solutions (i.e. those that save most energy) have tended towards the blue end of the spectrum rather than the red end. Lighting that is closer to the blue end of the spectrum tends to make the colour blue more visible and lighting that is closer to the red end of the spectrum tends to highlight red colours more. LED white light combines the full spectrum of colour from blue to red and therefore provides a better contrast across every colour. The combination of lower energy consumption, reduced environmental impact and improved lighting of specific areas has often prompted the deployment of street lights that are closer to the blue end of the spectrum than the red.

“The Sun is a natural source of blue light. On a sunny day people will be exposed to this part of the visible light spectrum”

Causes of lack of sleep

Lack of sleep can be caused by any number of factors, working either individually or in combination. People tend to experience less sleep when they have something on their mind, when the weather is unseasonably hot, when they have been working late or unusual hours and for any

number of medical reasons, such as sleep apnoea and depression. The assertion from the AMA is that blue light from LED lighting could impact production of melatonin, which could disrupt the circadian cycle and consequently cause lack of sleep and the associated health issues.

About melatonin/circadian rhythm

Melatonin is a hormone made by the pineal gland in the brain. Melatonin helps control daily sleep-wake cycles. The human body's internal clock (the circadian rhythm – see below) influences how much melatonin the pineal gland makes. Typically, melatonin levels start to rise in the mid-to-late evening, as the sun sets. They stay elevated for most of the night. They drop in the early morning as the sun rises.

The circadian rhythm is an internal body clock that governs when people are awake and when they are tired. It follows an approximate 24-hour cycle and regulates when people

feel tired and awake. Potentially, disruption to the circadian rhythm can impact sleep patterns. Lack of sleep over a sustained period can cause serious health issues.



Blue light exposure

The amount of blue light that a person is exposed to will depend on many factors. These will include: the amount of blue light emitted from the source; the distance from the source that the individual is; the length of exposure to the blue light. It will also vary from person to person.

Put simply, viewing a laptop close to the eyes just before going to sleep may mean that a person is exposed to blue light. Since there is a connection between blue light exposure by the eye and the body producing less melatonin, this could discourage sleep.

What is not clear is whether someone who is two feet away from a laptop for 30 minutes will be more affected than the same person being six inches away from a smartphone for the same amount of time. Factor in other sources of light within a household – such as whether the

person is in a room where lights are on or off, and you can see why it is so difficult to reach conclusive proof on the impact of blue light.

By far the single biggest source of blue light is the sun. Yet there is little evidence that suggests that people sleep less on sunny days because of blue light. In Scandinavian countries daylight lasts 24 hours in the height of summer. People sleep in darkened rooms despite the sunlight lasting beyond when they retire to bed.



Sleep patterns over time

Experts typically recommend seven to nine hours sleep per night for adults. According to research carried out by Gallup in 2013, 59% of U.S. adults met that standard. The survey reports that, in 1942, 84% did. This is a notable change. What is also clear from the table is that, since 1990 (when the survey began to be a regular event for Gallup) there have been only minor changes in the number of people getting more than seven hours sleep (in fact the number has increased slightly).

Figure One suggests that a significant step change must have taken place sometime after 1942 but before 1990.

It also suggests that (at least until 2013) the impact of smartphones (which became mainstream in the late 2000s) and tablets (early 2010s) had delivered negligible impact on sleep, although more data would be required to be certain.

LED lighting became a mainstream technology during the early 2000s also suggesting that it has, at least to date, had negligible impact that can be attributed to reduced sleep. It is important to continue to monitor these numbers in the future to see any trends, the most recent research shows that American citizens are getting slightly more sleep than they did in 2001.

HOW MUCH SLEEP DO YOU GET?

Sleep plays an important role in a person's mental and physical health

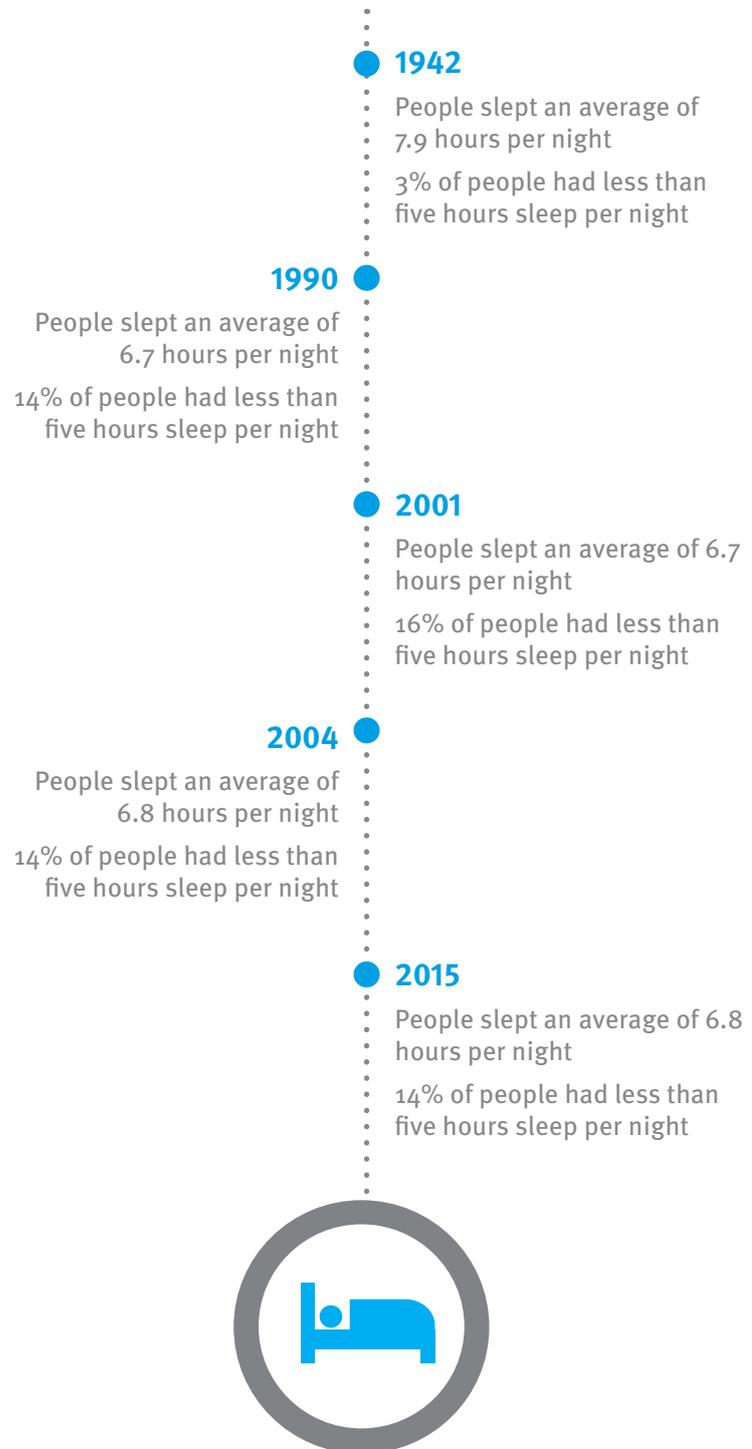


Figure One: How much sleep do you get?

LED STREET LIGHTING



THE ROLE OF LED LIGHTING

LED street lighting can contain more blue light than many of the previous technologies that it is replacing. However, this will often depend on the circumstances in which the lighting is deployed.

Traditional SOX street lamps provide a 360-degree ambient light that gives off a reddish - yellow glow. LED street lighting, as well as being far more energy efficient in delivering the same luminescence, also tends to be focussed on a specific area of a street, delivering less light “spill” or pollution. This is significant: if a person has a SOX street light outside their bedroom window it will probably be more disturbing than a well-directed LED lantern. As referenced earlier, looking directly at a source of blue light may be harmful to the eye. To do any damage an individual would need to stare directly into a lantern. Unlike smartphones, tablets or televisions, LED street lighting tends not to be stared at directly, but instead used to illuminate the way. Indeed, users never need to look directly at a LED street luminaire to use it effectively.

Most external LED lighting is used in streets and motorways. For street lighting LED technology provides an improved lighting contrast where it is deployed, making it more effective for the public to identify objects, which can bring significant safety benefits. On motorways, higher powered lighting may be deployed to provide a clearer passage for drivers.

In street and motorway lighting solutions it is important that drivers are alert, both to dangers on the road and in their own mindset. Any impact that LED lighting might have in reducing melatonin levels in these circumstances may actually be beneficial to driver alertness and reduce the risk of fatigue, another important safety consideration.

“There are currently 315 million LED streetlights in the world, a number expected to grow to 359 million total streetlights by 2026”

Good practice in LED lighting

Despite the inconclusive evidence around the impact of LED technology on sleeping patterns, responsible LED manufacturers, such as Schréder, can and do take measures to help ensure that lighting is efficient, effective and optimal for its surroundings.

A combination of highly effective lantern aiming angles and improved

photometry can contribute to better lighting solutions. The judicious use of light barriers to reduce light spillage and pollution, the dimming of street lighting when effective and the deployment of various kinds of light colour to suit relevant circumstances are all effective means to ensure that street lighting solutions deliver the required impact in the right place.

**SCHRÉDER'S
COMMITMENT TO
GOOD PRACTICE**



THE ROLE OF SCHRÉDER COMMITMENT

Schröder has a long commitment to delivering the most comprehensive and effective lighting solutions available on the market. As part of this commitment the company is continually innovating to facilitate excellence.

Below are some of the ways in which the company actively ensures that the LED street lighting projects it completes are best in class.

Superior optical design

Schröder is renowned for the quality of its optical design. This encompasses not only luminaire performance but also visual comfort for users of the solutions. The company regularly deploys secondary optics, reflectors and diffusers in projects to achieve an effective street lighting system without adverse impact on users and minimal risk of discomfort.

Product assessment by independent labs

All Schröder products are tested and certified by accredited independent laboratories (to assess the photo biological risk, conforming to the IEC/EN 62471 standard). Schröder's research and development department is committed to minimising adverse impact of lighting. Every Schröder product has precise information around exposure limits, measurement techniques and describes potential photo biological hazards and how to effectively mitigate these.

Mounting safety instructions

Schröder's commitment to safety extends beyond just the public.

Optical risk is correlated to distance, often meaning that the first people to be exposed to any blue light are installers and maintenance operators. Schröder provides comprehensive installation instructions to ensure installers and maintenance engineers understand the minimum distance they should use when a luminaire is switched on to reduce any risk.

The majority of Schröder's business globally is in warm white and neutral LED

Schröder provides the industry's most comprehensive range of warm white and neutral white LEDs, particularly for lighting residential areas, city centres and campuses. Cooler white LEDs are only deployed where there is a specific customers request. In total, the cooler LED lighting market represents less than 1% of the company's overall revenues.

Schröder also provides a full consultation process for current and potential customers, helping to educate them on the right lighting solutions that deliver both cost savings and more efficient and safe lighting.

“Schröder provides the industry's most comprehensive range of warm white and neutral white LEDs, particularly for lighting residential areas, city centres and campuses.”

CONCLUSION



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It is right that any concerns over the impact of LED lighting on sleeping should be fully and openly discussed in public. However, as demonstrated in this White Paper, there are a considerable number of uncertainties that question whether any causal effect can be demonstrated between LED lighting and melatonin suppression. Furthermore, a recent report by the European Union was unequivocal: there is 'no evidence of direct adverse health effects' from LEDs in normal everyday use.

There may be good reason for people to limit their exposure to screens (such as tablets, televisions and smartphones) in the evening if they are struggling to get enough sleep. However, this may be caused by the distraction and stimulation caused by such devices as much as any blue light effect.

LED street lights are designed to be used to illuminate spaces and the chances of anyone inadvertently staring into them for any significant length of time is therefore highly unlikely. By deploying best practice LED lighting installation and maintenance, companies can minimise any risk from the use of LED technology in street lighting solutions and benefit from the significant efficiencies and energy savings that LED technology provides.

ABOUT SCHRÉDER

Schröder is a worldwide leader in intelligent outdoor lighting solutions. The company, founded in 1907, is serving its customers around the world through 48 subsidiaries and 5 R&D centres.

As Your Partner Beyond Light, we design and develop intelligent solutions that transform public and private spaces into safe, comfortable, sustainable and smart environments with engaging experiences for the users and operational benefits for the managers.

For more information, visit us at www.schreder.com