

Creating sustainable buildings and a healthy working environment

How LED lighting can help meet the sustainability challenges of buildings of the future

As a planet we face a global challenge in reducing our carbon footprint. From 1965-2011 CO₂ released into the earth's atmosphere tripled from 10 to 30 billion tonnesⁱ. At the same time the world's cities are growing at a huge rate. Cities account for more than 70% of global CO₂ emissions and consume about 75% of the world's energyⁱⁱ. As public and commercial buildings are responsible for 40% of global energy useⁱⁱⁱ, then it becomes obvious that 'green buildings' need to be part of the solution to the carbon challenge.

What is a sustainable building?

We are hearing more about the importance of green buildings and their role in reducing global carbon emissions. There is general consensus that 'green buildings' refers to a structure and using process that is environmentally responsible and resource-efficient throughout a building's life-cycle: design, construction, operation, maintenance, renovation, and demolition. Typically, those with knowledge of sustainable buildings will automatically understand the positive impacts this has on the environment as well as the cost savings that can be made. However green buildings go beyond this. They should also be designed to improve the overall impact on human health and wellbeing.

How can lighting contribute to the global carbon solution?

Lighting is responsible for 35% of energy consumption in buildings – more than twice the amount consumed by IT and office equipment^{iv}. In short, globally energy-efficient lighting in offices, industry, retail and hospitality could save 331 million tons of CO₂,

936 million barrels of oil equivalent or 312 power stations @ 2TWh/yr^v. And replacing T8 fluorescent tubes in an office or factory by TL5s with lighting controls saves 61% energy or 93 kg CO₂ per year per lamp^{vi}, and the same is valid for replacing HID high-bay lamps in the industry with LED luminaires for hard to reach ceilings.

As Governments, industries and consumers around the world respond to concerns about the effect carbon dioxide emissions have on climate change and regulation becomes more stringent, the implementation of innovative lighting solutions in our public and office buildings can make a significant contribution to addressing the global carbon problem.

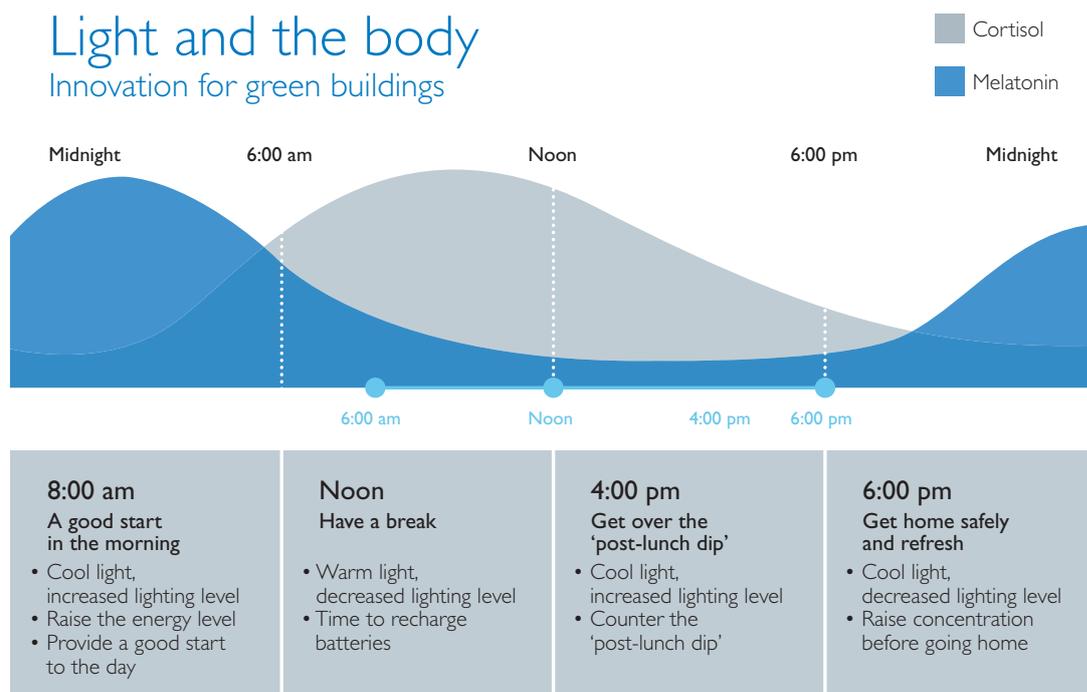
For Consideration

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PHILIPS

Light and the body

Innovation for green buildings



Philips light and the body: Innovation for green buildings

How does light benefit beyond carbon reduction?

Green buildings are designed to improve the overall impact of the built environment on human health and the natural environment. Lighting helps to create a healthier workplace. In fact, international standards such as LEED and BREEAM recognise the importance of lighting to personal welfare.

Light is a fundamental part of life and affects us in a variety of ways – visually, psychologically and biologically. Light enables us to see both small details and the world around us. Secondly, light influences our mood and behaviour. Although the literature is still ambiguous on the effects lighting can have psychologically, it is generally accepted that lighting can create different and inspiring ambiances. Lastly, research has revealed the importance of the biological effects of light on people^{vii}. Foster et al^{viii} demonstrated the existence of the third-type photoreceptor and that light captured by this photoreceptor is responsible for regulating our circadian rhythm and bodily processes such as sleep. Without resetting by light, the internal body clock would run autonomously, resulting in recurrent periods whereby the body's physiology would tell us to sleep during the daytime and be awake at night.

Light will subsequently affect a person's level of alertness and mood, and consequently the ability to perform a task.

Several researches revealed that changing traditional white-light lighting to blue-enriched white light helped office workers stay more alert and less sleepy during the day^{ix}. It showed improvements in subjective measures of wellbeing including positive moods, work performance, fatigue in the evening, irritability, ability to concentrate and focus and eye strain. Furthermore the workers reported improved sleep at night. In addition to these people focused benefits, research demonstrates that lighting has an impact on environmental and job satisfaction, and in turn corporate results, leaving an organisation and customer with higher satisfaction levels^x.

But aside from people benefits, there are also financial-driven benefits to green buildings. As energy certification becomes obligatory, it impacts asset valuation and building vacancy. Green Buildings increase real estate value. Research shows that property resale value is 16% higher, higher occupancy rate, effective rent premium is 7% higher and tenants are willing to pay up to 3% higher rental rates^{xi}.



Skanska Property Headquarters, Warsaw, Poland –
Philips LED Lighting & Controls – LEED certified



M&S Food – most sustainable store, Sheffield, UK –
Philips LED Lighting & Controls – BREEAM certified

How does intelligent lighting work?

Energy within buildings is consumed by its occupants and their behaviour, giving a clear case to move beyond switching to energy efficient lighting to intelligent lighting controls saving up to 70% in energy consumption per year. Controls automatically switch lights off when spaces are empty, and adjust lighting levels based on the amount of natural light. The controls monitor energy savings, and allow lighting to be customized to each work environment and gives occupants control of their own lighting. More comfortable lighting helps to enhance workplace productivity and efficiency. Blinds, shutters, and lighting are all integrated into and operated by the same, intelligent lighting control system. This is the future of buildings and energy management systems.

So where next?

In conclusion one observes that there are many reasons to improve the resilience and sustainable nature of our building infrastructure. Resulting in vast reductions in energy consumption, related energy budget cuts, as well as carbon footprint reductions, all contributing to tackling a number of the most imminent challenges mankind has ever faced. Perhaps even more importantly – despite the necessity and urgency to act on these challenges – such action would bring about significant tangible social benefits for the stakeholders that own and occupy buildings.

Our buildings will become more pleasant places to work, with improved productivity a key gain for public and corporate organizations, while at the same time adding value to these buildings, making them more future-proof.

Let's not forget that in current economic times the renovation of our buildings will also create jobs for the construction sector, that is hit hard by current economic stagnation. In that sense the 'green building agenda' turns from a 'moral necessity' into an aspirational innovation agenda, one that we can all embrace as well as should be eager to move from paper to practice to create value for not just our own generation but also for those to come.

About Philips Lighting

Philips has long been at the forefront of innovation in lighting technology to boost sustainability. Philips Lighting is a worldwide leader in developing LED and other lighting solutions that aid in the transition to a sustainable society, while delivering end user benefits. Philips was recently recognized as the 9th most sustainable company on a global scale in Newsweek's 2011 Green Rankings.

In 2011, Philips won the US Department of Energy's L Prize competition which demonstrated Philips leadership position in developing high-performance, energy-saving LED lighting technology.

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Harry Verhaar has over 20 years of experience in the lighting industry, and is currently Head of global Public & Government Affairs for Philips Lighting. Harry is a recipient of the 2011 UN Leader of Change Award, and has received the Carbon War Room's Gigaton award on behalf of Philips. He holds a MSc in Solid State Luminescence from the University of Utrecht, The Netherlands.

ⁱ BP statistical Review of World Energy, 2012.

ⁱⁱ C40 Cities Climate Leadership Group.

ⁱⁱⁱ Energy Efficiency in Buildings – Transforming the Market, WBCSD report 2009.

^{iv} Royal Institute for Chartered Surveyors.

^v The LED lighting revolution. Facts & Figures. Philips, 2012.

^{vi} The LED lighting revolution. Facts & Figures. Philips, 2012.

^{vii} I. Provencio, I. R. Rodriguez, G. Jiang, W. P. Hayes, E. F. Moreira, and M. D. Rollag, (2000) "A novel human opsin in the inner retina," *Journal of Neuroscience*, vol. 20, no. 2, p. 600; R. G. Foster, I. Provencio, D. Hudson, S. Fiske, W. Grip, and M. Menaker, (1991) "Circadian photoreception in the retinally degenerate mouse (rd/rd)," *Journal of Comparative Physiology A: Neuroethology, Sensory, Neural, and Behavioral Physiology*, vol. 169, no. 1, pp. 39-50; D. M. Berson, F. A. Dunn, and M. Takao (2002), "Phototransduction by retinal ganglion cells that set the circadian clock," *Science*, vol. 295, no. 5557, p. 1070.

^{viii} R. G. Foster, I. Provencio, D. Hudson, S. Fiske, W. Grip, and M. Menaker, (1991) "Circadian photoreception in the retinally degenerate mouse (rd/rd)," *Journal of Comparative Physiology A: Neuroethology, Sensory, Neural, and Behavioral Physiology*, vol. 169, no. 1, pp. 39-50.

^{ix} Surrey Sleep Centre at the University of Surrey in partnership with Philips Lighting and Viola AU, James LM, Schlangen LJM, Dijk D-J. Blue-enriched white light in the workplace improves self-reported alertness, performance and sleep quality. *Scand J Work Environ Health* 2008;34(4):297–306.

^x Veitch JA, Newsham Gr, Mancini S, Arsenault CD (2010) Lighting and office renovation effects on employee and organizational well-being NRC report IRC -RR-306 download at <http://archive.nrc-cnrc.gc.ca/obj/irc/doc/pubs/rr/rr306.pdf>, latest access October 1 2011

^{xi} Piet Eichholtz, Nils Kok, John M Quigley, The Economics of Green Building, Sept 2010.

