



White light

Transforming your urban nightscape

PHILIPS

sense and simplicity



This brochure gives you an indication of the many ways in which white light can transform urban streets at night. And by 'transform' we don't mean only aesthetically, but also in terms of safety, security and energy efficiency.

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Plaza de la Libertad, Porto, Portugal

Beating the darkness

Daylight. One of the most fundamental components of our lives. It is dynamic, invigorating, surprising, life-giving. And despite its ever-changing nature, it is also used as the reference for all other types of lighting.

When there is insufficient or no daylight, we have to rely on alternatives to illuminate our world. As far back as 1417, lanterns with candles were used on the streets of London during winter nights. The subsequent invention of gas, oil and finally electric street lighting helped bring urban areas out of the dark ages. Today, billions of people take street lighting for granted.

Historical context of yellow light

High-pressure sodium lamps have been the first choice in street lighting for a number of years, because they produce high levels of illumination for a given amount of energy and have a long, reliable lifespan. However, their distinctive yellow/orange light makes it difficult to distinguish colours. The unnatural tint of urban streets at night time is something we live with through necessity rather than choice.

The changing role of outdoor lighting

The role of street lighting has evolved over the years. Its function in the 1930s was to make driving safer. Three decades later it was also providing visual comfort for motorists. By the 1980s street lighting had an additional role - increasing pedestrians' feeling of safety. Today, lighting is often central in helping create more liveable and inviting streets with a better ambience.



Lighting atmosphere before with high-pressure sodium.
Eindhoven, the Netherlands



Lighting atmosphere after with MASTER CityWhite



Placencia, Spain

A new era in outdoor lighting

Today, outdoor lighting solutions no longer have to rely only on yellow light. There is an alternative which is much more successful in combining the best attributes of daylight with the energy efficiency associated with high-pressure sodium high quality white light.

White light offers many clear benefits when compared to yellow light. The ambience is perceived as being brighter and more natural. Various tests have shown that a considerable majority of people find it preferable and more pleasant¹.

The greater clarity of light also gives a general feeling of improved security. Easier recognition of people's faces and other details can act as a deterrent to crime and also help generate sharper Closed Circuit Television or CCTV, (e.g. security cameras) images.

By increasing visibility for motorists, pedestrians and cyclists, the roads become safer as well. Research has shown that white light enables drivers to see movement at the roadside from a greater distance, giving them more time to brake.

And that's not all. Modern white light sources have comparable or even better energy efficiency than high-pressure sodium lamps. In addition, the latest independent research shows that white light sources are visually more effective than yellow sources at the typical lighting levels used outdoors at night. That is you can dim lamps or even use lower wattage alternatives - both of which mean lower energy consumption - while producing the same perceivable result.

Each of these benefits - aesthetic enhancement, security, accident prevention and energy efficiency - is explained in greater detail on the following pages.

“We wanted to use white light, not only to improve amenities for residents and visitors but because it plays an important part in accident reduction. It also helps us and our police to fight crime by providing much better pictures from our CCTV equipment.”

Terry Felstead, street lighting manager for London's Royal Borough of Kensington and Chelsea, England, on the Philips lamps and gear installed on Ladbroke Grove, one of the city's main thoroughfares



¹ See appendix on page 23 for a list of research studies used to support claims regarding benefits of white light.

² Commission Internationale de l'Eclairage (International Commission on Illumination) is an independent, non-profit organisation 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, and image technology.



Saint Michaels quarter; Ghent, Belgium

Making cities beautiful

Highlighting the best features of the urban nightscape

White light is not the only choice for illuminating the urban landscape at night. There are many options available, and usually a combination of different lamp types is used.



Royal Palace, Stockholm, Sweden

“We are very satisfied indeed. The lighting complies with our strict aesthetic requirements. The white light is closer to natural vision, which increases the feeling of safety and the quality of life for local inhabitants - as well as increasing property values in the area.”

President of the Somosaguas Neighbourhood Association, Madrid, Spain

However, few options - if any - offer the flexibility of white light. It is suitable for general lighting, floodlighting, architectural illumination and many other applications. It is equally effective complementing modern construction materials like glass, steel and polished stone as it is highlighting classical structures. It even gives greenery a healthy, verdant look.

Yet it is also perfect for functional lighting of streets and communal areas, producing a natural ambience that is generally preferred by many to the traditional yellow glow of sodium; almost 90% of respondents in one recent survey perceived white light as being more authentic.

And when other benefits (e.g. improved safety, heightened feeling of security among pedestrians, low energy use) are taken into consideration, it becomes clear that white light really is the undisputed choice for making the streets more liveable and enjoyable.

“The white light floodlighting system emphasises the spacing and nuances in the Palace’s large construction. It gives a lift to the decorative details that were not previously visible in the evening light.”

Architect Johan Celsing commenting on the Philips MASTER CityWhite floodlighting used at the Swedish Royal Palace in Stockholm



Eindhoven, the Netherlands

Security

Making people feel safer when they go out at night

Many people feel anxious when walking through certain streets after dark. This feeling is often triggered by the distrust of the unknown - in poorly-lit areas, faces are harder to recognise and you don't know who could be lingering in the shadows. Recent research in Poland found almost three quarters of participants said they feared for their safety when walking in an unlit area.

White light is crucial in helping people feel safer outdoors at night. Superior colour rendering and a higher perceived brightness make it easier to distinguish objects, colours, shapes and other details. In particular, facial recognition is improved, even from a distance, which goes a long way towards removing anxiety.

There are no intimidating areas of shadow either, as was shown in a test in China. When asked which light source gave the most even outdoor illumination, everyone participating chose Philips MASTER CosmoPolis lamps over high-pressure sodium.

White light creates a virtuous circle. When city residents feel safer on the streets, they are likely to spend more time outdoors. Having greater numbers of people walking, cycling and playing makes the streets feel even more welcoming, and should discourage acts of vandalism and crime.



White light improves security camera footage



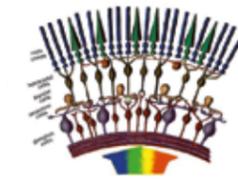
Clippers Quay, Docklands, London, England

Higher perceived brightness explained

In order to properly understand the idea of higher perceived brightness, it is necessary to grasp what happens to our sight when lighting levels are low.

The retina in our eye is made up of rods and cones. The cones allow us to determine colours, while the rods enable us to see when it is dark and help with peripheral vision. Cones enable photopic vision, which is typically associated with high light levels (daytime). The vision associated with rods, and with low light levels (nighttime), is known as scotopic. The transition phase between high and low light levels, when both rods and cones contribute to sight, is known as mesopic vision. This corresponds to lighting levels that are much lower than daylight, but are still higher than out-and-out darkness - exactly the kind of lighting found on city streets at night.

The sensitivity of our cones peaks at approximately 555 nm, which is towards the yellow end of the lighting spectrum. The sensitivity of our rods peaks at approximately 507 nm, closer to the blue end of the visible spectrum. If a light source has higher levels of blue light, it will trigger the rods, which are more active in low lighting (mesopic) conditions. This is what is effectively meant by higher perceived brightness. The light source is not necessarily giving out more light overall, but it is giving out high levels of a light frequency which can be picked up by our eye, enabling clearer perception of details and colors. This is the key differentiator for white light.



Lower lighting levels - and therefore reduced energy consumption - can be just as effective

Testing carried out by the Lighting Research Center in Troy, New York evaluated how people experience the effect of street lighting at night.

One of the most interesting conclusions from an energy efficiency point of view was that, when a much higher level of high-pressure sodium (15 Lux) was compared to 5 Lux of MASTER CosmoWhite (white light) illumination, the majority of participants still preferred MASTER CosmoWhite in four of the seven questions.

In particular, more than 70% of respondents judged the scene as more natural when it was illuminated with MASTER CosmoWhite. And perception of safety was the same even when the light level of the MASTER CosmoWhite lamps was approximately 30% lower compared to high-pressure sodium.

Lowering light levels when using white light can give the perceived level of brightness (and the various associated benefits) people expect, while reducing energy use.



Vechta, Germany

Accident prevention

Making the streets safer for drivers and pedestrians

Improved visibility is a major contributor to road safety. Tests have shown that drivers can detect movement at the roadside faster and from a greater distance with white light. Crucially, this can give them more time to stop if a child, adult, cyclist or animal is about to cross their path, or if another car approaches unexpectedly.

The converse is also true; pedestrians are more likely to see oncoming traffic and react appropriately. White light makes our roads safer and potentially prevents serious injuries or fatalities. This once again contributes to higher quality of life enjoyed by residents in urban areas at night.

Emerging research shows that better visibility also lowers accident rates among pedestrians, since they are less likely to trip over obstacles or on uneven pavement.

“White light improves vision and therefore plays an important part in accident reduction.”

Terry Felstead, street lighting manager for London's Royal Borough of Kensington and Chelsea, England.



Sion, Switzerland

“Visual comfort when driving has been improved, both when identifying other cars and pedestrians. It is our wish that all new lighting installations will be white light.”

Somosaguas Neighbourhood Association private security worker, Madrid, Spain

“I have always been in favour of sensible investments that pay in the long term. If you offset the cost of purchasing the new lighting against the fact that we save up to 50% on energy consumption, then it is certainly worthwhile. The saving per kilometre is roughly €2000 per year. At current energy prices the investment is fully paid for within eight years.”

Günther Nacke, local government officer responsible for road lighting, Vechta, Germany

Energy efficiency

Producing the required amount of light while consuming less power. Save money and the environment!

In the past, one of the main justifications for using high-pressure sodium lamps was energy efficiency. However, ongoing performance improvements mean the latest white light sources are more energy efficient than their high-pressure sodium counterparts.

These sources are the ‘green switch’ solution for outdoor installations, delivering significant savings in a number of ways. It is now possible to specify a greater distance between luminaire poles in new installations; reduce the mounting height during refurbishment; or install lower wattage lamps in upgrades. This reduces running costs and CO₂ emissions to a level lower than was previously considered possible - and delivers superior light quality.

The distinct advantage of white light is its proven higher perceived brightness. Because white light is experienced as being brighter than yellow light at low light levels, it becomes feasible to actually reduce light output while still giving people what they expect. The savings associated with this are enormous.

A CIE² review of photometric systems used to evaluate luminance levels resulted in a proposal for a new measuring system under low-light conditions. The Technical Committee recommends, based on actual performance in low-light conditions (night-time driving), a mesopic measuring system. This measuring system found, on average, a 30% difference in practical illumination from sodium lamps versus white-light sources.

This advantage has already been recognised in British lighting standards. In the UK, the level of illumination required by law on subsidiary roads and paths may be reduced by as much as 30% when the light source used has a colour rendering of 60 or more, which is the case with white light (but not with high-pressure sodium).

The CIE has launched a number of additional Technical Committees to investigate the advantages of white light for visual performance and its impact on energy savings and safety.



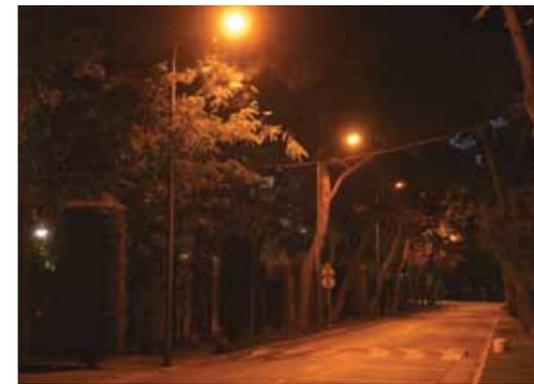
Frankrijk Lei, Antwerp, Belgium



Breskens, the Netherlands

² Commission Internationale de l’Éclairage (International Commission on Illumination) is an independent, non-profit organisation 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, and image technology.

Somogaguas, Spain



Before: yellow high-pressure sodium



After: MASTER CosmoWhite

By just upgrading a lighting installation it is possible to reduce energy consumption by as much as 43%, and with a new installation the savings rise to over 50%.

High quality white light is the ‘green switch’ solution for outdoor installations, reducing CO₂ emissions to a level that was previously considered impossible, while simultaneously cutting energy bills by a significant amount.



Den Bosch, the Netherlands

White light solutions from Philips

Lamp efficacy is a measure of the amount of light produced per watt of lamp power, expressed in lumen per watt. The energy costs of installations, as well as the environmental impact, are directly related to the lamp efficacy. But lamp efficacy should not come at the expense of colour rendering, which is always important. The colour rendering index (CRI) is an indicator of the extent to which colours are faithfully reproduced. For outdoor applications, a CRI greater than 65 is usually sufficient to produce the right ambiance. Figure 1 shows how different lamp types compare.

Research has shown that a colour temperature of 2800-3000° K is most suitable for urban lighting applications. Figure 2 shows that how several Philips light sources are positioned in terms of CRI and color temperature performance.

The lamps used in the comparisons are:

Fortimo HBM = LED High Brightness Module higher colour rendering	CDM = MASTERColour (Elite) - Compact ceramic metal halide
Fortimo LLM = LED Linear Light Module	HPI / MHN = Quartz metal halide
CPO = MASTER CosmoWhite - Outdoor compact ceramic metal halide	SON = High-pressure sodium
CDO = MASTER CityWhite - Outdoor ceramic metal halide	HPL = High-pressure mercury

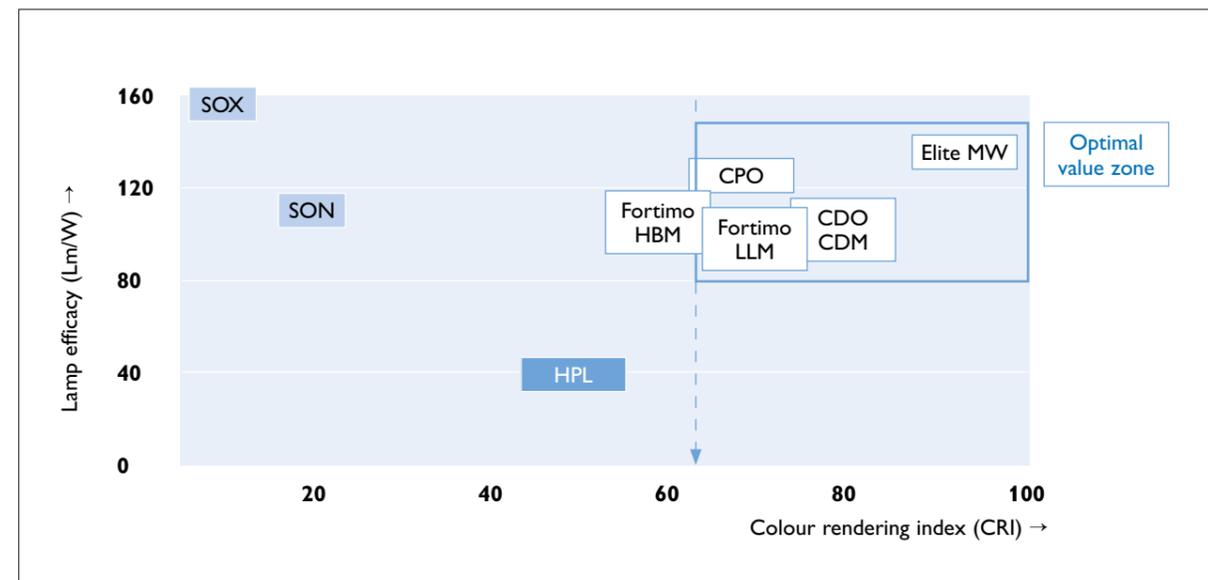


Figure 1: Colour rendering vs. lamp efficacy

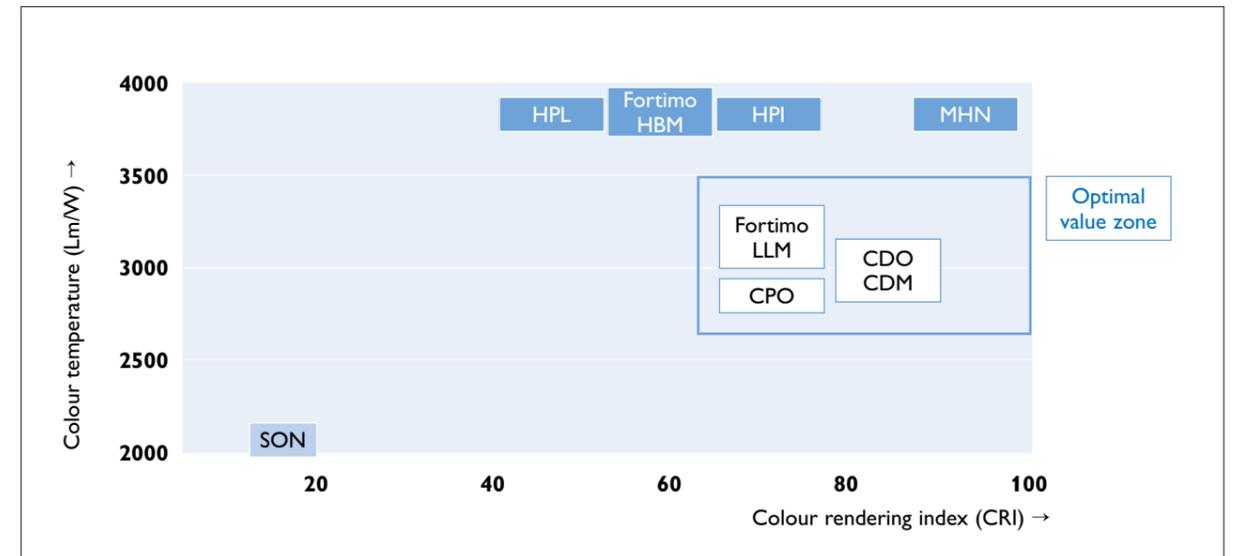


Figure 2: Colour temperature vs. colour rendering



Optimal White Light

Product overview lamps

MASTER CosmoPolis (CPO)

CosmoPolis systems (lamp & driver) combine the highest efficiency available in the market with high-quality, warm white light. These qualities, combined with an excellent lifetime, make it the preferred choice for new installations, both in city centres, residential areas and roads.

The energy cost and CO₂ reductions can further be optimised by using the easy automatic dimming functionality of the drivers, which are all available with Xtreme lifetime and lightning protection.



MASTERColour CDM Elite MW

The Philips MASTERColour Elite MW system offers an unrivalled level of light quality and performance and can therefore be seen as an addition to the CosmoPolis range towards higher wattages. The sparkling white light creates a natural ambience and really brings out the best in all colours, making it an excellent choice for high power indoor lighting as well.



MASTERColour CDM Elite

Compact ceramic metal halide lamps are suitable for flood- and decorative lighting and are used for city beautification. MASTERColour lamps offer crisp white light, excellent colour rendering and stable colour temperature and are already the lamp of choice in many different indoor applications.



MASTER CityWhite (CDO)

CDO lamps offer high-quality white light and can be used the same application areas as the CosmoPolis systems. While CDO lamps are slightly energy efficient than CosmoPolis, they offer a wonderful solution for those end users who would like to deliver the benefits of white light. The CDO lamps can be directly retrofit in existing high-pressure sodium installations, allowing an easy upgrade from yellow to white light without major renovations costs or investment in a new lighting installation.



White Light of the Future

Product overview LED systems

Long-lasting and low maintenance, LED-based light sources are an excellent solution for outdoor environments.

Fortimo LED Linear Light Module (LLM)

Philips Fortimo LED Linear Light Module system delivers a breakthrough in energy efficient, comfortable and high-quality diffuse white light.

The module is based on a remote phosphor technology which eliminates glare and creates a pleasant atmosphere. Future efficacy improvements in LED technology will be incorporated into the module without changing the physical dimensions, optical distribution or lumen output of the system. This makes Fortimo LLM a truly future-proof solution, enabling luminaire manufacturers to adapt existing luminaires and design new products with confidence. The LLM system delivers additional energy savings with LumiStep or 1-10V dimming protocols, and is suitable for telemanagement systems.

Application areas

- Residential areas
- Urban street lighting
- Parks
- City centres
- Parking lots
- Squares
- Cycle – footpaths



Fortimo LED High Brightness Module (HBM)

The Fortimo HMB system delivers a LED module which performs as a traditional lamp, offering a high lumen output from a small area. This enables luminaire design based on traditional reflector optics, making HMB an easy way for luminaire designers to leverage their optics expertise in a LED-based luminaire. The HMB system is a cost-effective LED light engine with a minimum efficiency of 100 lumen per watt. Like the Fortimo LLM, the HMB is future-proof, with fixed light emitting area, lumen package and mechanical interface. The module offers several lumen packages in the same form-factor, delivering reduced time to market and simplified supply chain. Both luminaire manufacturers and end users benefit from interchangeability of light engines from different LED manufacturers. Philips Lighting is fully committed to making Fortimo HBM module Zhaga³ compliant.

Application areas

- Road lighting
- Urban street lighting
- Tunnel
- Flood and area lighting
- High bay



³ For more information about the Zhaga Consortium and its efforts on LED standardisation, please visit <http://www.zhagastandard.org/>

Intelligent White Light

Product overview Gears and Controls

The benefits associated with switching to white light can be further enhanced with intelligent gear and controls options from Philips Lighting. DALI interface in both HID and LED drivers make and controls any lighting installation ready for a fully networked control system, meeting the growing demand for professionalization of municipal services. White light energy savings can be further increased by dimming light levels during off-peak hours. Stand-alone and integrated Dynadimmer functionality offers multiple dimming profiles, from a simple reduction of light during off-peak hours, to a complex schedule with 5 time periods and multiple dimming levels. Dimming does more than reduce energy expenditures and environmental impact. By lowering the light levels during off-peak hours, light pollution is minimised, improving quality of life for local residents and creating a more natural habitat for nocturnal wildlife.

DynaVision DALI Xtreme gear for HID lamps

DynaVision DALI Xtreme gear for CosmoPolis, CDO and SON lamps maximises the lifetime value of your outdoor lighting installation with Xtreme lifetime and reliability specifications. The gear is specified for a lifetime of 80,000hrs, or 20 years of operation. Additionally Xtreme gear offers robust protection against dust, moisture and destructive vibrations, and full functionality across a wide temperature spectrum. Xtreme surge and lightning protection of up to 5 kA/ 10 kV means the luminaires will continue to function even under the worst environmental conditions. Universal DALI interface provides additional energy savings through dimming by giving end-users precise control over light levels at all times. Maintenance costs are reduced by remote monitoring the installation.



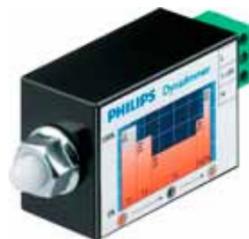
Xitanium LED Programmable drivers

Programmable LED drivers from Philips deliver the ultimate flexibility for LED luminaires. Since the output current can be optimised for each LED PCB, the luminaire manufacturers realize a quicker time-to-market, reduced SKU complexity and simplified logistics management. The driver delivers Xtreme luminaire reliability with specifications for long lifetime, robust protection against dust, moisture and destructive vibrations, and full functionality across a wide temperature spectrum. Reliable luminaire lifetime can be further extended with the Module Temperature Control (MTC) feature, which manages excessive temperatures of the PCB board and ensures the lifetime performance of the LEDs. Multiple dimming options provide energy savings and reduce light pollution and CO₂ impact. Constant Light Output functionality lowers energy use over the lifetime of the application. Maintenance is made easy with the Over the Life indicator function, which the manufacture can set to signal that it is time to replace the module.



Dynadimmer

The Dynadimmer is a luminaire based controller that can drive 1-10V electronic gears according to a programmable dimming schedule. The schedule provides up to five dimming levels and five time periods. Easy-to-operate PC based software and programming equipment enable end-users to re-program the dim times and dim levels as and when they wish. For added safety Dynadimmer SELV is available to provide the same dimming protocols for LED-based lighting applications. Dynadimmer is the ideal way to realise energy savings in existing installations.



Saint Michaels quarter,
Ghent, Belgium



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