



TotalTunnel®

See what complete LED lighting solutions
can do for tunnels

PHILIPS



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Keeping the traffic moving with tunnels

The more crowded our road networks become, the more tunnels are needed to keep the traffic moving, offer quicker connections between places by tunnels through mountains or under waters and protect urban areas from exposure to the dangers of cars and fumes. Lighting is essential for traffic in a tunnel, but tunnel lighting is a complex and demanding field. Not only is the lighting performance key for the safety and comfort of road users, maintenance of the system is critical due to the physical restraints of tunnels and limited access. What is more, energy and efficiency are also high.



With a long history of experience and expertise in road and tunnel lighting, Philips has unrivalled expertise in more complex lighting installations. We can now offer a rich portfolio of tunnel lighting products with a dedicated LED approach, extended with a complete range of service packages. So you can trust a single source partner for a totally integrated, intelligent lighting solution from concept to completion with exceptional levels of after-sales care.

Future lighting trends

The environments that we live in are growing at an unprecedented rate the world over. Large, heavily populated cities will become ever-more reliant on underground travel to improve logistics and free up valuable space.

This in turn will bring its own demands in terms of tunnel lighting, safety and driver comfort. Demand for new white light solutions that improve visibility, reduce accidents and prevent costly roadblocks will therefore increase.

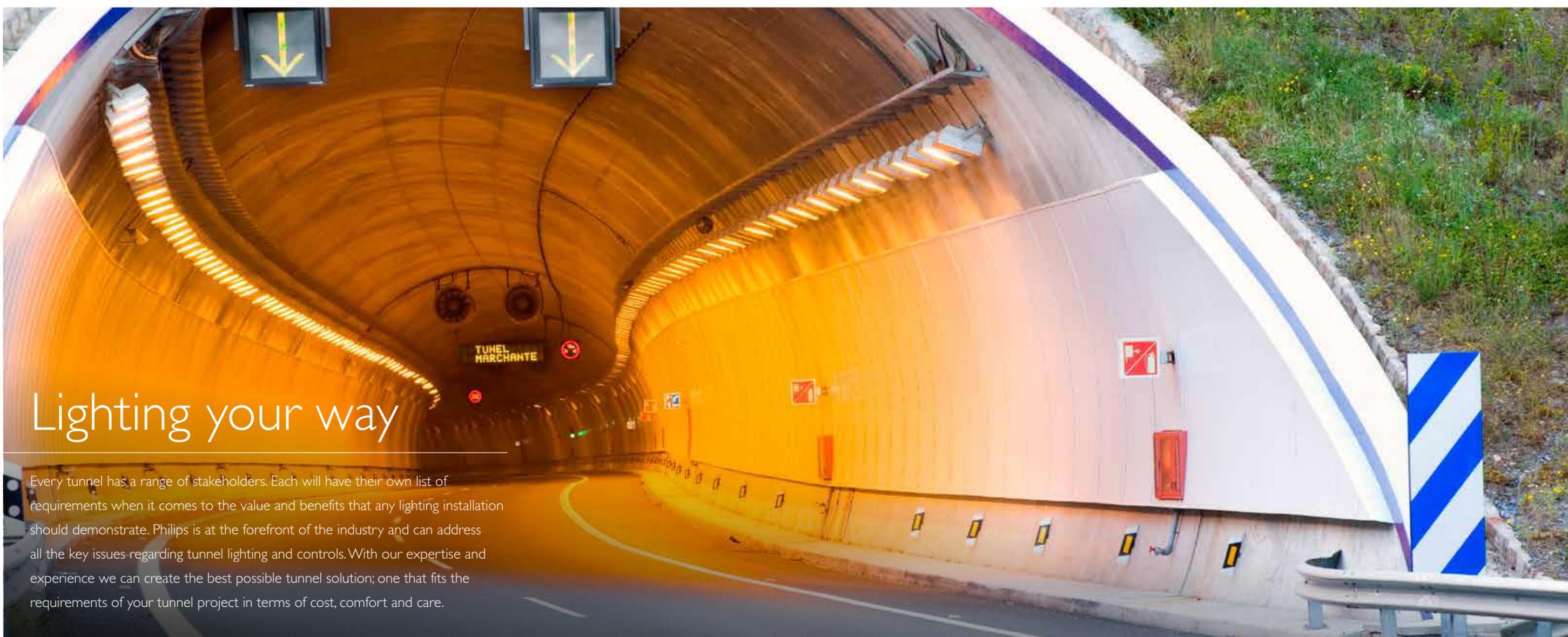
With rising concerns over the price, availability and environmental impact of high energy consumption, tunnel lighting solutions that use less power and result in fewer carbon emissions will also be in demand.

Financial constraints will put pressure on authorities and municipalities to reduce energy and maintenance costs, but they are likely to have little or no budget to invest. New business models will be required to satisfy their changing infrastructure demands.

Why do we need tunnel lighting?

With increasing urbanisation, authorities need to invest in tunnels to keep congestion on road networks to a minimum. But to ensure those tunnels provide a safe passage for motorists, lighting must recreate the same levels of safety, confidence and comfort that motorists experience on roads to tunnels - whatever the time of day or night.

Inside the tunnel, safety is paramount. The lighting should illuminate the presence and movement of other road users or objects, as well as helping to describe the tunnel's geometry to guide drivers quickly through the tunnel without any problems.



Lighting your way

Every tunnel has a range of stakeholders. Each will have their own list of requirements when it comes to the value and benefits that any lighting installation should demonstrate. Philips is at the forefront of the industry and can address all the key issues regarding tunnel lighting and controls. With our expertise and experience we can create the best possible tunnel solution; one that fits the requirements of your tunnel project in terms of cost, comfort and care.

Tunnel owners and operators

Owners and operators need reliable lighting solutions that are safe for road users. Ours are efficient, reliable and easy to control and maintain. With clear information on health of the lighting system and its service life time and maintenance it is easy to optimise and protect your investment. The long, reliable and efficient service lifetime also helps to reduce your maintenance and energy costs. State-of-the-art LED technology provides the high levels of comfort that tunnel users demand. What is more, our solutions come with the reassurance that you are dealing with a reliable partner that will be there for you for decades to come.

Tunnel users

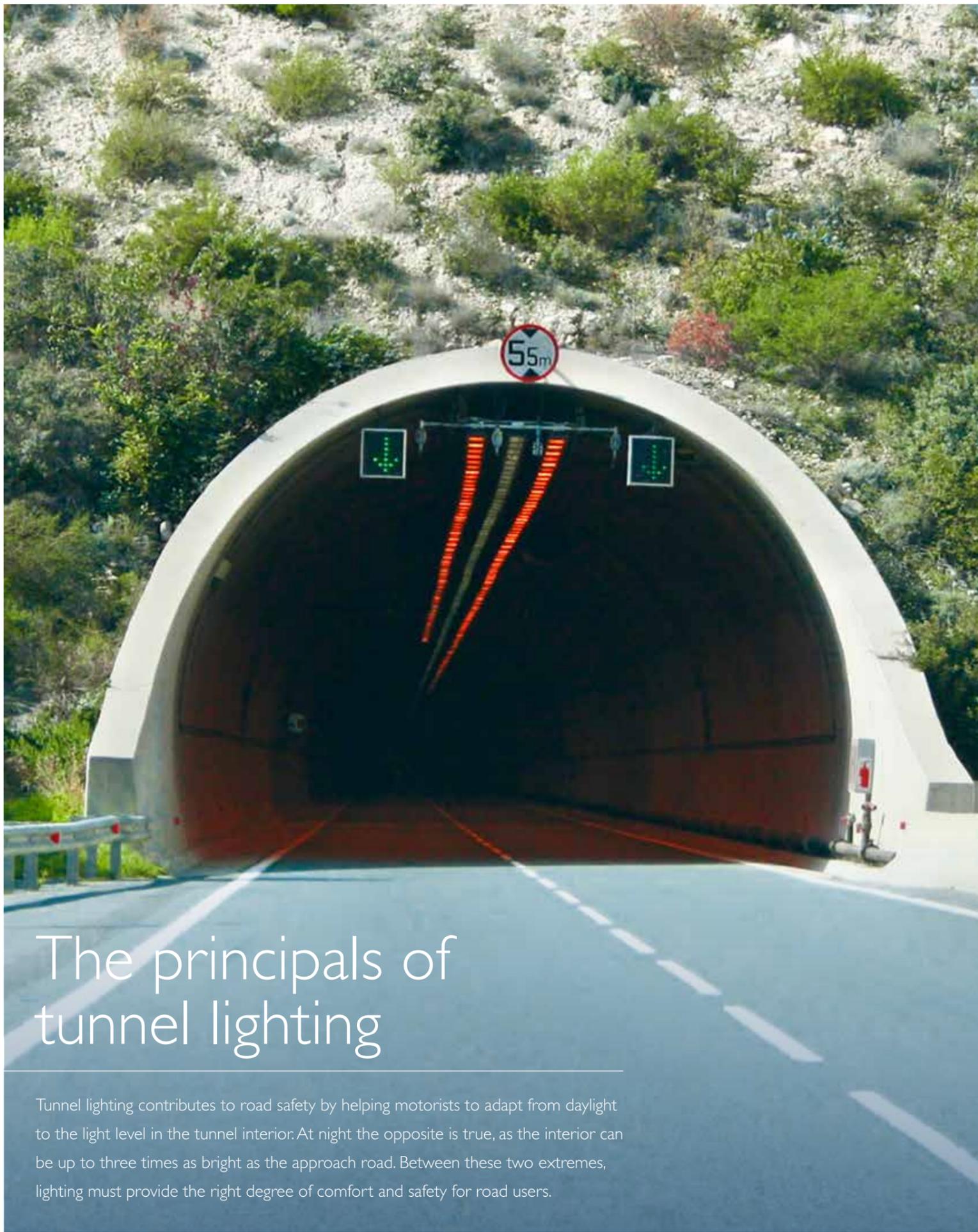
Drivers need a high quality lighting solution for safe and comfortable passage. Ours provide good colour rendering and colour rated temperature to improve their vision and perception. They also offer excellent uniformity and can aid guidance through LED lighting. To optimise traffic flow and minimise traffic disruption, our solutions come with a guaranteed performance and lifetime. They also take the needs of different drivers into account. Less bluish light can avoid scattering in the eye for elderly people and white light improves spacial perception for those who fear confined spaces.

Tunnel installation companies

Some installers have a limited knowledge of tunnel lighting and prefer to focus on electrical works. Our lighting solutions are available as a completely integrated system with clearly defined responsibilities on system integration. There's no need to worry about the control and monitoring side of things. The system keeps that completely separate so the installation team can concentrate on the electrical and mechanical work. With one knowledgeable partner for the entire lighting system, you also benefit from just one contact from design and compliance to delivery and commissioning.

Tunnel maintenance companies

Maintenance is a key consideration in any lighting installation. Our solutions are long lasting and easy to maintain, with service packages and predictable expenses to help you estimate your Total Cost of Ownership. The control and monitoring system provides information on the health of your installation so you can also plan for routine maintenance. What is more, our solutions have the longest available lifetime, reducing the need for tunnel closures and minimising downtime and disruption, thereby reducing maintenance costs significantly.



The principals of tunnel lighting

Tunnel lighting contributes to road safety by helping motorists to adapt from daylight to the light level in the tunnel interior. At night the opposite is true, as the interior can be up to three times as bright as the approach road. Between these two extremes, lighting must provide the right degree of comfort and safety for road users.

Entrance lighting

As motorists approach a tunnel the entrance will appear black (black hole effect). This is because of light levels inside the tunnel are much lower than those outside. Our eyes cannot adapt to extreme differences in lighting levels and will automatically adjust to the brighter light and thus will limit the visibility of obstacles in the entrance. To compensate for this effect, adequate lighting must be provided at the tunnel entrance. This will ensure that drivers can see objects within the correct stopping distance before the tunnel. It will also give them the vision and confidence that the tunnel is safe to enter without slowing down, which is important to maintain optimal traffic flow.

The amount of light required to avoid the black hole effect will depend on how bright the light levels are outside the tunnel (e.g. sunny or clouded). The L20 portal luminance measurement is normally used as input to regulate the different stages in light levels that are required. It takes time for our eyes to adapt from entrance lighting level to interior lighting level. To enable drivers to proceed through the tunnel without slowing down, the entrance lighting level must be reduced gradually over time, when driving through the tunnel according the CIE curve at the so called transition zone lighting.

Interior lighting

Once the eyes have adapted to the lower levels, sufficient lighting is needed in the tunnel interior for safe passage. This is usually provided by luminaires, spaced at regular intervals, throughout the full length of the tunnel.

During the day, typical luminance levels of 2-12 Cd/m² are required, depending amongst others on the speed and density of traffic. At night, lighting levels should be approximately twice that of the levels on adjoining roads.

Tunnel exits

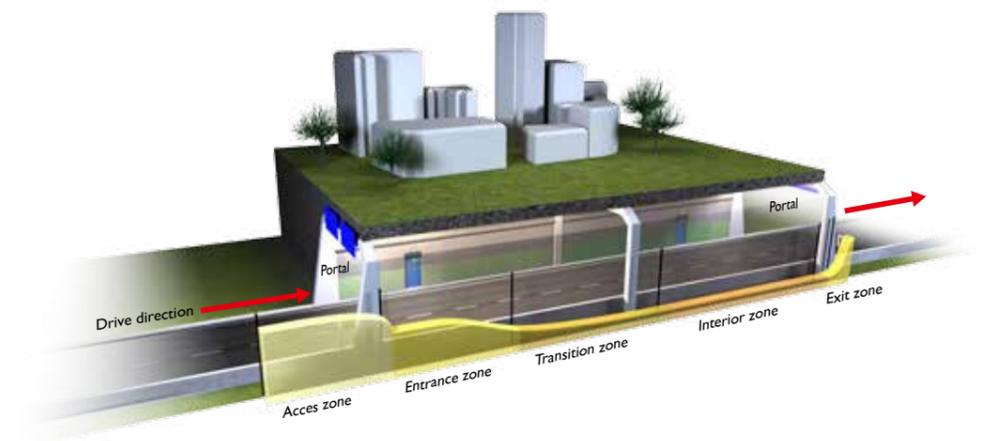
Although the tunnel exit zone is less critical, since the eye adapts more quickly to increased brightness, additional lighting may be desirable for the longer tunnels. Exit lighting mainly is applied to provide drivers, when leaving the tunnel, with sufficient visibility looking back in their rear-view mirror. Exit lighting is only activated during the day.

Long versus short tunnels

Tunnel lighting principals will also vary according to the length of the tunnel. Short tunnels with the exit fully visible, or those with good daylight penetration, high wall reflectance (> 0.4) and limited traffic, normally do not require daytime lighting. Tunnels, light technically, in between the short and long tunnel definition, can either be lit according "long tunnels" or with limited daytime lighting (e.g. 50%).

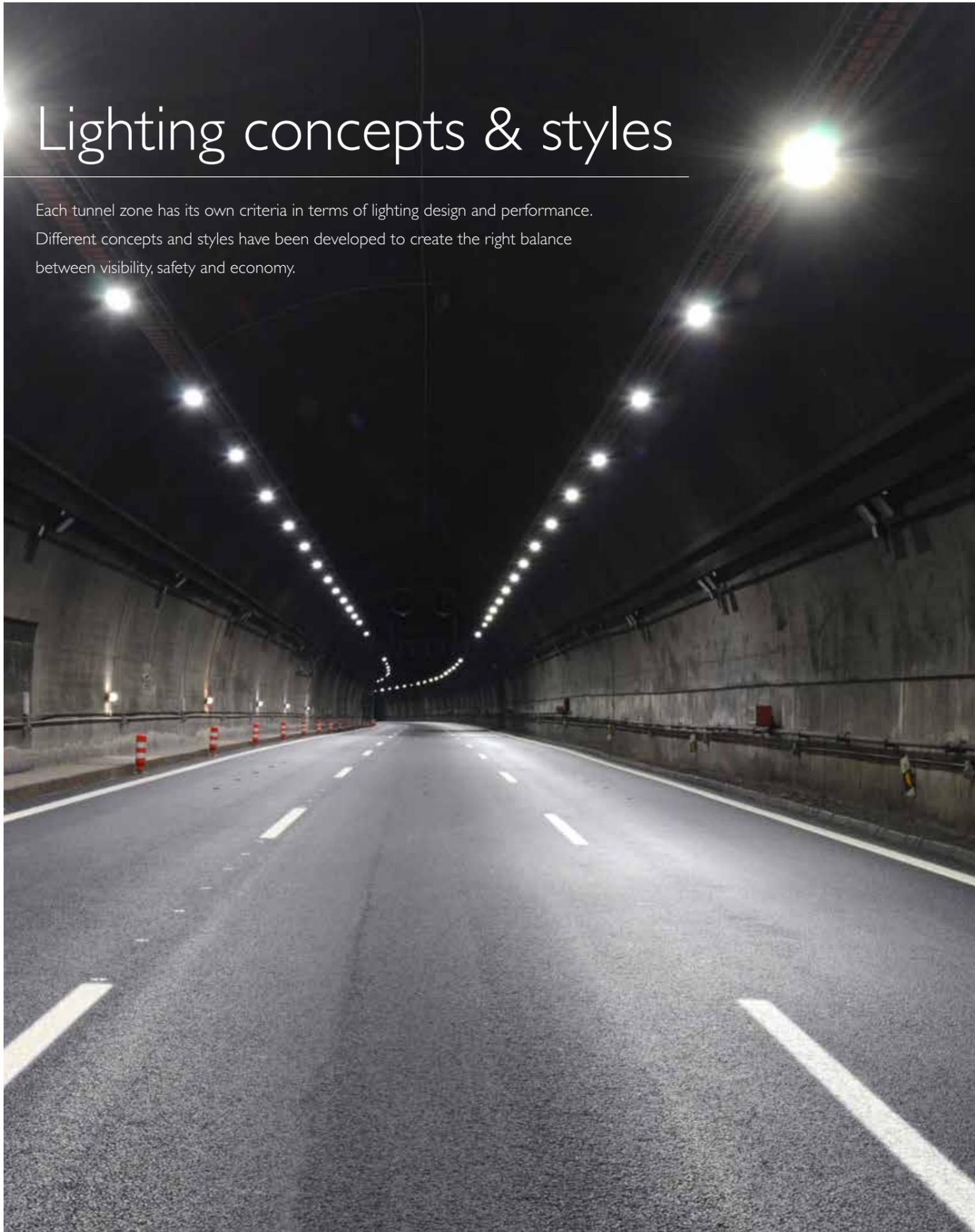
"European standards"

There is no European standard for tunnel lighting. Most of the countries have their own recommendation. Tunnel consultancy therefore is a very local business. We endeavor to be a partner of global scale, but with local experience and support.



Lighting concepts & styles

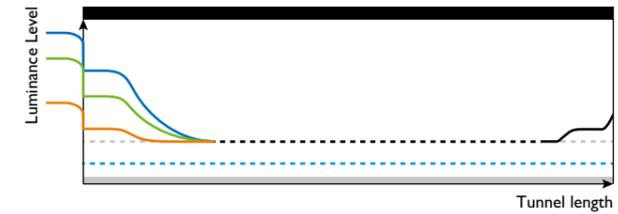
Each tunnel zone has its own criteria in terms of lighting design and performance. Different concepts and styles have been developed to create the right balance between visibility, safety and economy.



Entrance versus interior lighting

Tunnel entrances need high levels of light, luminaire spacing can be discontinuous and multiple lighting stages will be required. In contrast, interior lighting is at lower levels, luminaire spacing is continuous and only a day and a night stage will be required.

Lighting regulation

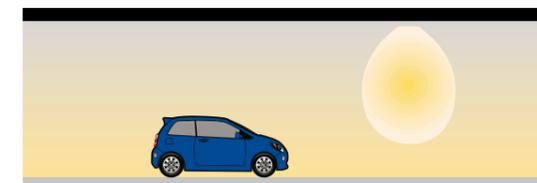


Entrance day settings: — L20 Sunny — L20 Bright — L20 Clouded — Exit day stage — Interior Day — Interior Night

Entrance lighting styles

The two most commonly used styles are symmetrical and counterbeam.

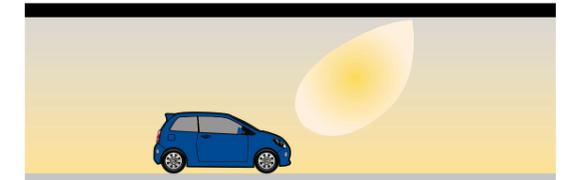
Symmetrical lighting provides lower contrast but often is perceived to be more comfortable (less glare). Symmetrical luminaires can be mounted centrally over the carrieway or cornice mounted.



symmetrical lighting

Counterbeam lighting projects the lighting towards the traffic flow. This results in a high object contrast, so showing up as a dark object against a light background. Due to the high contrast often lower entrance lighting levels are accepted. Although compliant to the standards, they can result in higher glare. This type of lighting is not suitable for cornice mounting in the tunnel.

Counterbeam lighting is only suitable in combination with more specular road surfaces. In case of e.g. concrete road surface (diffuse), counterbeam lighting cannot be used.



counterbeam lighting

The choice for counterbeam or symmetrical lighting is among others determined by the balance between comfort and efficiency.

Interior lighting styles

Interior lighting is created by symmetrical lighting. There are two options for interior lighting schemes: point source lighting or linear lighting.

Point source lighting, like traditionally created with HPS lamps, requires fewer luminaires, but gives a lower lighting uniformity and it will produce a restless flickering effect while driving through the tunnel (dynamic behavior).

Linear “line” lighting, like traditionally created with fluorescent lamps, requires more luminaires, but gives a higher lighting uniformity and will not produce any flickering effect.

Various light distributions are available to allow the interior lighting to be positioned at any location in the tunnel: centrally or cornice. The position of the lighting (both entrance and interior) can be determined either by creating the best guidance, by maintenance considerations or by the available traffic structure.



The advantages of LED

Now that LED technology has matured, tunnel lighting can benefit from a new balance between costs, comfort and care. Our LED solutions provide new concepts for Total Cost of Ownership. For example, with LEDs we can combine the benefits of high pressure sodium point schemes with the advantages of fluorescent linear schemes. What's more, you also have the peace of mind of knowing that they take greater care of the environment.

It is time to move to LED

With a tipping point being reached in the development of LED lighting, it can now be used with confidence for high-quality lighting projects in almost all applications. So there's never been a better time to make the move to LED. Public authorities are under increasing pressure to meet conservation goals by reducing their energy consumption while complying with lighting norms and standards. Not only will LED lighting help you to achieve your energy saving targets, it will also ensure you comply with environmental regulations such as the Energy-Using Products (EUP) Directive.

Why choose LED for tunnels?

A typical feature of LED is miniaturisation, which allows to develop flat, robust and smooth luminaire shapes. This can have great benefits in the design and specification of a tunnel as the lighting will ask for less space. Thanks to solid state technology, LED is also a robust solution that can withstand a tunnel's hostile environment with greater resistance to shock and vibration than conventional solutions. LEDs also offer a long and predictable lifetime and can perform reliably for many thousands of hours,

until they reach the end of their useful lifetime. So by moving to LED it's easier to plan for routine maintenance and replacements, thereby reducing tunnel disruptions and maintenance costs.

Intelligent digital lighting

LED technology is also revolutionising tunnel lighting with energy efficient, controllable solutions. Instant switching and dimming means the system can significantly reduce operating costs and energy usage. What's more, the digital technology is fully DALI compliant, enabling you use intelligent controls to adjust light levels seamlessly to accommodate real-time or changing daylight levels.

White LED for increased visibility

Improved visibility is a major contributor to road safety. White LED light makes tunnels far safer for drivers than the yellow glow of sodium. The superior colour rendering and higher perceived brightness makes it easier to distinguish objects and shapes. Drivers detect movement faster and from a greater distance with white light, giving them more time to stop should the unexpected happen.

An attractive TCO

LED also offers an attractive proposition in terms of Total Cost of Ownership compared with traditional lighting solutions. Not only does the superior system efficiency reduce energy costs, maintenance and installation are also minimised, while the robust design extends the life of your installation.

Trust Philips for LED

At Philips we firmly believe that LED is the future of lighting. Our focus is on taking the LED technology that has proven successful in road applications and applying the development experience to tunnel lighting.

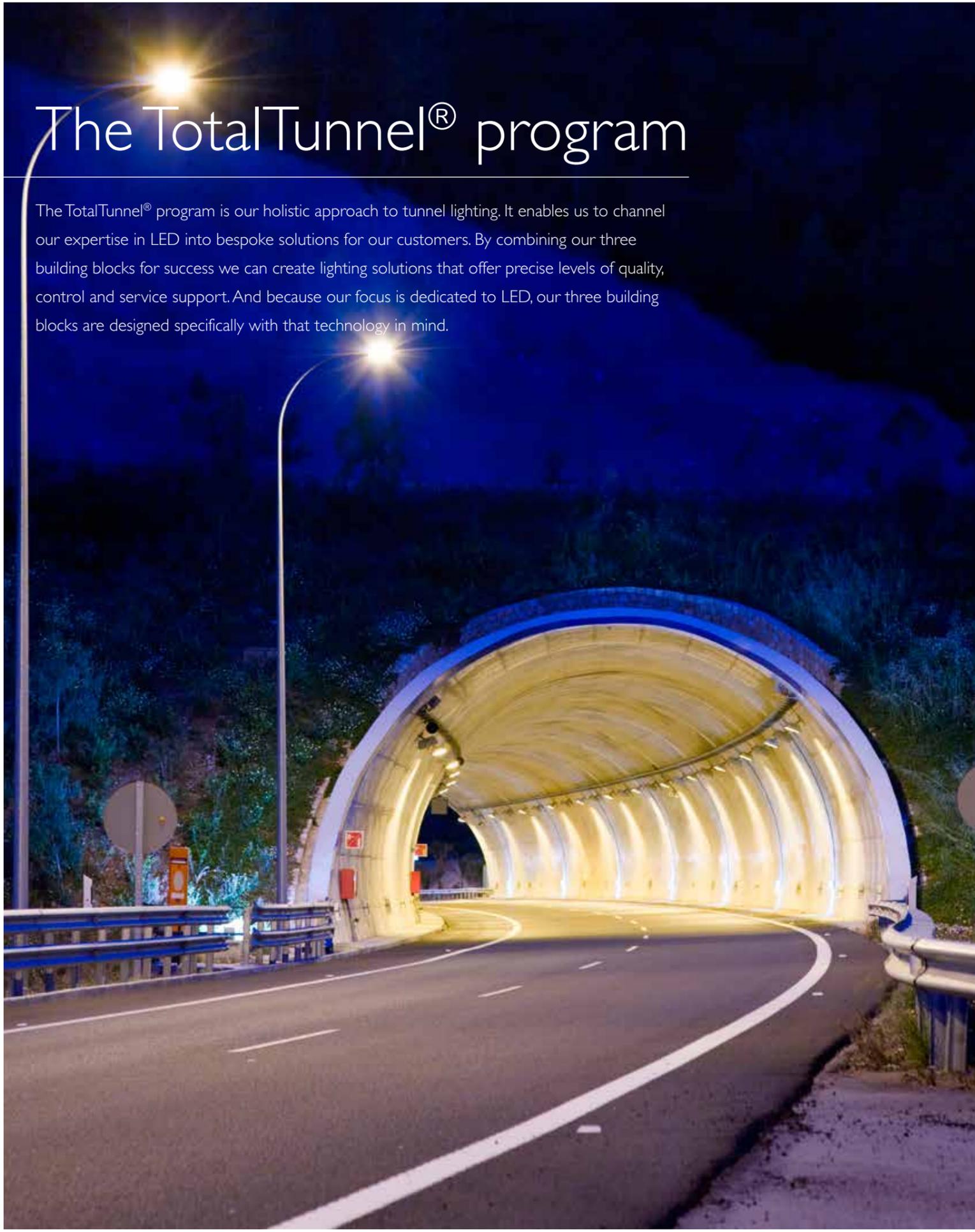
Philips Lighting is a leading provider of solutions for both professional and consumer markets. Our innovative lighting solutions are based on a thorough understanding of the customer needs. We also have the global infrastructure and investment capabilities to come first with any new developments that take place. So we can continue to shape the future with groundbreaking new lighting applications.

Integrated solutions

Choose Philips and you will also benefit from a totally integrated solution that is optimised for performance - from the LED and driver to the intelligent controls. All from a single source that you know and trust. From slow traffic underpasses to fast traffic tunnels we have all the lighting solutions you could possibly need to make your roads safer and your lighting more efficient.

The TotalTunnel® program

The TotalTunnel® program is our holistic approach to tunnel lighting. It enables us to channel our expertise in LED into bespoke solutions for our customers. By combining our three building blocks for success we can create lighting solutions that offer precise levels of quality, control and service support. And because our focus is dedicated to LED, our three building blocks are designed specifically with that technology in mind.



Balancing needs

Tunnel lighting is a highly specialist application and every project is unique. It is only by focusing on our customers' needs that we can gain the insights we need to create truly meaningful solutions. After all, there is no such thing as a European market – or customer. Each country has its own lighting standards and requirements. So although we are a global company, we think and act local. Equally, no two customers share exactly the same challenges. Whilst comfort may be the priority for one client, another may be more concerned with costs. Whatever is driving your project, we are here to listen.

Long term support

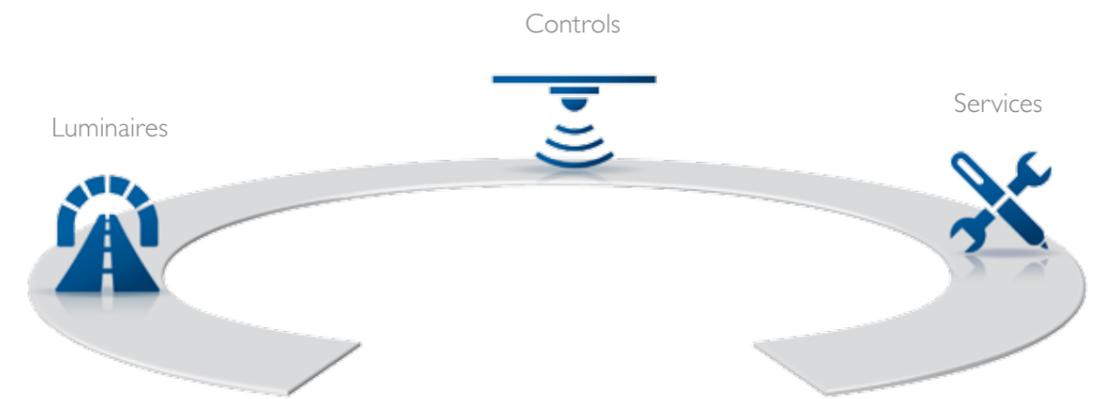
Tunnel lighting is a long term commitment that demands project excellence from start to finish. For example, it doesn't always make financial sense to base your choice of lighting on the cost of the initial investment. Because that could prove to be more expensive in the long run. Philips has the experience and expertise you need from the minute that you agree working with us. You can also rely on our full commitment for the total lifetime of your tunnel installation. We can offer all the help and guidance you need to make the right choice, and provide the after-sales support to ensure your project is a long term success.

Building blocks for success

The key building blocks for a tunnel lighting solution are:

-  • Luminaires – to support tunnel-specific lighting techniques
-  • Controls – from basic controls to elaborate monitoring systems to give you full control over the lighting system
-  • Services – from concept design and commissioning to lifecycle services so that we can relieve you in delivering the complete project and protecting your investment

Within each building block Philips offers a range of products from simple solutions that deliver unbeatable value to high performance alternatives. We select the components according to your specific needs, and then combine them to create a total lighting system that is unique to your project. So whether your focus is on the cost of the initial investment, or the total cost of ownership over the entire lifetime, Philips can build the right solution for you.





Tunnel lighting luminaires

Each zone within a tunnel has its own requirements in terms of lighting design and performance. For example, tunnel entrances require high levels of light with little or no luminaire spacing. In contrast, the lighting in the tunnel interior should be a low level with or without luminaire spacing. With our extensive portfolio of luminaires we can create any lighting concept to provide exactly the right balance between visibility, safety and economy.



Dedicated LED design

With our uncompromised focus on LED luminaire design, our solutions are optimised to deliver the best performance in every tunnel application. We have dedicated solutions that are specifically designed for each lighting concept and configuration. We also have a wide range of high quality optics to ensure that your project is lit with the optimum efficiency, taking into account the tunnel geometry and materials.

Maintenance concepts

By their very nature, tunnels have limited possibilities for closure without causing major disruption. With our easy installation and maintenance concepts we can maximise the serviceability of your lighting

scheme and minimise maintenance time. And because tunnels present a particularly harsh environment, all our solutions are designed for best-in-class longevity too.

Light your way

At the luminaire level, we can light your tunnel to provide the highest standards of comfort and safety, from linear solutions such as T-line and FlowLine (expected end of 2013), to point source options including TunLite LED, FlowStar (high flux entrance luminaire, expected end of 2013) and ClearFlood Tunnel. Our range also includes a comprehensive range of optics to support different mounting arrangements from central to cornice layouts. You can also expect the ultimate in intelligent control, including digital control and monitoring to support the unique dimming features of the LED luminaires.

What is driving your project?

Within our program we have a balanced choice of luminaires designed for all tunnel applications. This ranges from any basic solution to high performance luminaires that can offer significant benefits in terms of efficiency and TCO. So whatever your focus or budget, we have the right solution for you.

System approach

Although each zone within a tunnel has its own specific lighting requirements, we design all our LED luminaires with the entire system in mind. That means you can expect each luminaire to have a similar lifetime expectancy whether it is intended to be used at the tunnel entrance or the interior. By focusing on system design in this way, we can minimise the inconvenience of replacements and streamline routine maintenance to make life easier for everyone.

Local knowledge and support

We have a comprehensive portfolio of tunnel lighting solutions, all of which can be adapted to the requirements of your project in your market. We also have a dedicated local advice and consultancy team available for you. By working closely with you from the specification stage, we can understand what is viable in your tunnel project and ensure you get the solution that is right for you. Ask your local Philips representative for more details.



Intelligent lighting controls

Historically, traditional lighting control system designs have been the responsibility of the maintenance contractor. Through our extensive experience and integrated product solution design, including intelligent lighting controls, we have reduced the burden on the installer to minimise complicated electrical designs and significantly reduce labour, traffic management and capital expenditure.

End to end solution

Whatever your project requirements, whether it be new build, refurbishment, retrofit of a short underpass or a tunnel of many kilometers, Philips offers an end to end lighting control system solutions package for any type of tunnel project.

Our unrivalled pedigree, expertise and control system flexibility benefit the whole project lifecycle from a single source supplier from design and supply to installation, commissioning and training through to lifecycle maintenance services.

Intelligent control systems offer a dynamic approach to realising the project objectives and meeting client specifications. From the lighting design output and support from our application engineers, the lighting control system design is configured and programmed off site and installed ready for use.

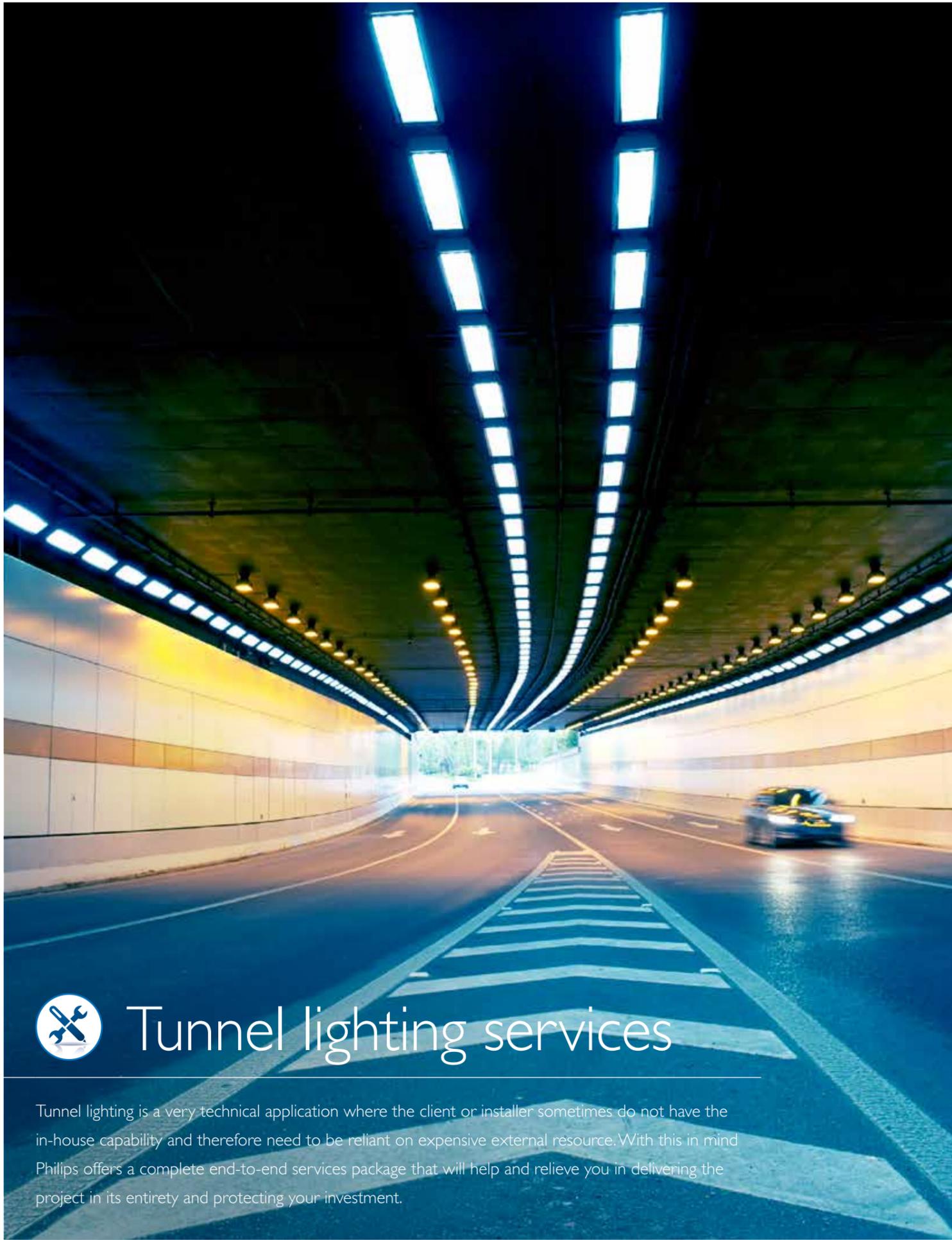
Delivering

Installation timescales are critical, with minimal system components and plug and play methodology, on-site installation is quick and simple affording the installer capital efficiencies over many other systems.

The user friendly interface for the lighting control computer allows operators and maintainers easy navigation menus for monitoring lighting system status as well as providing operational control either locally or via a scada network. Historical system data is easily accessible for photometer trending, system faults and stage burn

hours providing the operator a suite of information to suit their specific requirements.

High performance and system longevity is crucial to ensure your tunnel network is operational and traffic is kept moving freely. With demonstrable project evidence in demanding conditions across many countries, partnering Philips provides the best of both worlds for the project for cost, comfort and care.



Tunnel lighting services

Tunnel lighting is a very technical application where the client or installer sometimes do not have the in-house capability and therefore need to be reliant on expensive external resource. With this in mind Philips offers a complete end-to-end services package that will help and relieve you in delivering the project in its entirety and protecting your investment.

We recognise the importance of creating a partnership to deliver the demands of all key aspects of your asset from advisory services, project management through to lifecycle contracts and financial solutions. As being a single source supply of the total intelligent lighting system, we are able to integrate all components and provide services that both optimise and value engineer total system performance and deliverables.

Advisory Services

Often, complete project design criteria information is not available, which can result in non-compliance and misinterpretation of design requirements. As part of the solution service, we offer advisory services to maximise the benefits of the asset design and specification compliance.

- Maintenance, operational and life expectancy performance analysis
- Structural geometry and portal luminance evaluation
- Energy calculations and annual consumption advice
- Compliance checks to current lighting standards
- Lighting design criteria and product specifications advice
- Full lighting design proposals in accordance with client specification
- Principal inspections

Project Services

With our turnkey project supply approach, we are able to deliver projects from concept to completion to meet the demands of the project stakeholders. The scope of our involvement can be requirement specific or taking complete responsibility of an end to end solution. Realisation of the key areas of the project is important. We can provide several project services.

- Project management
- Application engineering
- Contractor liaison
- Factory acceptance testing
- Logistic support
- Installation and commissioning
- System integration
- Site acceptance testing

Lifecycle Services

With our lifecycle services our customers and channel partners are covered by a variety of contracts that guarantee long-lasting, cost-effective, warranty and hassle-free performance from our lighting solutions.

Lighting Capital

Philips Lighting Capital links financing to the returns that your lighting solutions will deliver. That means you can acquire a state-of-the-art solution now, with little or no upfront capital investment. So your cash flow stays positive from day one.



Upper Thames Street Tunnel

To reduce energy consumption and CO₂ emissions and improve road safety, a tunnel in central London was fitted with T-line lighting. It became the first in the UK with a fully linear LED lighting system. In combination with a B-Scout control system, the installation has saved more than 70% energy at the same time as improving light uniformity, colour recognition and visual guidance. It has also improved road safety for the 35,000 vehicles using the tunnel each day.

London, United Kingdom

Product solution:
T-line, B-Scout control

“Upper Thames Street tunnel became the first road tunnel in the UK to be supplied with a fully linear lighting installation exclusively using LED technology.”

Lundbytunnel

Transport Administration wanted a new lighting scheme for the 2.2km long Lundbytunnel in Gothenburg, one of Sweden's longest road tunnels. Since the tunnel is lit 24/7, the lighting had to be energy efficient and long lasting. After extensive testing, TunLite LED proved to be the best solution. The LED lighting is far more energy efficient, saving 21,000 kWh of energy per year and reducing CO₂ emissions by 25,000 kg. The reliable lifespan of 60,000 hours also reduces maintenance costs. The white LED light provides bright light, uniform illumination with good light scatter and no glare. It also uses 30% fewer luminaires making it an even more economical investment.

Gothenburg, Sweden

Product solution:
TunLite LED

“Road users are very positive. They think that the white LED light is much cleaner than the old yellow light. Moreover, they have better colour rendering, and we will have safer traffic in the tunnel!”

Zeeburger tunnel

Following successful installations in the Vlakte and Heinoord tunnels, Rijkswaterstaat (Dutch infrastructure authority) also opted for special LED luminaires to replace the entire lighting in the Zeeburger tunnel. Part of the A10 motorway, the 546 meter tunnel passes under the Buiten IJ canal and connects Zeeburger Island to the north of Amsterdam. T-line combines low energy use with improved comfort levels and provides light that is glare and flicker free. The solution saves 50% in energy and will provide improved vision and guidance for at least 15 years.

Amsterdam, the Netherlands

Product solution:
T-line, B-Scout control

“One of the major technical advantages of the LED line lighting solution from Philips is that the installation can be aimed very precisely: on the ground, on the tunnel wall and at the desired angle.”

Somosierra tunnels

The Somosierra tunnels on the A1 connect Madrid with communities in the north of Spain. It was decided to upgrade the old lighting to achieve the highest levels of energy efficiency. TunLite LED dimmable luminaires were installed in both tunnels, along with photometers at the tunnel entrance. Light management was included to monitor efficiency and adjust light levels according to outdoor conditions and circulating traffic. The new solution now saves more than 50% in energy use. Moreover by dimming the lights at night, the contracted power required by both tunnels is just 1 kW, which is significantly below that required previously.

Somosierra, Spain

Product solution:
TunLite LED

“With the new TunLite LED installation we expect a yearly energy consumption of 330,000 kWh, which is 50% less than the old installation.”