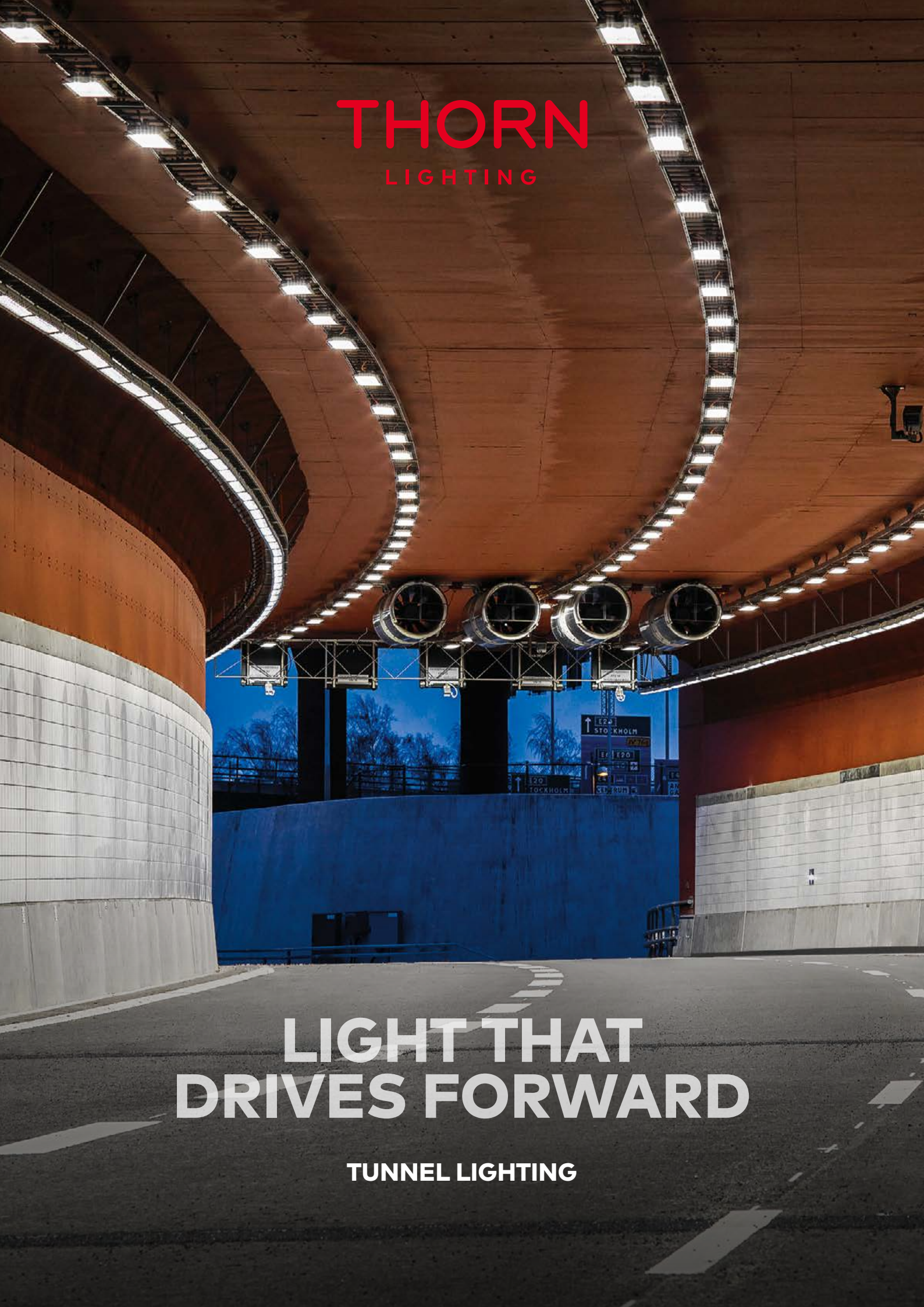


THORN
LIGHTING

# LIGHT THAT DRIVES FORWARD

## TUNNEL LIGHTING


REFERENCE PROJECT – E18, BAMBLE, NO

# LIGHT THAT DRIVES FORWARD

## WE KNOW TUNNELS

**Providing illuminating solutions across highly complex tunnel environments is always challenging. From ancient underground passageways to modern subterranean motorways, our need for safe and effective illumination has been constant.**

**Proper lighting enhances driver alertness, reduces the occurrence of visual illusions, and enables swift response to potential hazards. It also facilitates the identification of signs, signals, and lane markings, ensuring smooth traffic flow and preventing congestion.**

**We hope that throughout this brochure, you can feel our passion, experience and expertise in supplying exceptional tunnel lighting to each and every unique tunnel we help illuminate.**

# WE C

## SUSTAINABLE TUNNEL LIGHTING

**In today's world, where sustainability is a top priority, the realm of tunnel lighting holds significant potential for eco-conscious solutions. Tunnels, as crucial transportation arteries, require lighting systems that not only prioritise safety but also embrace sustainability. Solutions that are upgradable, and offer exceptional long life whilst being highly reliable really helps the sustainability credentials of a tunnel project.**

Tunnels are relatively heavy energy consumers when compared to other areas of the road network. This brochure sets the stage to explore the critical importance of sustainable tunnel lighting solutions. We hope you enjoy reading more on our balanced approach to illuminating these spaces for both people and the planet.

BUILD BACK BETTER GREEN

GOLD 2023 ecovadis Sustainability Rating

DARKSKY APPROVED · Reduces light pollution ·

# CARE

SUSTAINABLE DEVELOPMENT GOALS

## UNITED NATIONS SUSTAINABLE DEVELOPMENT ALIGNMENT


**GOOD HEALTH AND WELL-BEING**

Tunnel lighting plays a pivotal role in advancing SDG 3 by prioritising road safety, promoting well-being, and fostering energy efficiency in infrastructure development. It contributes to creating safer, healthier, and more sustainable communities for everyone.


**SUSTAINABLE CITIES & COMMUNITIES**

Tunnels are often used to by-pass towns and cities, ensuring safer spaces for the wider community. Tunnel lighting positively aligns with SDG 11 by enhancing road safety, improves transportation infrastructure, and promotes energy efficiency, fostering inclusive and resilient urban environments.


**CLIMATE ACTION**

Tunnels traditionally have a relatively high energy usage and we need to be more mindful about reducing that footprint. When we adopt energy-efficient and sustainable lighting solutions within a tunnel infrastructure, we can contribute to reducing greenhouse gas emissions and help to reduce emissions, whilst promoting a greener and more sustainable future.

# TOLL PLAZA

## KEEPING TRAFFIC MOVING

**SAFE SUBTERRANEAN JOURNEYS**

Great lighting at the point of the toll plaza can really enhance both digital and manned environments. Where people are present to take payments and check safe passage of vehicles, we can supply a range of optics that enhance facial and vehicle recognition as well as offering a low glare option to ensure workers in this space do not experience discomfort, including eye strain, during their shift. Similarly, where a toll plaza is not manned, it's essential that the lighting in these spaces supports the camera systems and highlight any potential safety concerns. Adequate illumination helps cameras capture clear images, essential for accurate character recognition. Insufficient lighting can lead to blurred or distorted images, hindering the algorithm's ability to interpret characters correctly.

Once a vehicle has passed through the toll plaza, this is where the luminaire choice becomes more focused towards specialised tunnel solutions like our GTLED fixture.

**Products used in the scene:**

**ISARO PRO**

**R2L2**

**FORCELED**

**AREAFLOOD PRO**


**PRIORITISING EYE COMFORT**

The importance of good lighting at the approach and entrance of a tunnel cannot be overstated. It serves as a critical safety measure, ensuring drivers can clearly see the upcoming lane merges and traffic filtering requirements. Proper lighting enhances visibility, reduces the risk of accidents, and allows drivers to adapt to changing road conditions. Well-lit approaches and entrances also provide psychological reassurance, promoting a sense of confidence and comfort as drivers approach the toll area, ultimately contributing to safer and more efficient transportation systems.

# TUNNEL APPROACH

## OVERGROUND TO UNDERGROUND

**SAFER ROADWAYS**
Safe roadway lighting is essential for supporting safe transport from the toll plaza to the tunnel entrance. The roadway lighting should support optimal visibility by illuminating the road surface, signs, and potential hazards. Additionally, proper lighting levels and distribution prevent glare and shadowing.

To responsibly illuminate the roadway approaching a tunnel entrance we must consider environmental conditions and employ energy-efficient solutions to minimise light pollution. By prioritising safe roadway lighting, we enhance traffic safety, improve flow, and create environments that are considerate of the well-being of all road users.

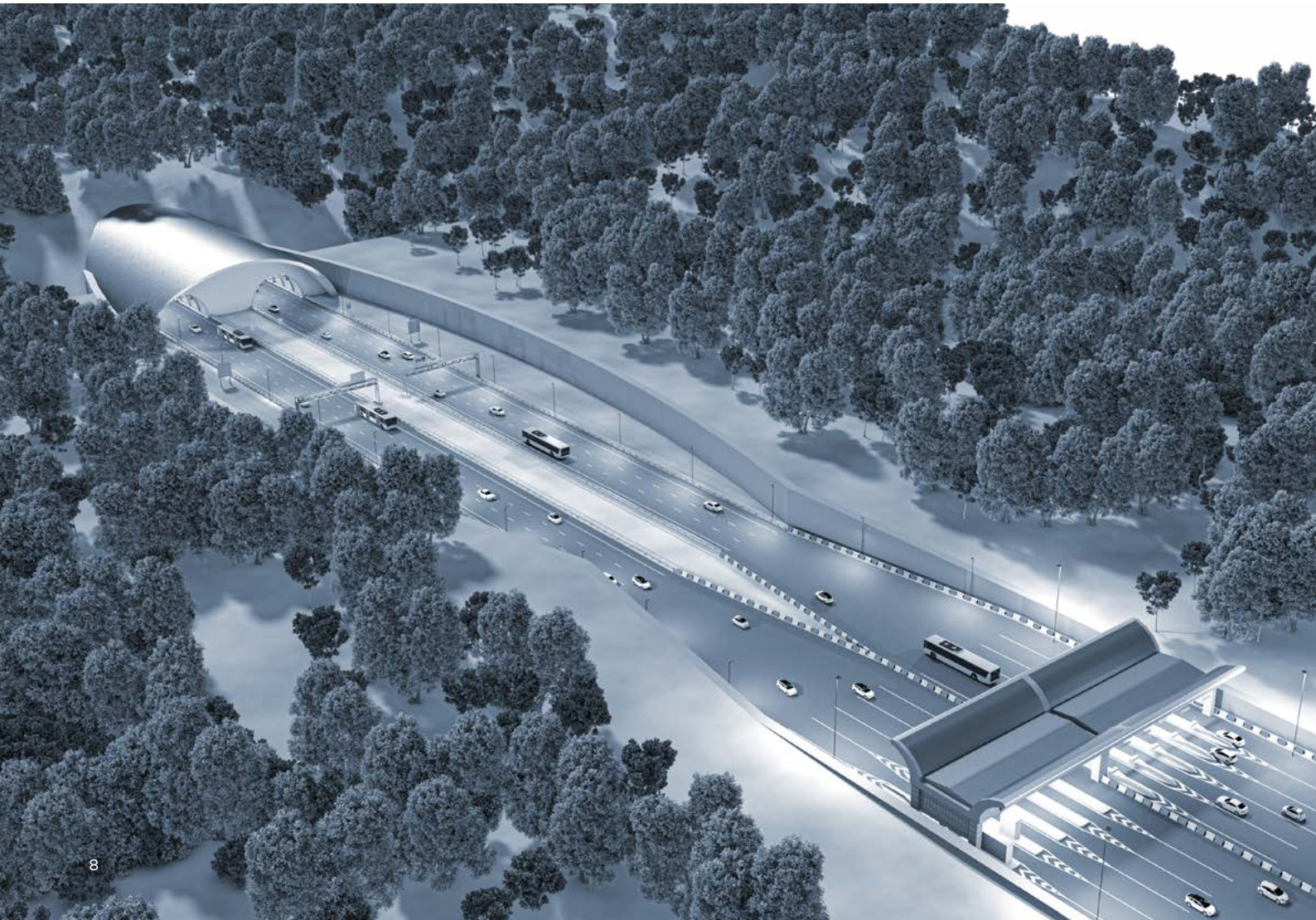
**Products used in the scene:**

**ISARO PRO**

**R2L2**

**Other recommended products:**

**AREAFLOOD PRO**



**DEPENDABLE LIGHTING**

In addition to the safety aspect, good lighting at the approach and entrance of a tunnel is crucial for human well-being and safety. Dependable lighting solutions ensure that drivers can perceive potential hazards in a timely manner. It helps maintain situational awareness and enables quick reactions to unexpected events, reducing the likelihood of accidents and potential injuries.

In addition, you need to make sure that you select reliable, durable and high quality luminaires. Once the lighting has been installed here, it can be highly disruptive to revisit a site to address performance issues. This is where Thorn Lighting's expertise in tunnel lighting applications can support you. From specification, to lighting design and all the way to installation.

Furthermore, reliable lighting mitigates the occurrence of visual illusions, such as the "black hole effect" which can disorient drivers and impair their judgment. Consistent and uniform lighting throughout the approach and entrance area aids in maintaining spatial perception and depth awareness, allowing drivers to navigate smoothly and safely.

This is why we're so passionate about our optical innovations. We know that each tunnel project is different and requires a fresh approach for each refurbishment and each new transportation network. Our unique illumination technologies, optical engineering approach and experience of tunnel lighting ensures that you're in good hands when it comes to finding a strong solutions partner.

# ENTRANCE & EXIT THRESHOLD

## SUPPORTING DRIVER SAFETY

**VISUAL ADJUSTMENT**

When both exiting and entering a tunnel, visual adjustment is crucial as drivers transition from high to low or low to high luminance levels. This adjustment isn't immediate due to two disability phenomena: spatial and temporal adaptation. Spatially, the stark contrast in luminance impedes vision, creating a "Black Hole" effect at the point in which our eyesight needs to adapt. Temporally, the human eye takes time to adapt from both brightness to darkness and darkness to brightness, with distance travelled playing a critical role during this adjustment period. During the day, depending on the project requirements, the final section of the tunnel may need to offer much higher luminance levels to ensure that drivers aren't blinded by the higher brightness of daylight when exiting the tunnel. Thorn's tunnel lighting solutions are designed to minimise the effects of these two phenomena, enhancing driver comfort and safety.

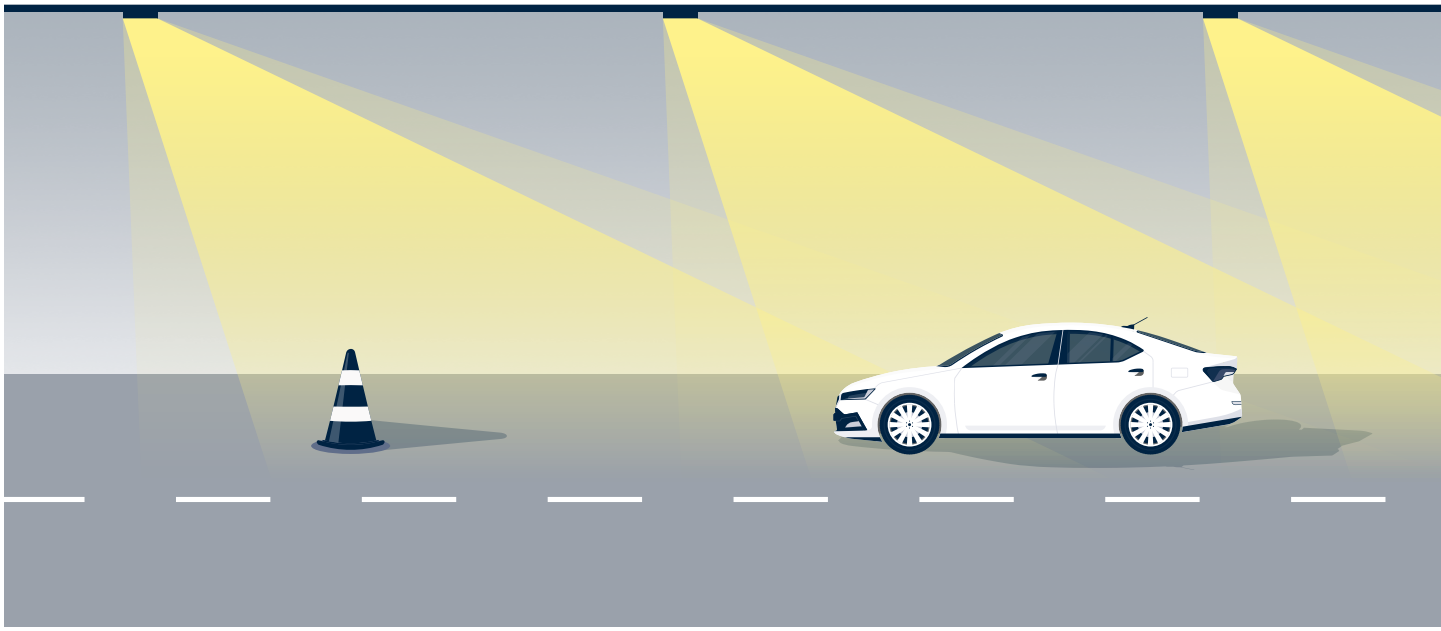
Using light fittings with higher power and lumen output at the beginning of the threshold zone, then gradually decreasing power along a presumed and defined adaptation curve,  we are able to maintain sufficient visibility while the eye adapts to the decrease in light level. The adaptation curve's level and duration is set for every project, depending on traffic type and density, velocity and the expected light levels in the field of vision while entering the tunnel.

**Products used in the scene:**

**GTLED PRO** **GTLED RS**

**Other recommended products:**

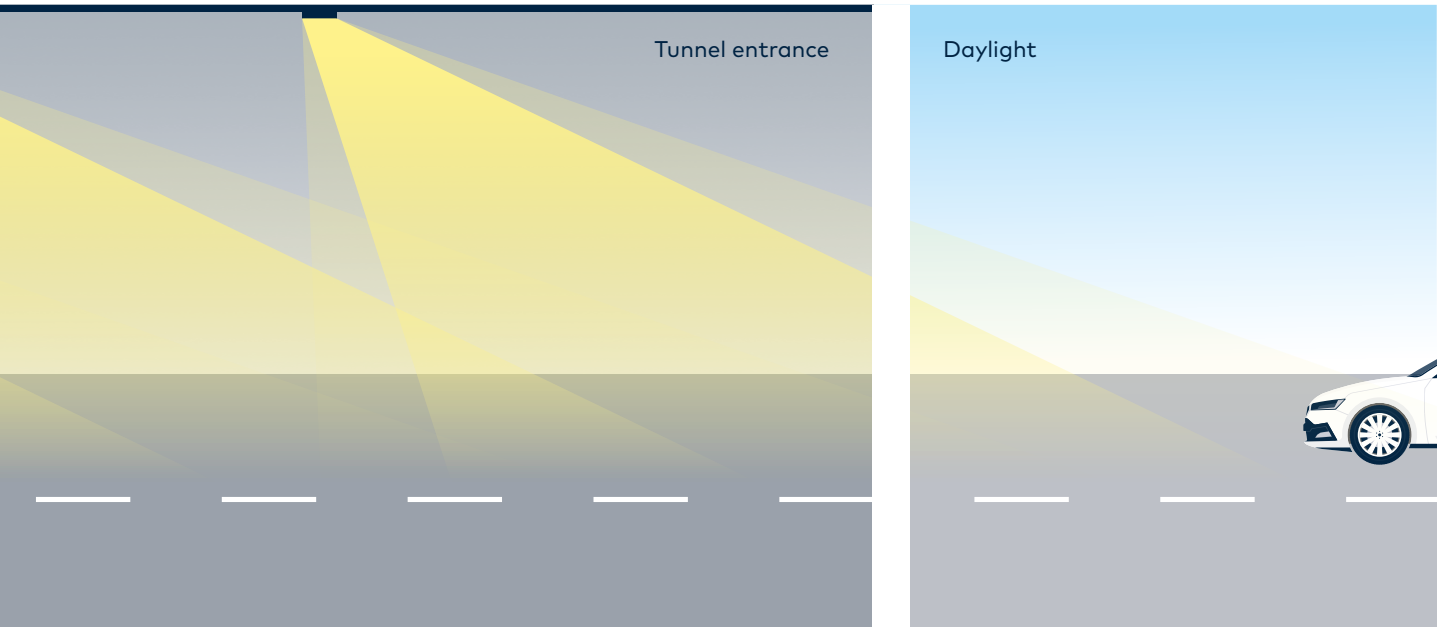
**AREAFLOOD PRO**



**GTLED PRO & GTLED RS COUNTER BEAM LIGHTING**
Asymmetric counter beam lighting enhances luminance and emphasizes potential obstacles by creating a negative contrast. It's a method used widely in tunnel lighting, where light is distributed asymmetrically toward traffic flow, including oncoming drivers and the road ahead. The light beam stops sharply at the luminaire's vertical plane, avoiding direct light flow with traffic.

This approach enhances visual adaptation and improves overall visibility for safer driving conditions.

Symmetrical lighting may still be preferred in certain applications, such as two way traffic, but then typically requires a higher luminance level and power consumption to reach the same level of visibility.




Application of counter beam lighting design.

# TUNNEL INTERIOR

## COMPLEX INFRASTRUCTURE EFFECTIVELY ILLUMINATED

### SPECIALISED SOLUTIONS

Each and every tunnel project is entirely unique and requires a nuanced approach. One thing remains, however. The fixtures illuminating the tunnel interior must be highly durable and specifically developed for use in these environments. GTLED PRO and GTLED RS are specifically crafted to provide uniform and consistent lighting throughout the tunnel, thus minimising shadows, glare, and visual distractions. By creating a well-lit environment, these fixtures enhance driver awareness and reduce the risk of accidents. Additionally, they play a vital role in shaping the psychological experience of drivers, promoting a sense of comfort and confidence as they navigate through the tunnel, creating a positive and secure driving environment. This is where solutions like Mystrid Flex can add a splash of colour that helps break up a potentially monotone environment whilst improving driver alertness. Our GTLED PRO fixture can also be fitted with green LEDs and asymmetric optics to clearly highlight emergency exits.

**Products used in the scene:**

**GTLED PRO**

**GTLED RS**

**MYSTRID FLEX**

**Other recommended products:**

**AREAFLOOD PRO**

**NEW SPECTRUM OF POSSIBILITIES**

The fairly new trend of incorporating coloured light within tunnels brings a myriad of benefits. The introduction of a broader, more colourful light spectrum adds a touch of vibrancy and aesthetics to the tunnel environment. It creates a visually captivating experience, enhancing the mood and ambiance for drivers and passengers. The use of coloured light can also serve as a navigational aid, providing distinct visual cues and supporting safe travel throughout the tunnel.

Different colours evoke specific emotional responses and moods, such as calmness and alertness, thereby enhancing the overall psychological experience of drivers and passengers as they journey through the tunnel by offering a refreshing driving experience.

# EMERGENCY LIGHTING

## CRITICAL, SAFE EMERGENCY EXITS

**DEPENDABLE EMERGENCY SOLUTIONS**

Essential in emergencies, tunnel emergency exit lighting guides occupants to safety during power outages, fires, or other crises. Positioned strategically, these lights illuminate exits, evacuation routes, and safety equipment, prioritising orderly evacuation. Compliance with safety standards, regular maintenance, and backup power sources are crucial for functionality. By prioritising reliable emergency lighting, authorities bolster preparedness and response capabilities, reducing risks and safeguarding lives. It's critical to ensure compliance with safety regulations, adequate coverage, and visibility through thoughtful placement, and reliable backup power sources for uninterrupted illumination until normality is restored. We offer a unique version of our GTLED Pro fixture with asymmetric green LEDs to massively enhance the visibility of emergency exits throughout the length of a tunnel. Luminaires that are connected to an uninterrupted lighting supply to light an escape path must adhere to EN 60598-2-22.

# TECHNICAL ROOMS

## RELIABLE, SAFE AND ESSENTIAL

**CRITICAL, SAFE ILLUMINATION**
Technical Rooms are used for tunnel maintenance, planned works and emergency scenarios. These spaces can be intensive environments and solutions like our ForceLED product offer simple installation, long life and built with reliability as it's core focus. Paired with a simple control solution, you can be sure that you achieve perfect lighting uniformity when illumination is required and maximum energy saving when it's not.

## KEY CONSIDERATIONS

**01 DURABILITY**
High IK and IP ratings on our solutions such as ForceLED and Aquaforce Pro are essential in technical rooms.

**02 UNIFORMITY**
Lighting here needs to effectively aid maintenance and ensure that users of mobile technology are protected from glare.

**03 ENERGY SAVING**
It's essential that we control the light in these areas so that when they are unoccupied, the lighting is automatically switched off.

**04 EMERGENCY**
The lighting here must assist with peoples' safe evacuation from both the technical room and all areas of a tunnel until they are able to reach a point of safety.

**Products used in the scene:**

**AQUAFORCE PRO**

**Other recommended products:**

**FORCE LED**

**EYEKON**



**KATONA**

# CONTROL SYSTEMS

## OPTIMISED, CONTROLLED LIGHT

**ENABLING LIGHTING FLEXIBILITY AND INTELLIGENCE**
Enabling a light point to communicate to widely utilised control systems is key when implementing a lighting control system throughout the infrastructure of a tunnel.

Proprietary lighting control systems can be less than ideal due to their limited compatibility, vendor lock-in, and potential difficulty in sourcing spare parts or obtaining support from a single provider.

## KEY CONSIDERATIONS

**01 COMPATIBILITY WITH OPEN STANDARDS**
Implementation of DALI D4i lighting control systems based on open standards ensures interoperability with a wide range of lighting fixtures, promoting flexibility and future-proofing investments.

**02 SCALABILITY AND FLEXIBILITY**
Tailored solutions for different tunnel sections are possible through flexible programming, accommodating varying traffic flows and time-of-day lighting requirements.

**03 LUMINANCE CAMERA INTEGRATION**
Real-time adjustment of illumination levels enhances driver comfort and safety by monitoring natural light levels and adapting internal lighting accordingly. Individual or group control further optimises visibility along the adaptation curve of the eye.

**04 FAULT REPORTING**
Our solutions offer comprehensive fault reporting at both individual luminaire and group levels, enabling proactive maintenance and minimising downtime.

**05 ENERGY EFFICIENCY**
Dynamic lighting adjustments based on real-time conditions, facilitated by integration with sensors and occupancy detection technology, optimise energy usage and contribute to your sustainability goals.

**06 MONITORING AND MAINTENANCE**
Robust monitoring capabilities empower operators to remotely diagnose and address issues promptly, ensuring continuous operation and maximising system reliability.

# INSTALLATION CONSIDERATIONS

## GETTING THE HARD PART RIGHT

### ELECTRICAL, MECHANICAL & WINDAGE CONSIDERATIONS

**01 ELECTRICAL LOAD CAPACITY**
Efficiency of the light point is crucial to ensure the installation meets the tunnel's power supply infrastructure.

**02 WIRING AND CONDUIT PLACEMENT**
It's essential that the lighting solution offers flexible cable options including cable entry and through cabling.

**03 LIGHTING FIXTURE SELECTION**
Elements like light output, efficiency, durability, and compatibility with control systems are essential for tunnel installations.

**04 LIGHTING CONTROL SYSTEMS**
Allows for energy-efficient operation and customised lighting settings.

**05 MAINTENANCE AND ACCESSIBILITY**
It's essential that the tunnel luminaire offers a flexibility of mounting types. Both over lane mounting and off-centre mounting.

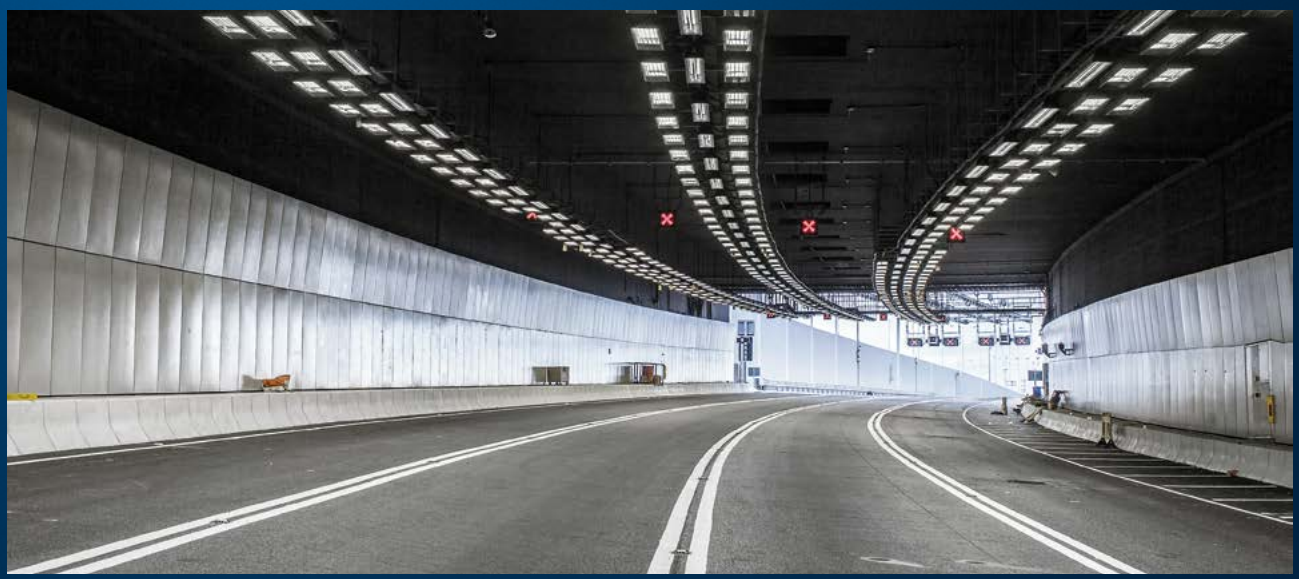
**06 WIND LOAD ANALYSIS**
This analysis helps determine the appropriate product design and installation methods to ensure stability and resistance to wind-induced stresses.

**07 FIXTURE DESIGN AND ORIENTATION**
Select lighting fixtures with aerodynamic designs that minimise wind resistance.

**08 MOUNTING AND FASTENING METHODS**
Utilise solutions with robust brackets, clamps and anchors that can withstand wind forces.

**09 PLUG AND PLAY SOLUTIONS**
Installing light points in a tunnel is a significant challenge, both our GTLED PRO and GTLED RS both assist in simple and straightforward installation.

**10 GALVANIC CORROSION**
It's essential that disimmilar metals are kept separate to avoid metal corrosion and ensuring durability of the installation.



# TUNNEL LIGHTING SOLUTIONS

## A SUMMARY OF LIGHTING SOLUTIONS

**GTLED PRO**
Durable, slim, compact and lightweight

**GTLED RS**
Supreme corrosion resistance

**EBOX**
Optimised Central Battery System

**MYSTRID FLEX**
Flexible linear Illumination

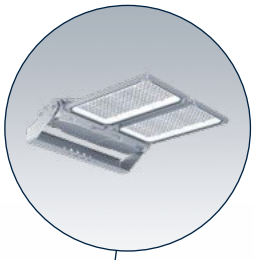
**EROA**
Optimised visual comfort

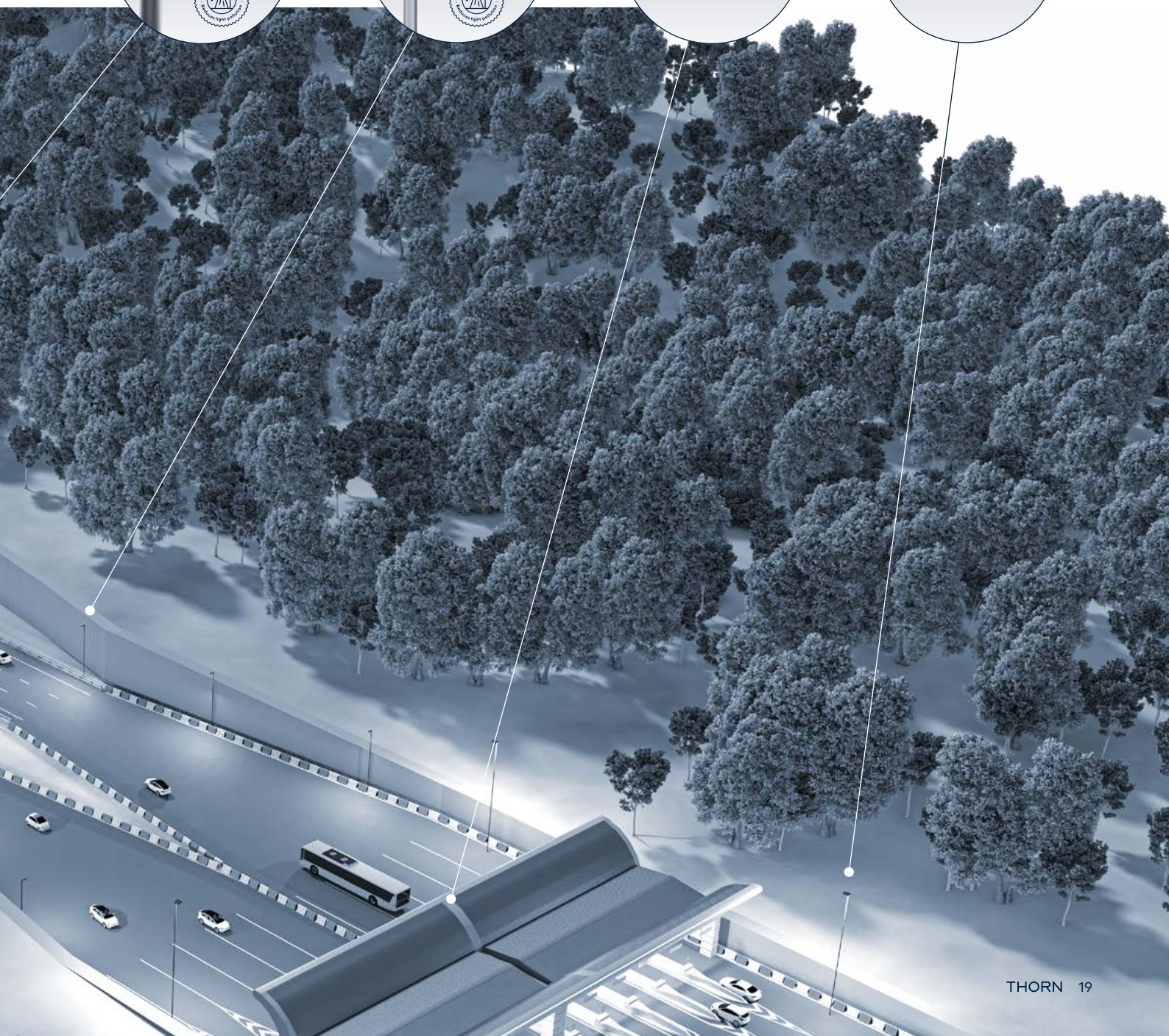
**ISARO PRO**
Brings comfort and safety to any road

**R2L2**
A complete road lantern family

**FORCELED**
Compact and durable with a unique diffuser

**AREAFLOOD PRO**
Superior optical performance






WE
MAKE
LIGHT
WORK

REFERENCE PROJECT – MARIEHOLMSTUNNELN, GOTHENBURG, SE

# THE BENEFITS

## OF WORKING WITH THORN

01

### OVER 95 YEARS' EXPERIENCE

Yes, we really have passed the 95-year mark! Thorn has had nearly a century to develop its unique knowledge and expertise. And the best part is that we can build on this knowhow to make sure that we are always ahead of the game with the latest technology, the most reliable services and a price that works for everyone.

95
YEARS
EST. 1928

ELECTROMAGNETIC COMPATIBILITY (EMC) TESTING LABORATORY

02

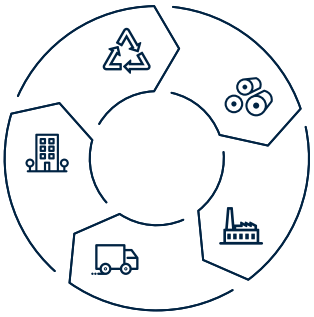
### CONSTANT RESEARCH AND INNOVATION

Thorn has been at the forefront of lighting technology for decades, and continues to push the boundaries. Our investment in R&D and innovation aims to bring customers the very best performance, thanks to the latest advanced engineering in light and electronics, with in-house development.

03

### EXTENSIVE TESTING AND CERTIFICATION

Thorn's products undergo demanding tests for compliance, safety and performance. With Thorn, you can be sure that your lighting product does what it says it will do, meets all relevant standards and regulations, and comes with a guarantee of quality and safety.



## 04

## ENVIRONMENTAL PRODUCT DECLARATION (EPD)

At Thorn we provide EPDs as a standard service. The EPD for each specific product details its impact on the environment throughout its lifecycle. The EPDs are based on EN ISO 14025 and EN 15804. The information given by an EPD is relevant not only for environmental certifications such as LEED, BREEAM or ÖGNI. EPDs form the data basis for an environmental building assessment.

## 05

## BEST-IN-CLASS OPTICS

Thorn's product range benefits from our class-leading optical systems. They offer several precision light distributions to fulfil various requirements, with excellent uniformity and glare control.

## 06

## QUALITY FROM THORN'S SPENNYMOOR FACTORY

Thorn's products go through intensive quality manufacturing, assuring the best processes to develop better products all the way. In addition, we are one of the first companies in the UK to be certified to ISO 14001 – the standard for environmental management. In addition, we have successfully been recommended for certification to ISO 50001:2018 for energy management. Our factory at Spennymoor in the UK has achieved a reduction of approximately 25 % in significant energy uses and 14 % in electricity use compared to the previous year.

## 07

## FIVE YEAR GUARANTEE

All Thorn products carry a five year guarantee.

**5 YEAR GUARANTEE**

## 08

## ZUMTOBEL GROUP MEMBER

The Zumtobel Group is an international lighting group and a leading supplier of innovative lighting solutions, lighting components and associated services. With its core brands, Zumtobel, Thorn and Tridonic, the Group offers its customers around the world a comprehensive portfolio of products and services.

# GET IN TOUCH

www.thornlighting.com/contact

WE MAKE LIGHT WORK

06/2024