Light at Night

A Balanced Approach for Responsible Use

GLOBAL LIGHTING ASSOCIATION

LIGHT AT NIGHT

A BALANCED APPROACH FOR RESPONSIBLE USE

Introduction

While the issue of Light at Night (LAN) might appear straightforward, it is a multifaceted issue demanding a balanced perspective and collaborative effort from all stakeholders. As responsible global lighting manufacturers, we believe it's crucial to embrace this complexity and clarify our role in creating sustainable and beneficial LAN solutions.

Publications like the "Responsible Outdoor LAN (ROLAN) Manifesto" by Dark Sky International in 20221 bring vital attention to the topic. However, it's essential to emphasise that the responsibility for management of LAN rests with all stakeholders. The lighting design community, installers, policymakers, and end-users all play critical roles in shaping how light is used and experienced at night. Manufacturers alone cannot address the intricacies of the lighting ecosystem, and shared accountability is needed to ensure positive change.

Positive Community Impacts of Light At Night

LAN has been enabling a variety of beneficial and desired community functions for many centuries. Well implemented LAN can facilitate economic development by extending productive hours while highlighting a city's architecture and enhancing safety.

It also improves the atmosphere of neighbourhoods, promotes tourism, contributes to keeping drivers alert, and supports outdoor leisure and sports activities. However, the extent of LAN has significantly increased in recent decades, leading to challenges such as impacts on biodiversity, wasted energy, and skyglow that hinders the visibility of stars and celestial objects.

LAN has also promoted economic development by extending productive hours, facilitating outdoor (leisure) activities and encouraging social interaction during the evening and night. As an example, well-designed roadway lighting is known to enhance the visual performance and comfort of motorists and contribute to overall traffic safety.

To borrow a well-used phrase in the lighting industry, LAN should use 'the right light at the right place at the right time'.

In practice, various measures can be implemented:

RIGHT LIGHT	RIGHT PLACE	RIGHT TIME
Ask. Is light required?	**Ask. Where is light required?**	**Ask. When is light required?**
Optimised light levels	Optimised optics	Time Scheduled Operation and Control
Appropriate light source spectrum	Luminaire location and position	Sensor activated Operation and Control
Appropriate luminaire distribution	Luminaire orientation	Central / local control for seasonal and area variation

Potential Adverse Aspects of LAN

Following demographic developments and societal needs, the prevalence of LAN has increased significantly in recent decades and is expected to continue to grow. Accompanying this growth is increased awareness and understanding of potential adverse effects of LAN including:

- Impact on biodiversity and natural habitats.
- Diminished visibility of stars and celestial bodies.
- Wasted energy from incorrectly utilised light.
- Obtrusive light adversely affecting humans.

However, when designed and installed appropriately, the adverse effects of LAN can be minimised while preserving the desirable positive impacts.

Lighting Industry Can Help Mitigate Adverse Effects of LAN

The transition to LED technology and the expanded use of sensors and controls has provided lighting manufacturers, designers, and end-users with many more tools to optimise lighting systems and mitigate potential adverse effects.

Smaller LED sources give optics designers more cost-effective solutions and flexibility to design precision optics to more effectively control light distribution. LED light sources can dim to suit the changing nature of the lit task and to a greater extent than was possible with lamp technologies. This together with an optional ability to tune the spectral wavelength of the light emitted, helps to mitigate adverse LAN effects.

Finally, improved controls and sensors complement LED technology to enable light levels to be adapted and tuning of the spectrum specifically for the task or occupancy need.

The Legislative and Regulatory Landscape Is Diverse

Many countries in the world do not have any guidance or restrictions to mitigate the adverse environmental effects of LAN.

Where guidance or restrictions are established, they vary between country, region and city[1]. This misalignment complicates addressing the overall LAN challenge.

It is worth highlighting that effective LAN regulations must emphasise the requirement for professional lighting designers to select and specify solutions that result in responsible use of LAN, based upon professional guidelines for responsible use of lighting systems and for regulators to ensure provisions for effective enforcement.

For example, in October 2023, the City of London (U.K.) published a lighting planning document[2] to ensure "the right light, in the right place at the right time, is controlled by the right system". In addition to this, planning authorities in the UK apply the Institution of Lighting Professionals (ILP) Guidance Note GN01, which addresses the reduction of obtrusive light[3] and artificial light. Under certain conditions, excessive lighting can be considered a legal nuisance[4].

[1] Science for Environment Policy (2023) Light Pollution: Mitigation measures for environmental protection. Future Brief 28. Brief produced for the European Commission DG Environment by the Science Communication Unit, UWE Bristol.

[2] https://www.cityoflondon.gov.uk/assets/Services-Environment/lighting-spd-2023.pdf

[3] https://theilp.org.uk/publication/guidance-note-1-for-the-reduction-of-obtrusive-light-2021/

[4] https://www.gov.uk/guidance/artificial-light-nuisances-how-councils-deal-with-complaints

Recommendation For Outdoor Lighting Products and Systems

Recommendations to mitigate adverse LAN effects should differentiate between product specific parameters and application dependent parameters.

- Product specific parameters can be validated and measured at the product level and do not depend on specific application conditions.
    - Examples include luminaire light distribution, dimmability, spectra, and features for adopting the amount, spectra, and/or distribution of light depending on the activity or time of day/year.
- Application dependent parameters can only be specified, checked and validated within the context of the application.
    - For example, light reflection can contribute to undesirable conditions that require adjustments in the installed design.

Restrictions for product specific and application parameters are primarily but not solely dependent on environmental lighting zone distinctions as advised within CIE 150[5]. In this way, an urban city centre would permit higher maximum values than less inhabited rural areas.

Recommendations For Legislation, Regulations and Ordinances for Municipalities

When developing legal frameworks, it is not enough to only focus on the lighting products which include the right features to help mitigate negative LAN effects, it is equally important to ensure that lighting is designed by competent lighting professionals, equipment is installed with great care, according to the design specification and manufacturer's guidelines, properly commissioned and operated in a responsible way. The option for local or remote management of light sources gives municipalities and end-users the opportunity to adapt and control light sources according to specific facility needs/preferences, local curfew orders or other public requirements.

Throughout the design and installation process the 'separation of responsibilities' remains important to clearly distinguish between product-related mitigation measures and site-specific design and application measures.

[5] https://cie.co.at/publications/guide-limitation-effects-obtrusive-light-outdoor-lighting-installations-2nd-edition

Conclusion

State-of-the-art lighting systems that are planned, specified, designed and installed by competent professionals, can minimise the potential for adverse effects of LAN whilst ensuring that the required lighting requirements are achieved.

The guiding principles for responsible outdoor lighting are:

- All lighting serves a purpose.
- Light level and light source spectrum are optimised for the application (“right light”).
- Light is directed only where it’s needed (“right place”).
- Light is dimmed down or turned off when not required (“right time”).

The lighting industry is dedicated to fostering a future where LAN is used responsibly and sustainably. We believe that by working collaboratively as an industry together with other key stakeholders, we can create lighting solutions that benefit people and minimise impacts on the planet. To this end, we are providing the following best practice guide for the design, procurement, installation, and commissioning processes of lighting systems.

This guide is intended to serve as a resource for all stakeholders in the lighting ecosystem, helping to ensure that LAN is used effectively, efficiently and responsibly.

Light at Night (LAN) – Best Practice Guide

1. Introduction

This Global Lighting Association (GLA) Light at Night '(LAN) - Best Practice Guide' identifies the tasks and challenges facing stakeholders who influence decision making about providing LAN for exterior public and private areas. The stewardship responsibilities necessary to ensure delivery of high-level environmental performance outcomes must be separated for the different stakeholders.

This Guide addresses various stakeholders of the lighting industry, including lighting designers, suppliers, installers and decision makers who specify, procure, own, manage, and operate outdoor lighting systems. It outlines planning and application principles that can be included in a comprehensive lighting design deployment. The best practices for outdoor lighting are discussed in reference to impacts in three natural domains:

Astronomical	Night skies
Terrestrial	Humans, plants and wildlife
Aquatic	Marine plants and creatures

Developing solutions for the needs of these three domains can sometimes conflict with traditional lighting design objectives and requirements for people in nighttime environments. It is of vital importance to balance the relevant factors to achieve an optimised outcome by avoiding too much focus on any single design aspect. The following recommended steps can assist in satisfying this challenge.

2. Planning Overview

Proper project initialisation is an important task. It is a common occurrence for lighting installations to provide excessive light levels, not in harmony with these three natural domains.

Projects should start by identifying:

- Is lighting required?
- Occupant/Observer needs and tasks

- Applicable light control regulations (national/regional/local)
- Applicable product and application standards/norms
- Environmental impact mitigation goals

The goal for all projects is to provide safe and amenable functionality for vehicle and pedestrian roads, human work, sports, security and social activity. Additional consideration is required of the potential impacts to night skies, terrestrial species, and aquatic life related to the site circumstances.

3. Client Engagement

Project design documentation should be developed comprehensively to shape project outcomes. Clients, asset owners, and facility managers should be included as stakeholders with a responsibility to educate themselves on unintended consequences and environmental impacts of LAN as well as the potential benefits of a properly executed design. A limited budget can provide unique challenges related to the lighting design options and availability for commissioning services, but the features and performance of an optimised system of luminaires and controls can be employed at any budget level.

The client has the role and responsibility to empower the design team to balance the priorities and best mitigate negative consequences unique to each project.

4. Outdoor Lighting Design Principles

The guiding principles for best practice outdoor lighting are:

Is light required?

- ***'The right light'***:
    - Select appropriate tasking light level and uniformity targets given the application and the CIE environmental lighting zone(s) using regional lighting standards.
    - Minimise light levels to what is required to satisfy lighting tasks.
    - Select appropriate source spectrum with a preference for 'warmer white' when possible.
    - Prevent light from being directed upwards above the horizontal plane in the installed position.
    - Consider with caution the use of emerging technology options such as warm spectra, and species-specific lighting, and balance them with the potential negative consequences to other functional, environmental or societal priorities.
    - Identify other lighting design aspects that are critical for the purpose of the lighting installation in its environment, including sufficient vertical illumination and ambience in support of a feeling of security.

Where is light required?

- ***'The right place'***:
    - Separately identify specific areas:
        - where supplemental illumination is needed.
        - where the presence of light could be harmful.
        - where there is a transition between general and sensitive areas.
    - Select luminaires with optical capabilities to satisfy the identified areas and objectives.
    - Optimise luminaire locations to match capabilities and area needs.

When is light required?

- ***'The right time'***:
    - Utilise luminaires and/or system components that have dimming capability, as well as astronomical timing and sensing when applicable.
    - Develop a schedule for needs that occur at various times of day/night, seasons, and transient events (holidays, animal migrations, etc.)
    - Consider the use of adaptive light delivery based on prevailing traffic and task conditions.

5. Lighting Design

It is imperative to engage professionals who are competent in lighting design and experienced in outdoor lighting. These professionals will take responsibility for defining outcomes that meet all aspects of the lighting design principles outlined in the previous section.

Lighting of special areas such as near astronomical sanctuaries or in Protected Natural Areas (PNAs) requires additional scrutiny and reference to regionally applicable lighting standards. The project documentation should specifically address unique objectives or regulations.

In such applications, lighting design services may need additional support from commissioned site-specific scientific, environmental or urban-planning experts to achieve the most appropriate outcomes and utilise specialised equipment which should be considered in the earliest phases of project planning.

6. Lighting Technology

LED luminaires are available with a wide range of light source spectra values, including adaptable spectra. The optimal spectra choice must strike a balance between enhancing human visual performance at night, including aspects like visual acuity and response times, and minimising overlap with the spectral sensitivity of wildlife. Additionally, it must account for the relatively low sensitivity of the human eye to very warm white, which can

necessitate luminaires with a higher lumen output. This, in turn, increases capital costs and leads to higher energy consumption and resultant CO2 emissions.

Lighting control devices (including ambient light and movement sensors) are available both as discrete/standalone and system based. For larger deployments, networked lighting controls can be deployed that use wireless communications (i.e. Bluetooth, Zigbee, etc.), internet-based Central Management Systems (CMS), and distributed wired or wireless digital protocols. Deploying appropriate sensors and controls can greatly reduce the operational hours to minimise the potential adverse impacts of LAN while also conserving energy.

7. Economic and Procurement Considerations

An important step in any lighting design project is considering the full cost of ownership impacts of the design over the expected lifetime of the system. This includes the initial cost of the equipment and installation, maintenance expectations and broader impacts such as life cycle costs of the equipment. When completing this exercise for LAN, it is additionally important to incorporate economic considerations that may be unique to a project. Decisions on economic and financial matters should be made at an early stage in project planning.

To justify investment in design time and higher performing luminaires and control systems, Life Cycle Costing (LCC) and Net Present Value (NPV) financial assessment methods are customary. For LAN projects, these calculations should include the costs and benefits of appropriate environmental management including controls, scheduling, and potential regulatory impacts. Such justification methods identify all financial Return On Investment (ROI) to support realistic project funding necessary in the optimisation of LAN.

Procurement of equipment and systems should follow standard best practices including clear technical requirements and identification of critical performance characteristics. Of particular importance is adherence to the project objectives throughout the project. When considering alternative products or solutions, the economic impact of potential adverse impacts of LAN must be included along with any potential first-cost savings.

8. Commissioning and Maintenance

Commissioning is an essential part of any lighting project. This includes verifying the proper luminaire locations, luminaire aiming, and control system programming. System functionality and performance should be evaluated for every identified scenario in the verification plan. Clearly structured commissioning methods based on project details, manufacturer guidance, and international or regional standards provide robust

processes that give client assurance regarding the LAN performance outcomes as well as ensuring attainment of the expected economic value from suppliers and contractors.

Building on the original project documentation and commissioning results, routine maintenance will be needed throughout the project life. In addition to addressing any failures in the performance of the equipment or controls, maintenance should include updates to the settings to reflect an evolved understanding of the task needs or environmental constraints. This may include changing times the lighting turns on and off automatically as well as the programmed output and aiming of the luminaire. Ongoing maintenance will ensure that that lighting system is continuously optimised for its task and/or to minimise environmental impacts.

9. Post-installation Stakeholder Communication

On project completion, a guided site-visit at night for facility owners, maintenance personnel, municipal officials and/or wider community stakeholders can be very beneficial as part of community engagement and education. Such a tangible visual experience can highlight good outcomes and help explain the justification of the investment in future design services.

Additional positive publicity showcasing the successful optimisation of LAN can serve to enhance the reputations of the asset owners, encourage proper maintenance and reduce barriers for other projects in future.

10. Next steps

The Global Lighting Association (GLA) welcomes other organisations to join in endorsing these guidelines to bring together worldwide lighting organisations in agreement on best practice for optimising Light At Night.

ABOUT THE GLA

The Global Lighting Association (GLA) is the leading voice for the lighting industry worldwide, representing over 5,000 lighting manufacturers and generating $75 billion in annual sales. Through its network of 27 national and regional lighting associations, the GLA advocates for policies and practices that promote sustainable lighting solutions, energy efficiency, and human well-being. The GLA is committed to fostering a collaborative environment that supports innovation, fair competition, and the growth of the lighting industry on a global scale.

This document is designed to provide advice and guidance for relevant stakeholders. It is subject to change or update without prior notice. The content is compiled based on the best available knowledge of participating GLA members, who cannot be held liable for any inaccuracies, omissions, or misinterpretations.

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