

Dark Sky Ireland

Our vision and policy on reducing light pollution in Ireland

March 2019



Credit: Brian Wilson

Executive Summary

Ireland currently has no legislation or public policy in place to deal with light pollution. Carefully crafted and robust public policy is crucial to fulfilling Dark Sky Ireland's goals to protect the nighttime environment and our heritage of dark skies.

Within this document Dark Sky Ireland has presented a policy on dealing with light pollution and calls for legislation to be implemented accordingly. This document highlights the consequences of implementing a national lighting plan based on energy reduction objectives, without considering the consequences to biodiversity, public wellbeing and rural tourism.

Why Ireland should take light pollution seriously in planning and public policy

- Light output from Ireland nearly doubled in the two decades to 2014.
- 45% of the population lives under skies 5 times brighter than normal, for which the Milky Way cannot be seen, even when directly overhead.
- For 18% of the Irish population their daytime (colour) vision is active at night.
- Around 95% of the country has a night sky degraded towards the horizon.
- The 5% of the country, which still has pristine skies, needs to be protected as a resource, including for tourism.
- Clouds dominate our skies most of the time and reflect upward-directed light pollution back to the ground thereby exacerbating light pollution effects – this compares with the unpolluted conditions that species have evolved in where overcast skies lead to much darker conditions.
- Light pollution is a threat to Ireland's biodiversity. Over 50% of invertebrates and 30% of vertebrates are nocturnal and need natural darkness.

Facts and figures

- In the Republic there are more than 480,000 public lights, consuming 50 MW of electrical power, resulting in an energy usage of 210 GWh annually.
- The annual cost of national public lighting is €7.4 million.
- Nearly all public lighting is on from dusk to dawn, and 98% of the electricity use is unmetered.
- Including the contribution from architectural, commercial and retail lighting, energy equivalent to 30% of that used for public lighting ends up in the environment away from its intended area.
- 16% of residential electricity is used for lighting with a household equivalent of 195W, or 20% of an electricity "unit, roughly similar to the energy demand of a modern wide-screen TV.
- Domestic lighting costs €233 million annually and the energy production results in 71k tonnes of CO₂ being produced.
- Per household the costs for lighting are €230/year and ≈5 kg CO₂

Who is this document for?

This document is intended as a public resource for all aspects of outdoor lighting in Ireland. It is intended for policy-makers, planners, national and local entities, community groups, commercial businesses and individuals.

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About Us

The Irish Light Pollution Campaign (ILPAC) founded in the early 2000s by Colm O'Brien and Albert White. It became a chapter of the International Dark-sky Association¹ known as Dark Sky Ireland in 2003 and in 2009, hosted the 9th European Symposium for the Protection of the Night in Dublin attracting an international delegation.

In October 2018, a meeting was held at the Mayo Dark Sky Festival by a group of individuals²representing various organisations and committees from around the island of Ireland with a common interest; they are passionate about protecting Ireland's night skies from light pollution. The purpose of the meeting was to discuss a new project entitled EcoStars³. The project application was written and submitted by Blackrock Castle Observatory and successfully funded by the International Astronomical Union. It was one of only 16 special projects selected out of 164 applications and the only one representing Dark Skies for All as a thematic pillar.

In previous meetings, the key stakeholders had discussed forming a national entity and it was decided a formal group should be established in order to execute the EcoStars project. With kind permission of Albert White, the name "Dark Sky Ireland" was adopted to reflect the new group representing interests on dark skies on the whole island of Ireland.

The main objective of Dark Sky Ireland is to protect and preserve night skyscapes for present and future generations, featuring the following primary areas of focus:

- The preparation of a 'Pathway to Dark Skies' policy framework
- The provision of a public portal for information and resources on Dark Skies
- The development of Dark Sky educational programmes and events for public engagement
- Preparation of a policy and strategy document for dark sky preservation.

¹ International Dark Sky Association (IDA)

² Representatives list included at end of document

³ EcoStars

Artificial Light in our History

As a society today, we are very familiar with artificial lighting. It illuminates our homes, office buildings, car parks, sports fields, commercial premises and our roads. Cities are visible from high above far above due to the power of light. Yet, we have taken this journey in a relatively short space of time since Edison's light bulb, a mere 140 years ago, first illuminated a room at the flick of a switch. In those dark Victorian times, people were accustomed to dark streetscapes and dark skies above them. In ancient times the construction of such sites as the magnificent passage tomb at Newgrange indicates the connectedness of our ancestors with their prehistoric skyscapes. Our forefathers used the stars for navigation, time-keeping, seasonal indicators and to discover the wonders of the heavens. Today however, we are largely unfamiliar with the night and our popular culture

What is Light Pollution?

In broad terms, there are three types of light pollution:

- **skyglow** – the pink or orange glow we see for miles around towns and cities, spreading into rural areas, caused by a scattering of artificial light by airborne dust and water droplets
- **glare** – the uncomfortable brightness of a light source when viewed directly
- **light trespass** – light spilling beyond the intended area of use, e.g. beyond the boundary of the property on which a light is located, sometimes shining through windows and curtains of adjacent properties

often associates the darkness with fear and, conversely, light with safety.

Electricity first arrived in Ireland in 1880 when the first electric streetlight was installed on Prince's Street in Dublin. It took until 1927 before a nationwide electricity market could be established and, even then, some rural communities were not connected to the national grid until the mid 1970s. Public lighting is sometimes considered a symbol of wealth and economic progress, with the lack of lighting in some areas being considered a sign of spatial inequality (Edensor, 2017).

Despite the obvious benefits of artificial lighting, there are negative consequences too and one of the most prevalent of these is light pollution, though the phrase "light pollution" is a modern term and would have made no sense even in the relatively recent past.



Figure 1: Poorly designed light can create light pollution

The impact of light pollution not only affects our view of starlight from above, but can interfere with our body's melatonin production, circadian rhythms and sleep patterns. Wildlife, insects and even trees are also affected by the interruption of natural night and daylight cycles.

Why should we protect our night skies?

In both the US and UK over 80% of the population can no longer view The Milky Way from their home due to light pollution. In Ireland over 50% of us have also lost sight of this natural night sky phenomenon and this figure is rising due to the increase in

domestic, commercial and public lighting over recent years.

Our nightscape is disappearing rapidly, yet it is a valuable asset; preserving it helps us save energy, enhances our biodiversity and benefits our mental and physical wellbeing.

The good news is that here in Ireland, we have two naturally dark areas that are protected for future generations to enjoy: Kerry International Dark Sky Reserve and Mayo International Dark Sky Park. Both have been awarded a "gold" designation by the International Dark Sky Association for the quality of their night skies, free from light pollution and these are important assets of natural night sky heritage.



Figure 2: Mayo International Dark Sky Park



Figure 3: Kerry International Dark Sky Reserve

Such landscapes are considered important cultural assets at an international level too and where Astronomical Heritage involving the sky can be shown, UNESCO states:⁴

The sky, our common and universal heritage, forms an integral part of the total environment that is perceived by humankind. Heritage that bears witness to people's interpretation and understanding of the sky from earliest times through to the present day stands as a record of the extraordinary diversity of ways in which our species has viewed, interpreted and understood the relationship between itself and the world—the universe—that we inhabit. If we are to keep this record intact, it is vital to recognize and safeguard cultural sites and natural landscapes that encapsulate and epitomize the connection between humankind and the sky.

⁴ <https://www3.astronomicalheritage.net/index.php/why-preserve-it>

The growth of light in Ireland and Light Emitting Diodes (LEDs)

In Ireland, between 1992 and 2010 there was a more than 60% increase in light output across most of the country as determined from satellite measurements, mainly due to increased development during the boom years. This trend has continued with over 480,000 public lights now installed across the country consuming 210GWh⁵ in electricity annually and costing €56 million annually⁶. A proportion of this light ends up far from the site of its intended use, and it is estimated that from all sources the energy equivalent of 30% of that used for public lighting ends up outside of the useful area. This light contributes to light pollution and is partially a result of reflections from surfaces, but also due to inefficiencies in shielding as well as design and installation, including upward-directed and inappropriate levels of light.

Artificial lighting is undergoing a radical worldwide change toward high intensity LEDs and these are appearing more frequently on our roads and streets in an attempt to reduce energy costs. LEDs appear to have many advantages including being cheapness, energy-efficiency and ease of control. On the other hand, there is an increasing body of research emerging that indicates a need for consideration and consultation before LEDs with high blue-rich colour content are widely installed.

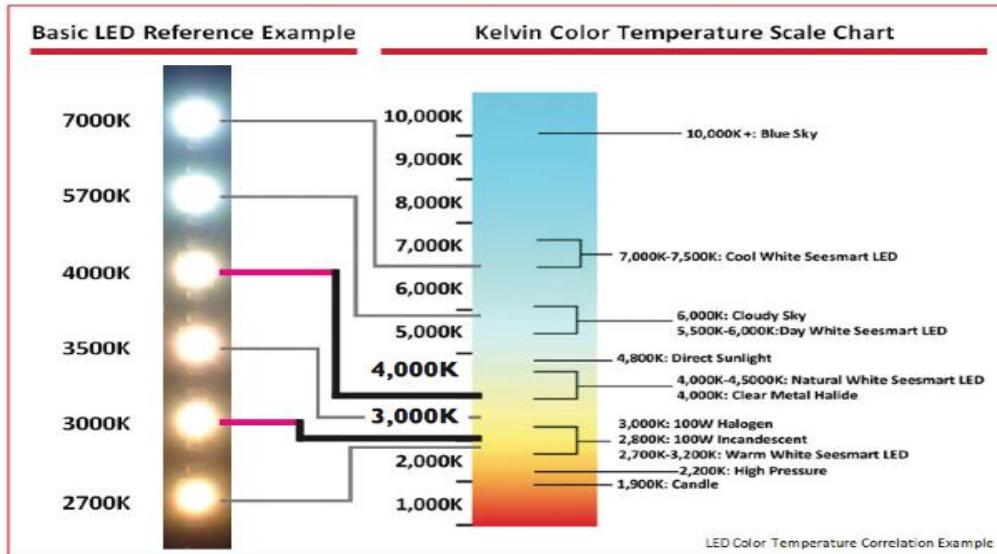
This blue-white light reflects from grass and foliage and scatters high into the atmosphere, causing more than five times more sky-glow than previous warm white/amber lights. The benefits of otherwise good downward direction of light may be negated the scattering of blue-rich light, excess brightness and glare.

The Importance of Colour Temperature

The “colour” of light is measured by the equivalent temperature a body would be heated to in order to provide the same colour and expressed in units of kelvins. The illustration below shows various levels of artificial light compared to natural lighting conditions from daytime to dusk conditions on the Kelvin temperature scale. Streetlights of >4,000 kelvin are effectively recreating daylight conditions at night time, which not only contributes to sky glow but is a factor affecting the circadian rhythm of most vertebrates, invertebrates and indeed ourselves.

⁵ SEAI 2017 Annual Report on Public Sector Energy

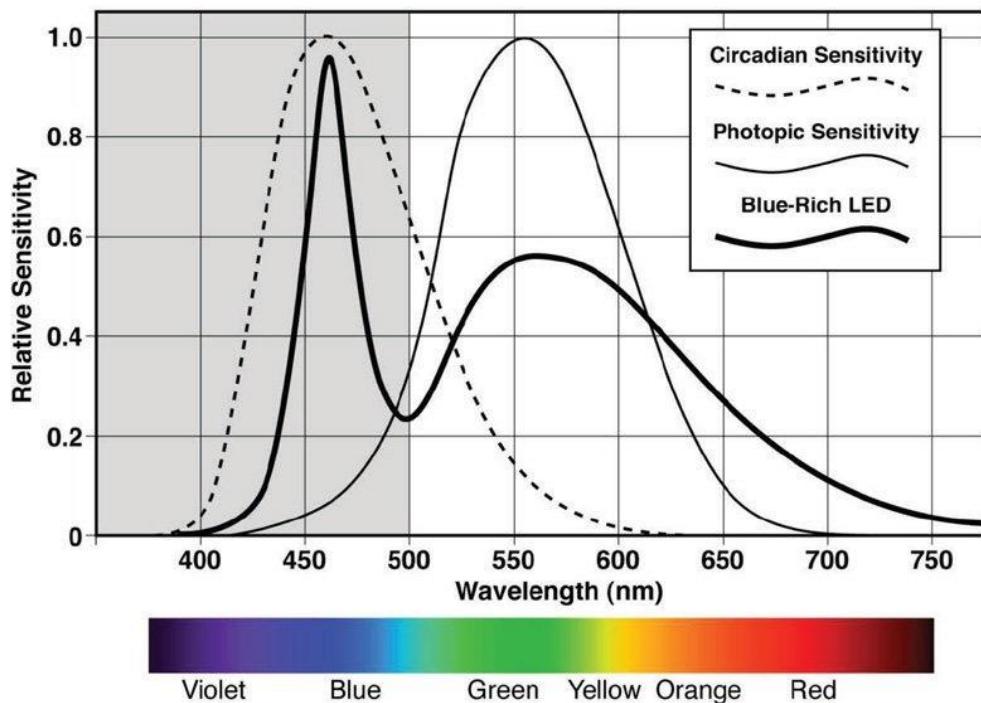
⁶ Public Sector Energy Efficiency Strategy Jan 2017



How does blue-rich light affect living organisms?

In creating daylight conditions at night, we now know that over 18% of the Irish population already uses colour vision at night. Our evolution as a species over millennia has developed imaging sensors to adjust between daylight and low light conditions. One of the unintended consequences of creating artificial daylight at night with blue-rich light technology is that we trigger a biological signal to suppress melatonin in our bodies. This has longer-term implications for human health matters such as obesity, diabetes, sleep disorders and even some associations with cancer. Blue rich light also triggers responses in much of our biodiversity; drawing important species such as night pollinators away from natural habitats and food sources.

The graph below illustrates the peak of circadian sensitive coinciding with blue-rich light sensitivity, which acts as a trigger point in our biological clock.



Concerns for the implications of blue-rich lighting are raised in the UK's Chief Medical Officer's report for 2017. This document dedicates a full page to light pollution and health, referencing LEDs and blue rich lighting with the following comment:

"Local authorities [in the UK] have been replacing mercury and sodium street lights with LEDs. If this is done purely on the basis of energy efficiency and cost, it is possible to end up with installations that may not be fit for purpose."

The widespread installation of LEDs has taken place in a relatively short pace of time due to the rapid development of light technology and without assessment for environmental impacts. UNESCO's Earth Charter states the prevention of harm before it happens "*is the best method of environmental protection. When knowledge is limited, apply a precautionary approach:*

- *Take action to avoid the possibility of serious or irreversible environmental harm even when scientific knowledge is incomplete or inconclusive.*
- *Place the burden of proof on those who argue that a proposed activity will not cause significant harm, and make the responsible parties liable for environmental harm."*

With an increasing amount of research starting to question the suitability of high efficiency blue-rich light, there appears to be grounds to take a more considered approach. From the dark sky friendly view, light in the blue portion of the spectrum is more readily detected when we use our more sensitive dark-adapted vision – this

can lead to light pollution from more distant sources appearing worse in dark sky areas.

Legislation on Light Pollution

Despite hosting two internationally recognised dark sky areas, with others about to join the list of dark sky assets, Ireland has no legislation in place to protect these national treasures. Nor do we have any protection in place for our citizens who are subject to light trespass on their own properties or indeed limits of the amount of light emitted.

In the UK, residents have a channel for recourse to protect themselves from light pollution under Section 102 of the Clean Neighbourhoods and Environment Act (2005) (example below⁷).

Central Europe has been somewhat more progressive with 2019 legislation passed in France to set standards for the protection of night skies through the controls on emission of light in outdoor spaces. There are significant restrictions on the blue-rich light, limiting correlated colour temperatures to (CCT) to <3000 kelvins with lower thresholds for protected areas such as nature reserves.

In February 2019, the European Union adopted a new “Green Public Procurement Policy” on Road Lighting, which supports limitations on LED emitting white-light and introduces a lighting principle of “As low as Reasonably Achievable” (ALARA) in determining levels of illumination.

Austria has produced guidelines also for public lighting and the protection of naturally dark areas, using warm toned LED lighting that is ecologically sensitive as well as dark sky friendly and energy efficient. In Slovenia legislation in the form of a light pollution decree has been in place since 2007 to limit upward light in public areas as well as commercial lighting, curfews on sports ground lighting and guidelines for illuminating heritage buildings.

It is Dark Sky Ireland’s position that Ireland should implement appropriate legislation to address light pollution and its impact on our environment and citizens.

⁷ https://www.maldon.gov.uk/info/20097/nuisance/9122/artificial_light/4

The Benefits of a Dark Sky Friendly Lighting Policy

There are multiple benefits to implementing dark sky friendly policies throughout our society, affecting some of the most important subjects in our lives

Energy: Policies that promote dark skies are tied directly to reducing the consumption of energy by promoting appropriate and efficient outdoor lighting technologies. These policies not only control the types of outdoor lighting that may be installed by various public and private entities, but also determine appropriate lighting levels and warranting conditions for light (whether lights may be installed in certain areas and/or operated during particular hours of day).

Economics: Implementing appropriate lighting in policy and planning will assist authorities to meet targets for cost savings as well as assisting individuals and communities to make financial savings through responsible lighting. Curtailing or reducing light use (“trimming and dimming”) saves more money than improvements in lighting technology alone.

Ecology: Wildlife is all around us, whether we live in urban or rural settings. Choices made by various jurisdictions about outdoor lighting impact all species and are especially important for locations in or near sensitive habitats. Bad lighting policies can have lethal consequences for wildlife, but good policies can actually help restore healthy urban ecosystems.

Human Health: The preponderance of available scientific data suggests that exposure to artificial light at night presents potential risks to human health. Local authorities can limit residents’ exposure to artificial light during their outdoor nighttime activities while providing adequate light levels to ensure safety and security.

Public Safety: Poorly designed and/or installed outdoor lighting is a known hazard to motorists, bicyclists and pedestrians in transit at night. The same policies that keep nighttime skies dark can also reduce glare and put the right amount of light in the right place and at the right time to ensure the safety of all.

Crime: The notion that the preservation of dark skies requires turning lights off and compromising security is not supported by scientific evidence. Over-lighting outdoor spaces at night in the belief that lighting deters crime can actually create favourable conditions for crimes of opportunity. Our vision is based around contrast and good policies that protect dark skies enhance security by reducing glare, attenuating harsh lighting that creates shadows, and retaining the element of surprise through the use of adaptive lighting controls.

Culture & Heritage: Natural night skies have inspired artists, musicians, writers and philosophers for many years. By protecting our natural night skies, we retain links with our culture and heritage as well as creating opportunities for future generations of creative Irish citizens to take inspiration from a natural night sky above.

Tourism: As travellers seek new experiences, dark sky places offer visitors a rare opportunity to experience a clear, unpolluted view of the stars. Astro-tourism offers rural communities and local providers new sustainable opportunities to attract visitors during quieter, winter months – which are an ideal time for stargazing.

Education: By including dark sky and programmes into education, not only offers young people an introduction to astronomy; but also offers the potential to expand learning into a multi-disciplinary themes including environment and energy conservation.

Health & Wellbeing: Excessive light can interrupt our sleep as well as our enjoyment of our homes at night. Dark sky friendly lighting policies, enhance residential areas with visually attractive, shielded light that allows citizens to enjoy safely lit streetscapes and undisturbed starry skyscapes at the same time.

Toolkits and Guidelines For Local Authorities:

TYPE & COLOUR

Local authorities should give careful consideration to the type of Light-Emitting Diodes (LED) lighting they use and consider the potential impacts that higher temperature blue-rich lighting has on ecology and on human health. New LED streetlights should have a correlated colour temperature of 2,700 kelvins or less as a default specification with exceptions justified, and all lights should be fully shielded. Fully shielded lights mean that light is not radiated above the horizontal from the light source.

TESTING

Include lighting impacts in all Environmental Impact Assessments. Testing new street lighting ‘in situ’ (i.e. after-dark) before new schemes are rolled out in wider areas to ensure that it is suitable for the task and does not cause a nuisance to residents.

POLICY

Local authorities should have a policy to control light pollution in their Area/Local Development Plans. This policy should include identifying existing dark areas that need protecting.

ZONES

Local authorities should consider adopting Environmental Lighting Zones into their lighting policy to ensure that the appropriate lighting levels are used in each zone, with very strict requirements applying in identified dark areas.

TIMING

Set a preference for trimming (part-night lighting) schemes over dimming, in consultation with communities.

PUBLIC EXAMPLES

All public buildings and car parks should lead by example; lighting only where and when necessary and using responsible, dark-sky friendly lighting. Lighting on new buildings should take account of light trespass, glare and with maximum correlated colour temperature of 2,700 kelvin.

PROTECT

There should be a strong presumption against new lighting in naturally dark areas. With commitment to preserve and protect existing dark sky areas.

Toolkits and Guidelines For Residential and Commercial Lighting:

Before installing new lighting fixtures, it is important to identify exactly what area you are intending to light, how often it needs to be lit and for how long the light needs to be turned on.

Mis-directed or excess light can often mask the area it is intending to illuminate, sometimes even assisting criminals to conduct their activities. However, lights that are correctly positioned without glare, can enhance property features and provide just the right amount of light at the right time.

Traditionally most people are used to buying light bulbs (lamps) with the light output graded in units of watts (W). Watts are a measure of electrical power, not light intensity. With a larger range of lamp types, a better measure is the 'lumen' (lm) output of a bulb as provided by the manufacturer. This is a measure of the total amount of light emitted from a source that lies in the most sensitive part of our vision. Dark Sky Friendly domestic lighting should be no more than 600 lumens and often around 150-200 is perfectly adequate.

The conversion table below identifies the approximate lumen output emitted from light sources of varying wattages. Note that more efficient lamps emit the same amount of light with less electricity used.

Approximate lumen output emitted from light sources of varying wattages

BRIGHTNESS (lumen)	220+	400+	700+	900+	1300+
Standard Bulb 	25 W	40 W	60 W	75 W	100 W
Halogen Bulb 	18 W	28 W	42 W	53 W	70 W
CFL Bulb 	6 W	9 W	12 W	15 W	20 W
LED Bulb 	4 W	6 W	10 W	13 W	18 W

Figure 4: Northumberland National Park Lighting Guidelines

Floodlights and Security

Floodlights are expensive to run and very inefficient, shining light over a wide area rather than just where it is required and, in some cases, creating dark shadows in the illuminated areas. Home security lights are often 10-20 times the power required in a typical domestic setting. In most case a 10w power is perfectly sufficient and lumens is the measure of brightness output.

Garden Lights

Artificial light at night can impact nocturnal pollinators, mis-directing them away from their role in the eco-system and thus affecting biodiversity. The colour of outdoor lights is especially important and we recommend avoiding those with high blue-rich colour content (eg over 2,700kelvin).

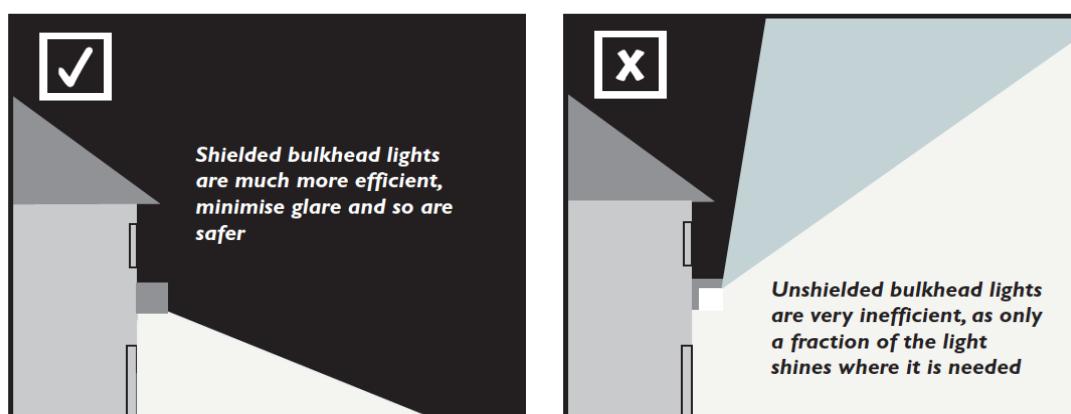


Use low level fully shielded lights to illuminate pathways with warm rich colour and ensure all outdoor /ornamental lights are not left on overnight.

Subtle fairy lights are typically low in luminosity and add to atmosphere, however, again we would recommend only opting for warm coloured light and avoiding blue/purple/bright white lights with a high correlated colour temperature.

Fully Shielded Lights

Fully shielded lighting fixtures prevent light being wasted into the sky and are becoming increasingly popular due to their efficiency and because they direct light to its intended purpose only, allowing less power to be used. Fully shielded lights mean that light is not radiated above the horizontal from the light source.



Examples of Dark Sky friendly (fully shielded outdoor lights):



In both the above cases the lights illuminate the area intended, subtly and without glare. Both use very low wattage power and a welcoming warm light.

Bulkhead Lights

Unshielded bulkhead lighting (wall packs) should be avoided, since the majority of the light actually shines into people's eyes, causing glare, which can actually make an area less visible and also light pollution and light trespass.

Examples of non Dark Sky Friendly unshielded lights commonly seen:



In both of the above cases, light escapes in all directions, creating glare, dark shadows and allowing light to travel behind its intended use. These types of lights are a common cause of neighbourhood complaint.

Commercial Premises

Lighting on shop fronts and on commercial premises is more effective if directed downwards to illuminate window contents and the name of premises. Strip lighting is not recommended as it is often harsh and uninviting for the onlooker.

Recommendations for domestic/commercial lighting:

- Low wattage, well-directed lights save money and do a better job.
- Home security lights – less than 600 lumens and maximum 150W (higher power creates more glare & dark shadows)
- Use fully shielded fixtures so light does not escape above the horizontal - Unshielded bulkhead lights, no matter how low their luminosity, should never be installed.
- LED Lighting – chose warm temperature colour tones “warm-white” (less than 2,700 kelvins)
- Consider using a Passive Infra Red (PIR) motion sensor light to illuminate an area only when needed.
- Angle the light downwards, make sure it only illuminates your property and does not trespass to your neighbour.
- Do not "over" light. This is a major cause of obtrusive light and is a waste of energy.
- Dim or switch off lights when the task is finished. Generally a lower level of lighting will enhance the night time scene required for safety and security.

Toolkits and Guidelines For Heritage/Façade & Public Buildings:

The use of artificial lighting, particularly flood lighting, on historical heritage buildings can be excessive and a significant contributor to light pollution and light waste. In some cases the architectural beauty of the buildings design is literally overshadowed by excessive lighting and some poorly placed light fittings can have an adverse impact on protected wildlife species such as swifts and bats.

Ornamental lighting of public buildings, bridges, monuments and public spaces must prevent light from falling beyond the area intended to be lit, and should never be directed skywards. Architecturally sensitive tones such as passive, warm coloured lights should be considered before blue-rich white lights, and only where deemed necessary.



Figure 5: Well designed heritage lighting

Lights should be adapted to the size and location of the object intended to be lit. If necessary, visors, shields, deflectors and cowls should be installed to guarantee lighting is limited to only the area of focus (see illustration below). The use of floodlights on heritage buildings is not recommended, not only do they bleach the façade and architecture, but they often dazzle visitors exiting the building with excess glare.

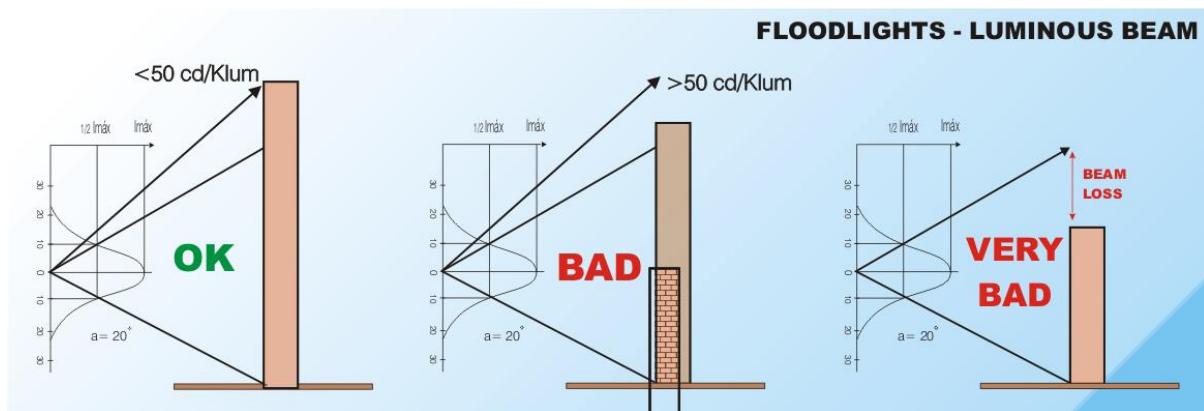


Figure 6; Designing ornamental & Decorative Lighting

Considerations for Lighting Heritage /Public Buildings

- Avoid flood lighting buildings. Light should be designed as part of an architectural feature and used creatively.
- Consider the distance and general direction from which the object or building is typically observed.
- The light source (eg fixture bulb) should not be visible if light is installed correctly to enhance the features of a building.
- Avoid potential inconveniences to other users of the surrounding area (intrusive light, glare).
- Consideration for Wildlife (eg. bats, moths, swifts and other species impacted by artificial lighting).
- Ornamental lighting position, aiming and optics.
- Lighting levels according to recommendations and the colour of the object to be lit.
- Energy saving, timers and installation switch-off.
- Light fixtures installed near rivers and waterways will need special attention to take account of water reflection and the impact of light on marine life.

Thank you for taking the time to review this information, we hope you have found it useful. Our group contact and document reference materials are below:

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Kerry Dark Skies Group
Lough Gur Heritage Centre
Armagh Observatory

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