Environmentally Friendly Lighting Guide

Funded by
An Chomhairle Oidhreachta
The Heritage Council

DARK SKY IRELAND

dark source

Dark Sky Ireland is a non-governmental organisation dedicated to ensuring Ireland's nightscapes are celebrated, restored and protected for present and future generations of all living things. It recognises the significance of reducing light pollution and its impact on our environment, wildlife, and human health. By raising awareness and advocating for responsible lighting practices, Dark Sky Ireland aims to create a sustainable future where everyone can enjoy the wonders of a dark, star-filled sky. Dark Sky Ireland's work is crucial as it not only enhances our connection to the natural world but also contributes to scientific research, promotes energy efficiency, and fosters a sense of tranquility and well-being in our communities.

This handbook is produced by the lighting design studio, ***Dark Source*** in collaboration with the Dark Sky Ireland for:

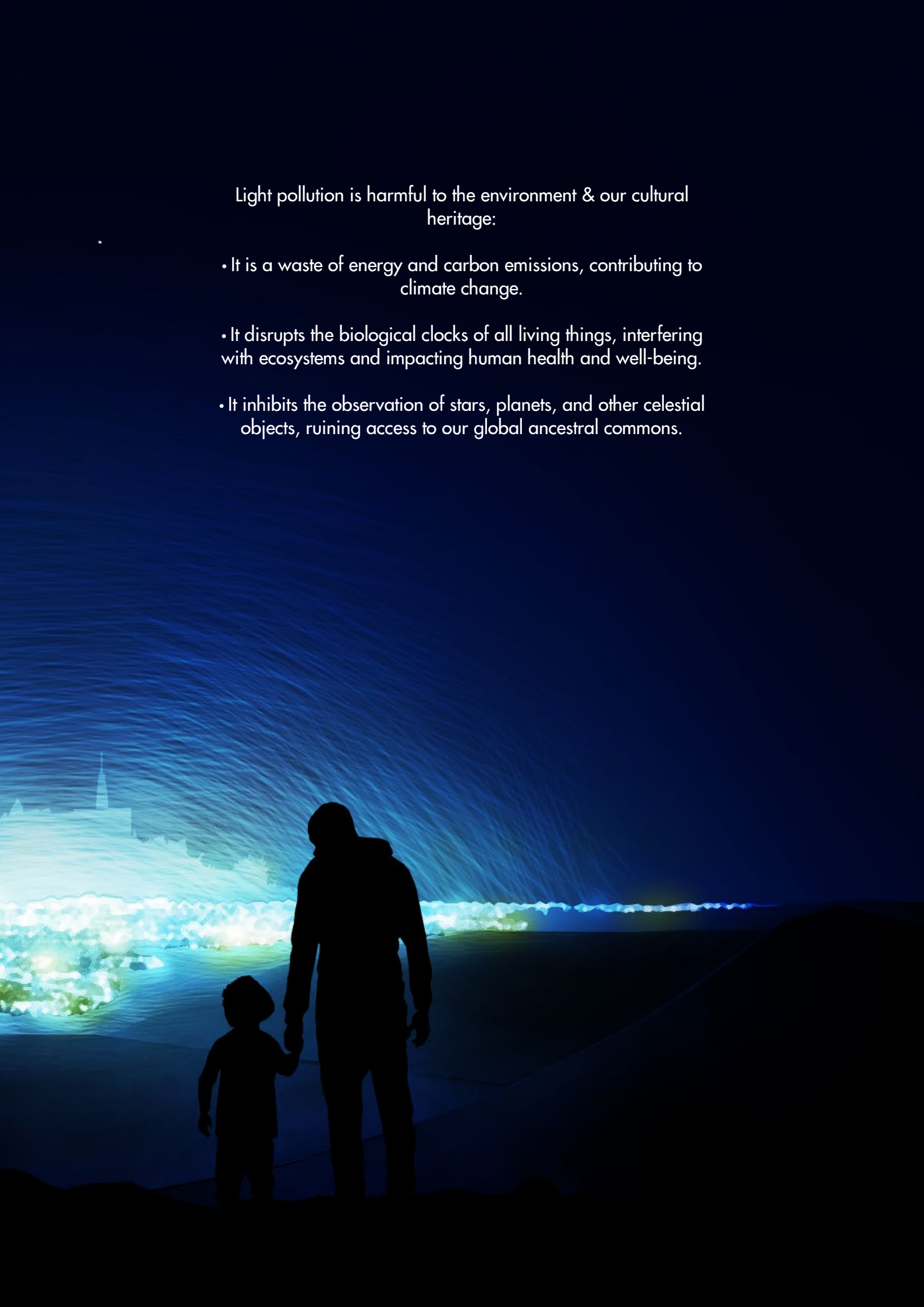
- friends of the natural environments of Earth and sky,
- installers of considerate lighting,
- campaigners against the misuse of artificial light,
- and those adversely affected by light pollution.

Light pollution is harmful to the environment & our cultural heritage:

- It is a waste of energy and carbon emissions, contributing to climate change.

- It disrupts the biological clocks of all living things, interfering with ecosystems and impacting human health and well-being.

- It inhibits the observation of stars, planets, and other celestial objects, ruining access to our global ancestral commons.



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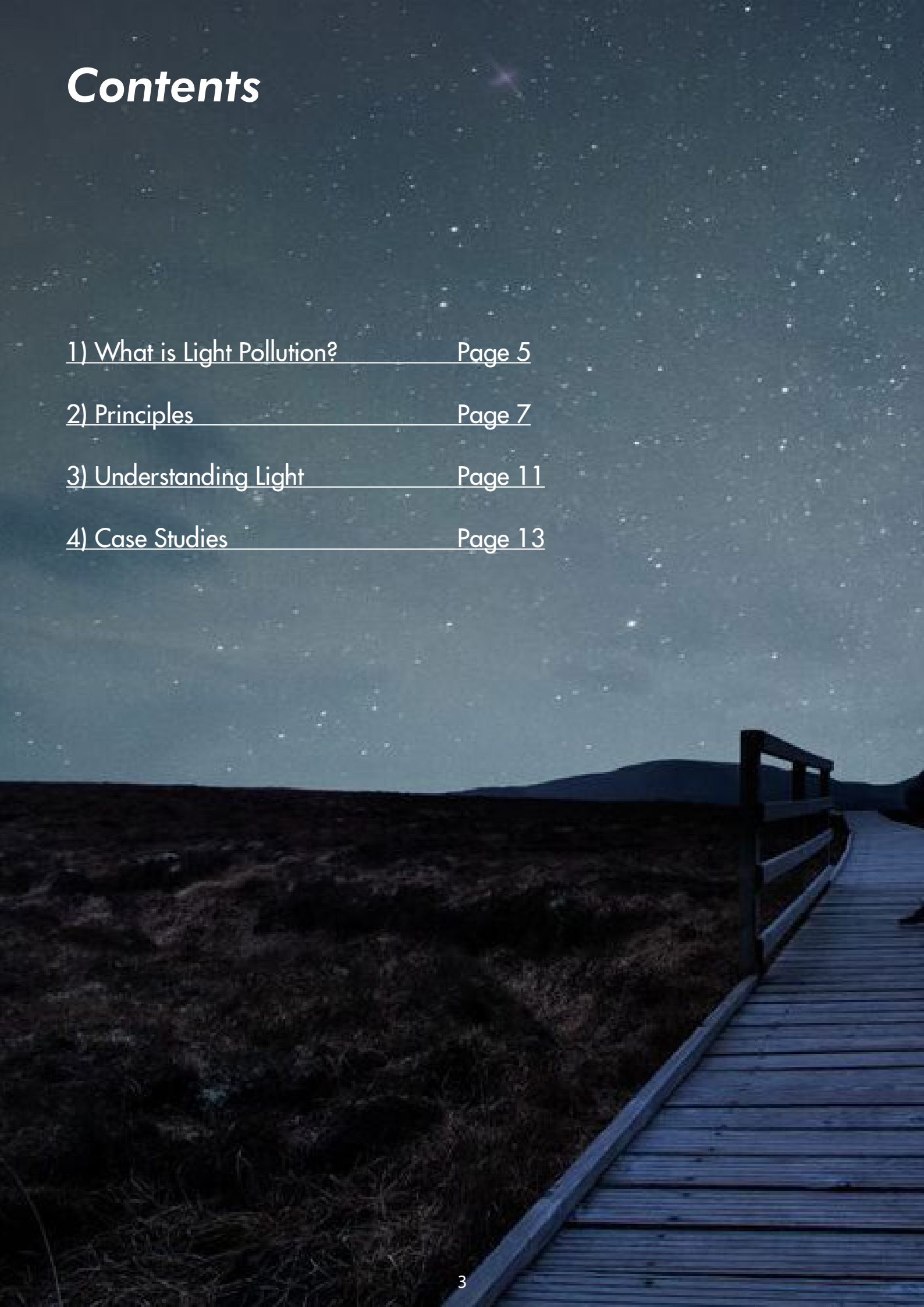


1) Introduction: The Problem

What is Light Pollution?

Life on Earth has lived and evolved without the presence of human-made light for billions of years. Humans, flora, and fauna operate on daily cycles of night and day – biodiversity depends on this balance in order to thrive. In only a few decades, artificial light at night has become a prominent source of pollution, harming the health and well- being of humans, disrupting entire ecosystems, and damaging our cultural heritage with the night sky.

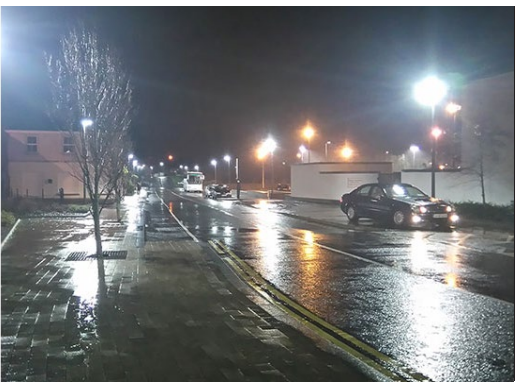
Light pollution is the brightening of the night sky, due to human-made lighting, and is especially significant in urbanised areas. Artificial light at night has a disruptive effect on the biological clocks of all living things and inhibits the observation of stars, planets, and other celestial objects. Light pollution is artificial light that's excessive, obtrusive, harmful and ultimately wasteful in electricity. The types of light pollution area:

Skyglow is a diffuse brightening of the night sky due to excessive illumination.

Glare is an intense and blinding light that reduces our ability to see.

Light Intrusion is caused by light falling where it is not intended or needed.

The impacts of artificial light at night can be summarised in three main aspects:



Socioeconomic
Inefficient lighting is a waste of money, energy & carbon emissions. Light pollution degrades the qualify of life and visibility by creating uninviting places at night.

Ecological
Artificial light at nigh affects the circadian rhythms of living things and disrupts the habits of species, such as foraging, reproduction, pollination, and drives their decline.

Physiological
Blue light suppresses the production of melatonin, the hormone which governs our sleep cycle. Disruption of this cycle has been proven to lead to a range of health conditions.

The night does not only prescribe a period of time, it is also a realm we inhabit. The experience of the night is a subjective term which is defined by the context. This diagram conveys that there is plenty to improve as well as to protect within Ireland.

2) Principles

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THE RIGHT LIGHT,
IN THE RIGHT PLACE,
AT THE RIGHT TIME.

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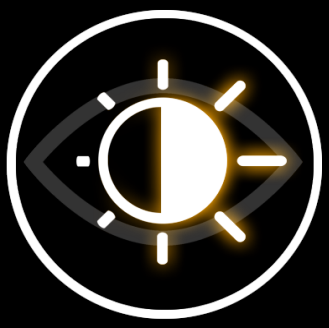

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1.Use light only when necessary.
Illumination that is not meant for any particular reason or purpose is excluded.

2. Choose warm colour temperatures.
≤ 2,200 Kelvins should be used as warm colour temperature is least harmful for both the wildlife & the night sky.

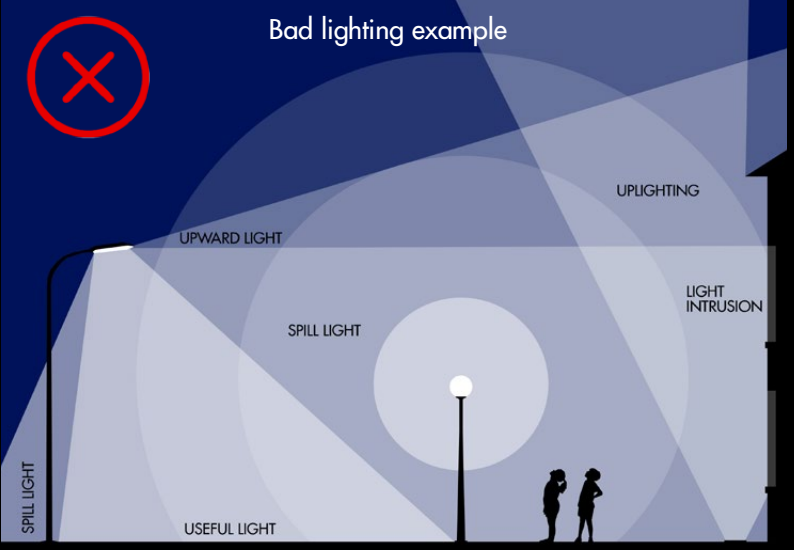
3. Minimise glare and brightness
Our vision is harmed when intense light glares. The design uses lighting sensitively & judiciously to ensure it's comfortable on the eye.

4. Angle it downwards.
The scheme avoids over lighting and clutter by directing light downwards and using the correct beam distribution.

5 Apply lower mounting height where possible.
Lower mounting height contains light more effectively which is utilised in the large majority of the project.

6. Use switch off, dimming or PIR sensors.
By employing remote control, dimming and PIR technology, lights are only on when needed in order to reduce carbon emissions and electricity bills.

7. Keep nature dark
A healthy natural world needs natural darkness to function. Avoid the illumination of wildlife; including trees, water bodies and potential nesting areas.



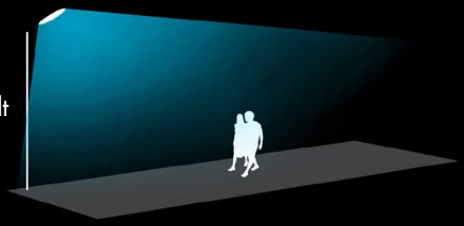
Light pollution is caused by the factors listed below:

- Light going upwards.
- Light trespass into or out of the houses.
- Use of cool colour temperatures.
- Unshielded & glary lighting.
- Intense light which gets reflected from the floor plane.
- Light left on throughout the night for no paricular reason.

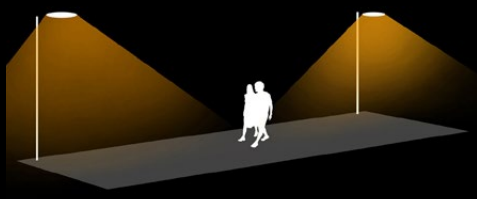
It can be eliminated through the measures below:

- Use the light where it is needed & in the amount it is needed.
- Shield the light & do not allow it to go upwards or sideways.
- Reduce glare through accessories or using the correct beam.
- Use warm colour temperature.
- Utilise dimming profiles, astronomical clock, photocell, lighting control systems or PIRs.

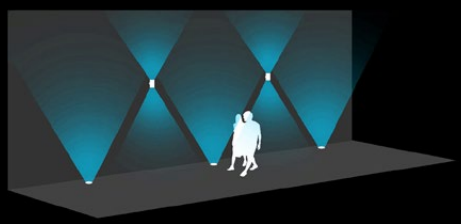
- Do not illuminate a large area with a single source. Don't mount lights higher than necessary. This will result in a steep tilt angle causing glare and light pollution.



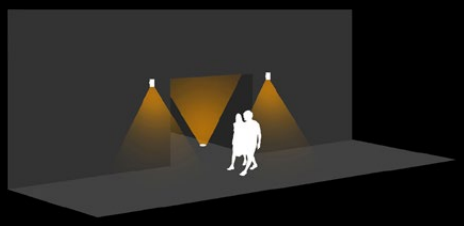
- Distribute the task between multiple down-facing lights mounted at low height. As long as the quantity is not excessive, this will help reduce light spill & glare.



- Do not uplight & floodlight unless the upward spill can be contained & controlled.

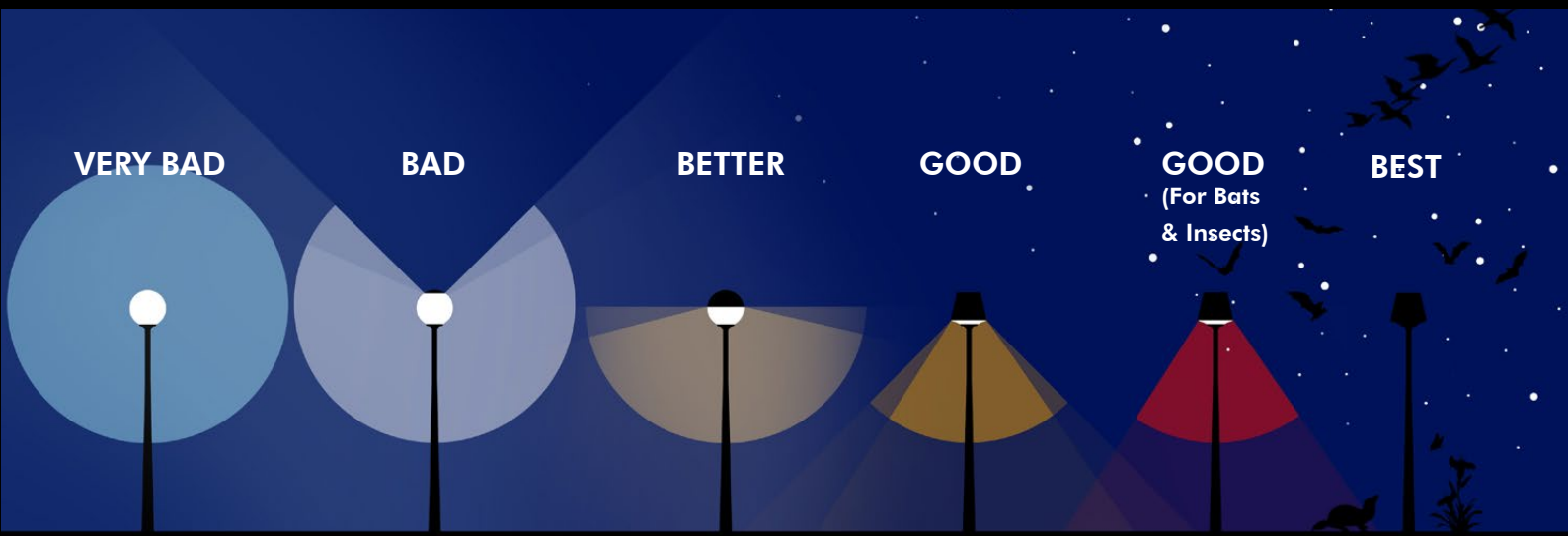


- Uplights & building-mounted light can be used if the spill can be contained & if they won't cause excessive illumination.

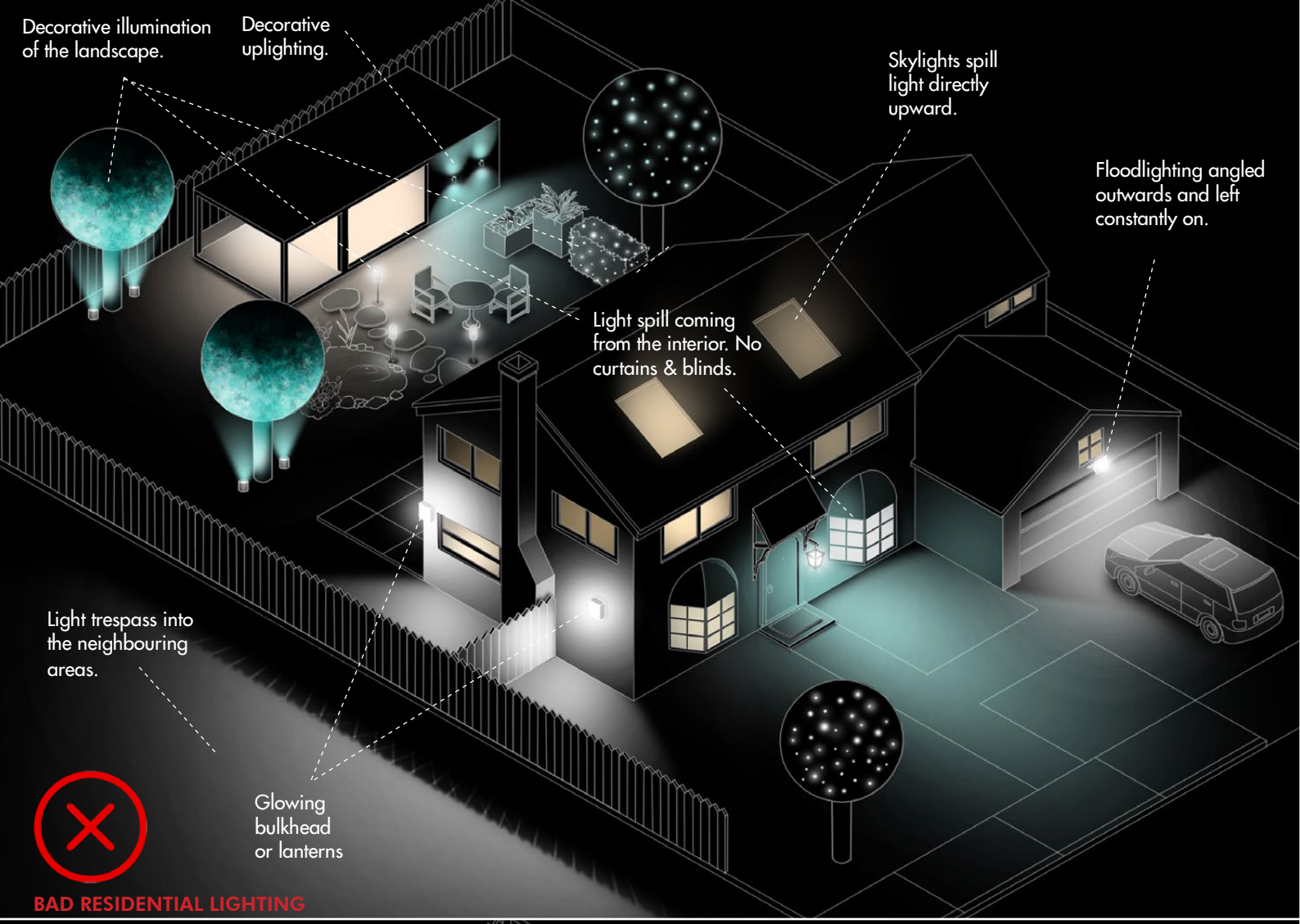


- Do not light planting for decorative purposes. Do not use glary & glowing lights.

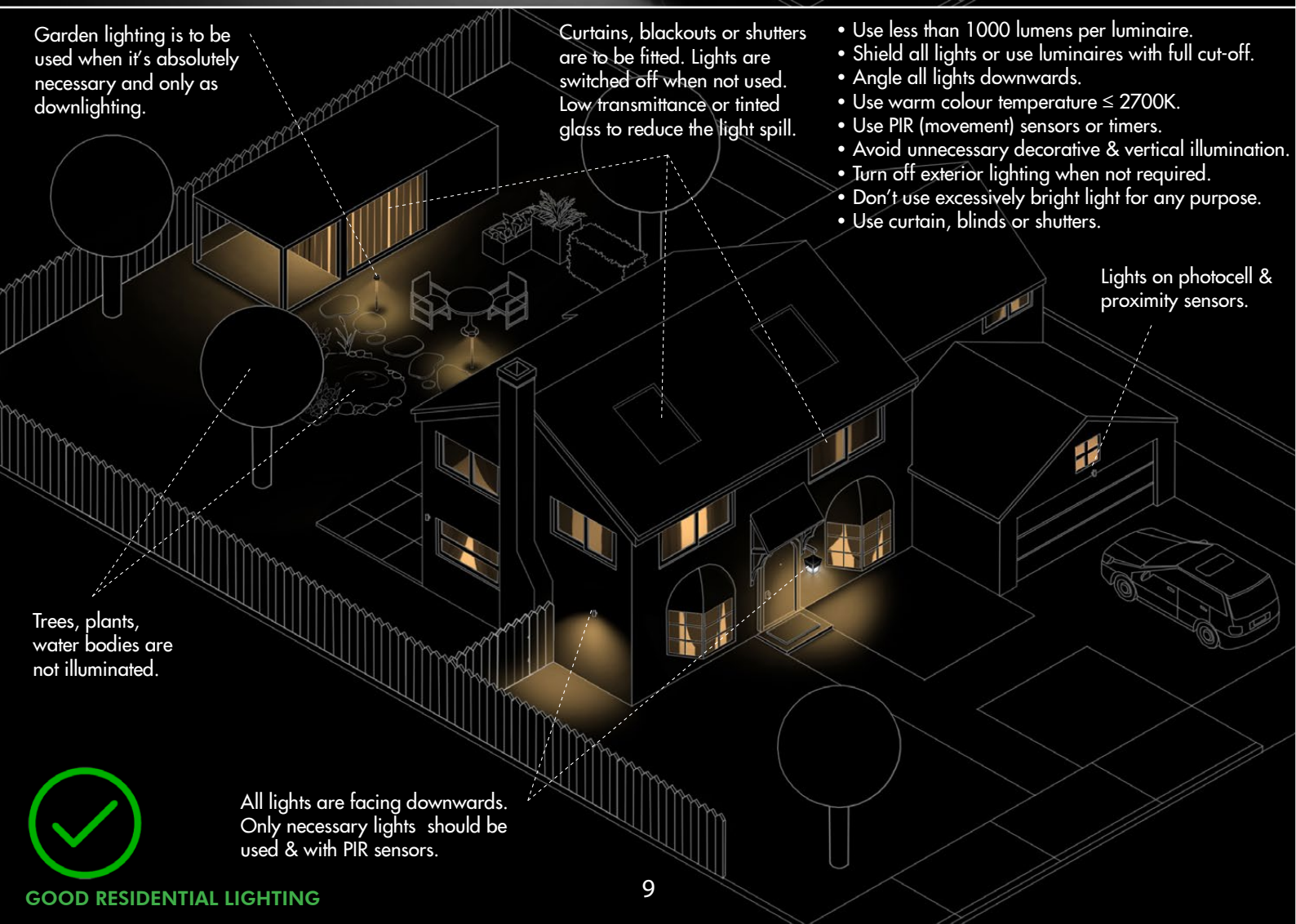
- Use low level lighting where possible. Don't overlight and keep the quantity low if you are not expected to meet certain lighting standards.



*Warm colour temperature, suitable power and intensity, appropriate beam distribution, mounting height and tilt angle employed with a dimming or switch-off schedule. See ***ILP GN08*** for bat-friendly lighting guidelines.



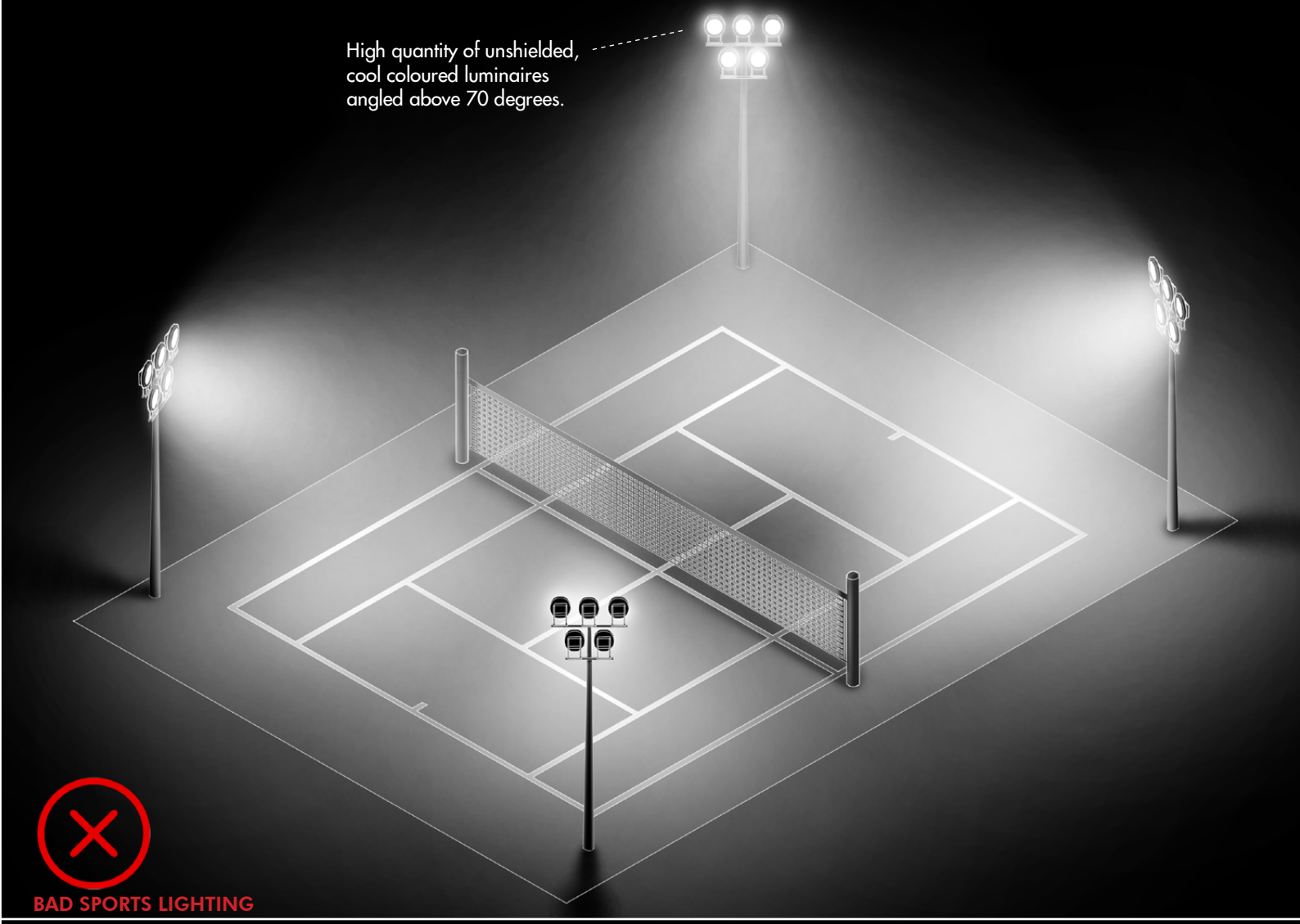
BAD RESIDENTIAL LIGHTING



- Use less than 1000 lumens per luminaire.
- Shield all lights or use luminaires with full cut-off.
- Angle all lights downwards.
- Use warm colour temperature ≤ 2700K.
- Use PIR (movement) sensors or timers.
- Avoid unnecessary decorative & vertical illumination.
- Turn off exterior lighting when not required.
- Don't use excessively bright light for any purpose.
- Use curtain, blinds or shutters.

GOOD RESIDENTIAL LIGHTING

High quantity of unshielded, cool coloured luminaires angled above 70 degrees.

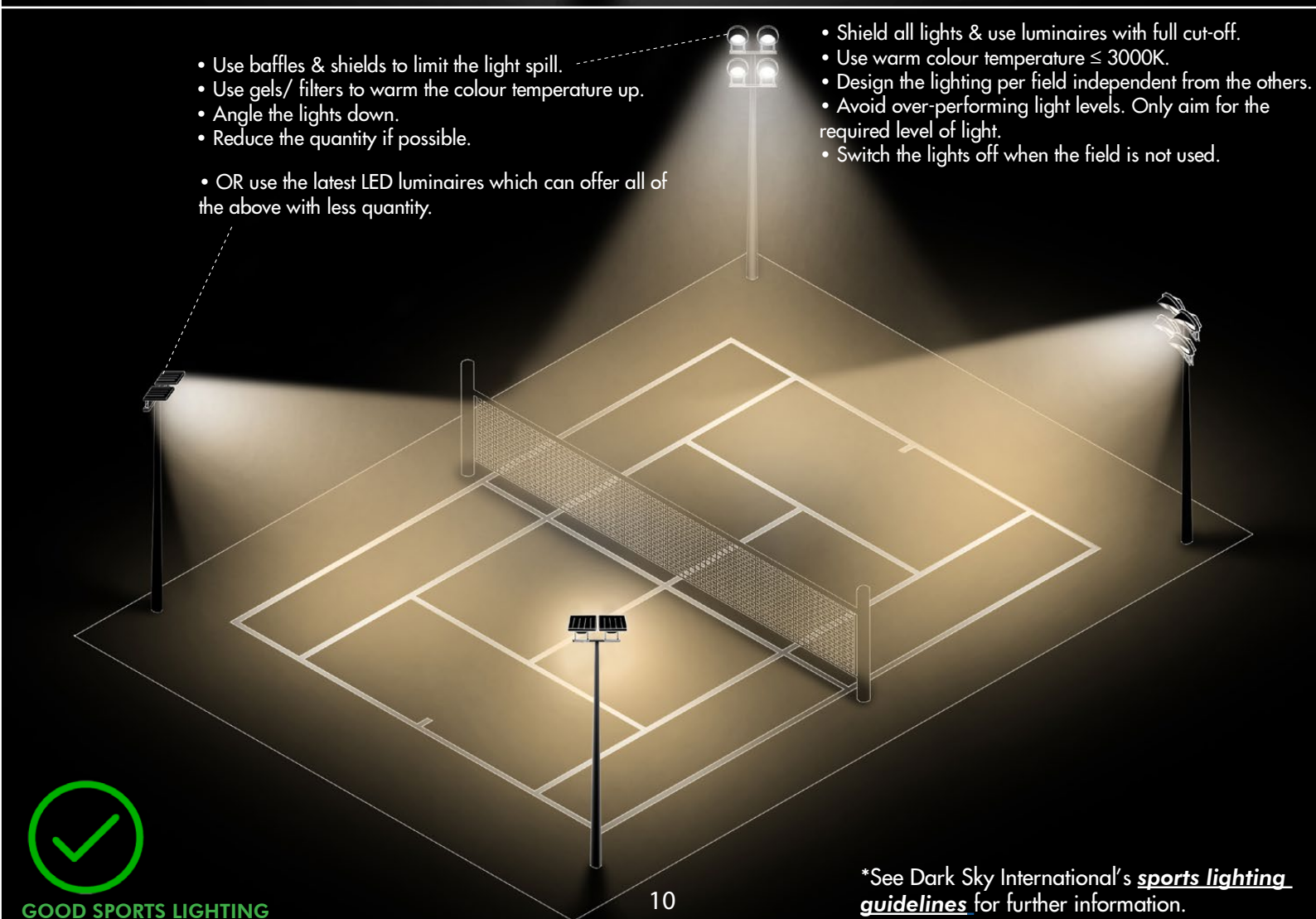


BAD SPORTS LIGHTING

- Use baffles & shields to limit the light spill.
- Use gels/ filters to warm the colour temperature up.
- Angle the lights down.
- Reduce the quantity if possible.

- OR use the latest LED luminaires which can offer all of the above with less quantity.

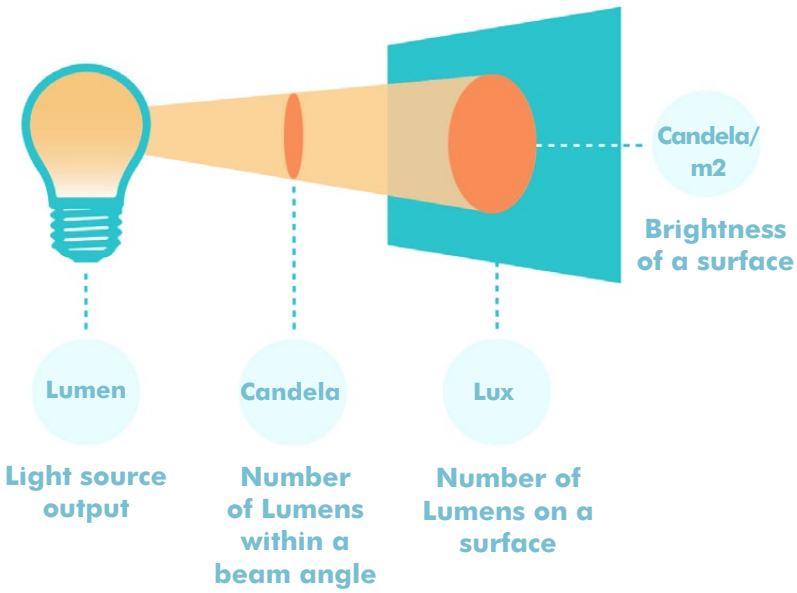
- Shield all lights & use luminaires with full cut-off.
- Use warm colour temperature ≤ 3000K.
- Design the lighting per field independent from the others.
- Avoid over-performing light levels. Only aim for the required level of light.
- Switch the lights off when the field is not used.



GOOD SPORTS LIGHTING

*See Dark Sky International's ***sports lighting guidelines*** for further information.

3) Understanding Light



Light is electromagnetic radiation which only a small portion of it can be perceived by the human eye. Some of light's properties are useful to assess its suitability:

Lumens (Luminous Flux): The total light radiated by a lamp. 500 lumens is sufficient for most domestic needs. Anything above must be shielded.

Candela (Luminous Intensity): The intensity of light in a given direction. A candle roughly emits 1cd of luminous intensity.

Lux (Illuminance) Lumens per m2: The illumination on a surface. A higher value lux means the illumination is brighter. 1lux is equal to 1lumen per square meter. Moonlight provides around 0.2 lux.

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Surface Brightness (Luminance) Candela per m2: The intensity of light emitted from a surface per unit area in a given direction.

LED is a semiconductor diode which glows when a voltage is applied. 21st century's most dominant & abundant lighting technology offers superior qualities but when not used right, it can have devastating impact on the environment.

It can be too bright and glary.
Blue-rich spectrum can be harmful.

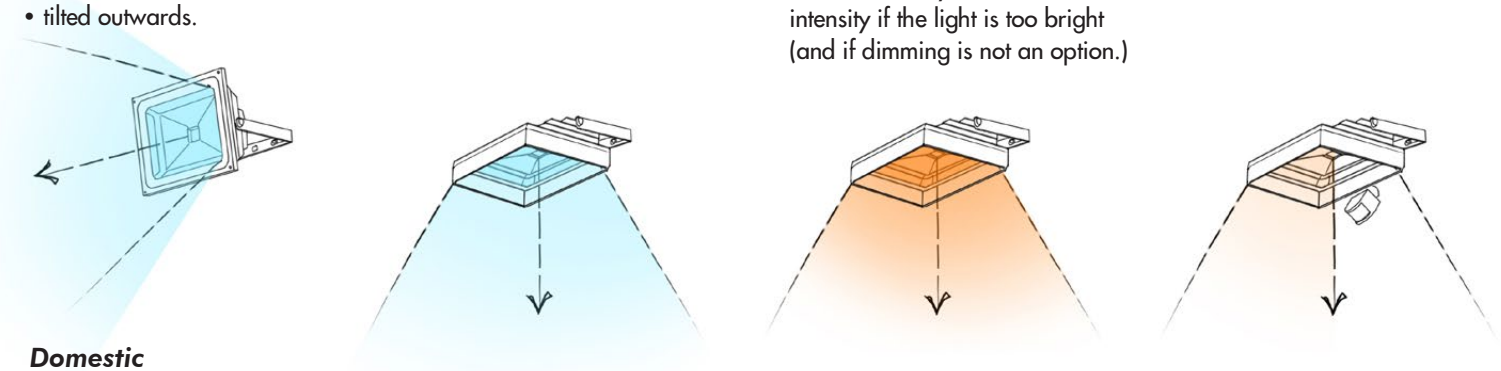
It's dimmable and programmable.
It can be offered in warm colour.

1) Don't use light:
- If you don't need it.
- too powerful for its purpose (≥ 40W)
- in cool colour temperature (≥ 2700K)
- tilted outwards.

2) Keep:
- it angled down.
- shield to reduce glare & beam distribution.

3) Use:
- gels & filters to warm the colour temperature (≤ 2700K)
- additional layers to reduce the intensity if the light is too bright (and if dimming is not an option.)

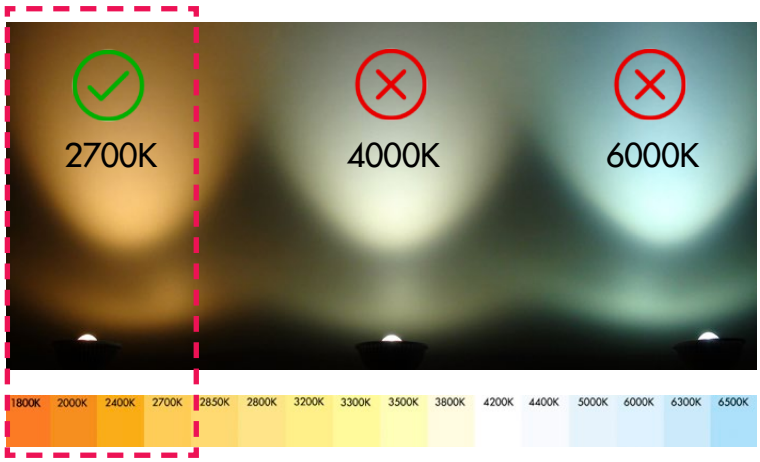
4) Apply:
- dimming or switch off at late hours.
- PIR sensors to avoid energy waste.



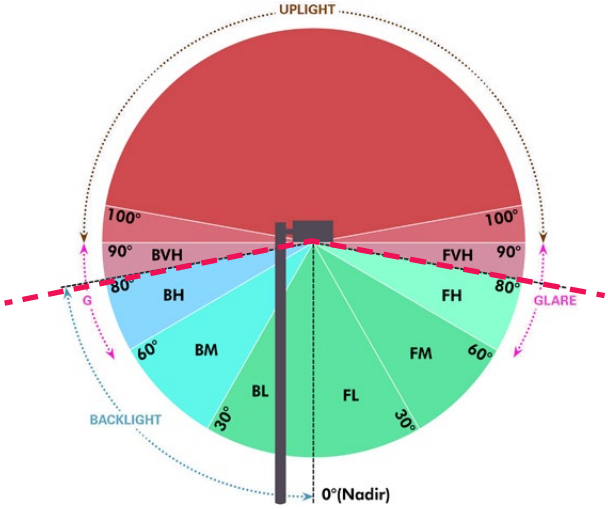
Domestic
Any luminaire that is: ≤ 2700K, ≤ 10W, ≤ 1000 lumens with ≤ 80° beam mounted at ≤ 3m, angled downwards, ideally with baffle & PIR sensor is acceptable.

Industrial
Any luminaire that is: ≤ 2700K, ≤ 40W, ≤ 4000 lumens with ≤ 80° beam mounted at ≤ 8m, angled downwards with baffle & PIR sensor would be acceptable.

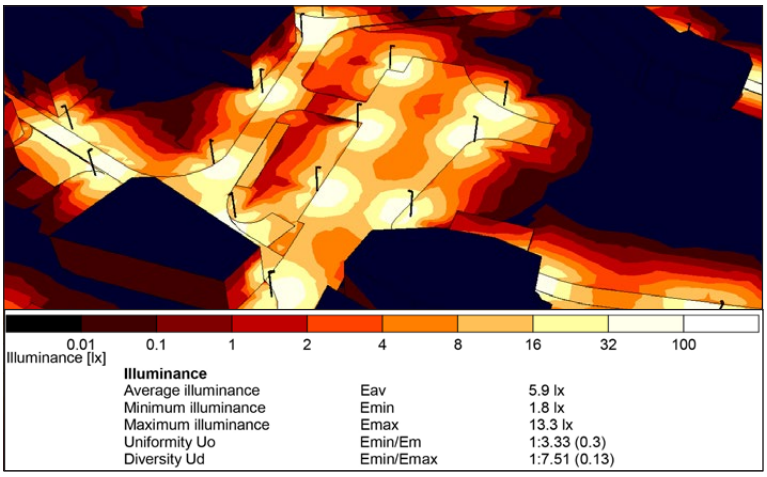
Important qualities of light:



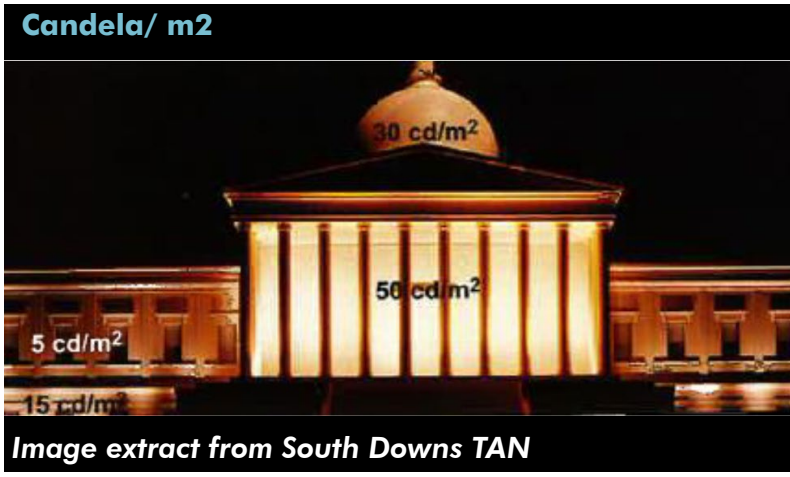
1) Colour Temperature is often referred to as the CCT of the source. Lighting ***should not have a CCT higher than 2,700K.*** Cool white (or the blue-rich) lighting is the most harmful to wildlife and humans. There is a substantial growing body of evidence that shows that the colour temperature, CCT of the lights can be particularly disruptive to circadian rhythms, sleep patterns and the production of melatonin.



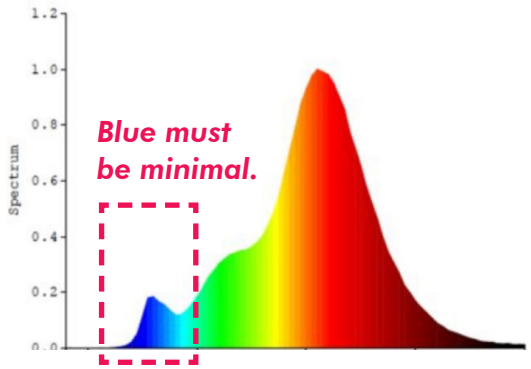
2) Light Distribution is a very important feature of a dark sky friendly luminaire. Light should only be projected downwards and luminaire's beam **should not exceed 80°**. Narrower the beam, lesser the glare. If backspill is not acceptable, the beam should be narrow & asymmetric. Zero ULOR (Upward Light Output Ratio) and Full Cut-off means that the luminaire does not emit any light above the horizon line.



3) Illuminance is used for describing the amount of light on a defined surface area. If the project is not expected to meet a lighting standard, lighting can be intermittent. Light levels of ***any lit surface should not exceed 5 lux average.***



4) Luminance is used for describing the brightness of vertical surfaces & luminous surfaces including media walls. High luminance means that the surface is bright or glary. Surface brightness of ***any lit layer should not exceed 100 cd/m2.***



5) Colour Rendering Index (CRI or Ra) is a quantitative measure of the ability of a light source to reveal the actual colours of an object or space. Broad spectrum should be avoided to eliminate the spill of harmful wavelengths, particularly in the Ultra-Violet which affects wildlife. Exterior lighting CRI **should not exceed Ra90.** The spectrum example shown above is 2200K Ra80 CRI.

6) Energy Efficiency is an important feature of the LEDs. It ***should not drop below delivered total of 40 lumens per watt*** to avoid waste & to maximise the efficiency which LEDs can offer. Any luminaire greater than 10W of power consumption, ***must be dimmable and programmable.***

4) Case Studies

70% Reduction

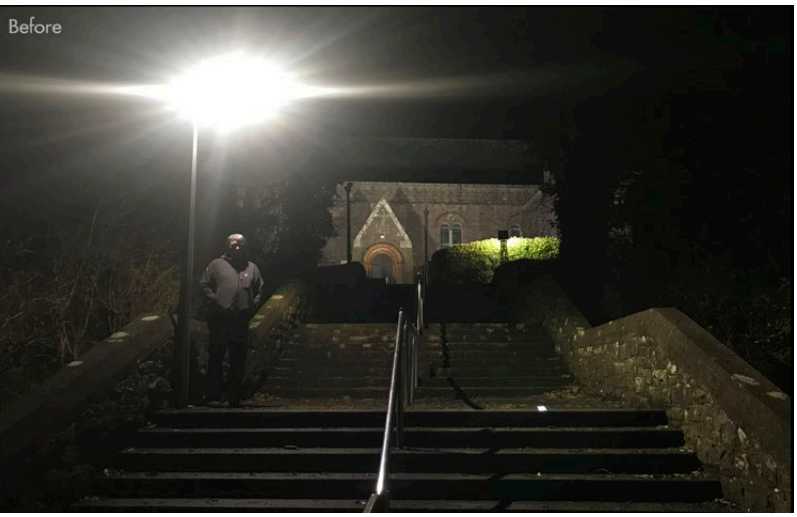
4,200 kWh

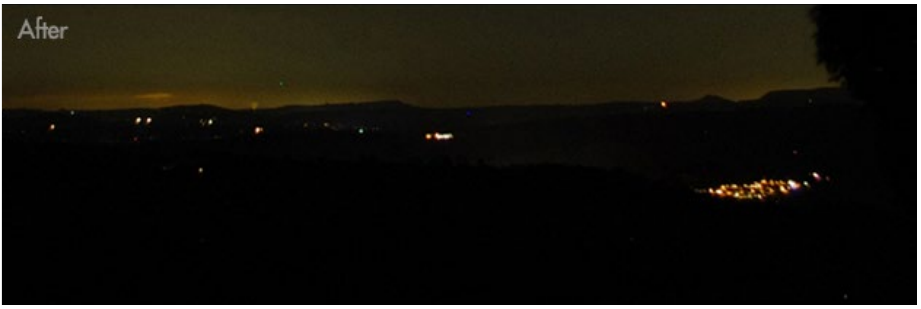
1 Tonne of CO2e

€1,806
(43c/kW)

0.6 Billion lumens

Located in Mayo, the new lighting of the St Patrick's Church forms the first phase of the Newport Dark Sky Masterplan. Working closely with the local community, the project aims to eliminate light pollution through the new lighting design but also balancing the visual, social & environmental objectives with the ultimate aim of protecting dark skies & enhancing night-time experience for both people & biodiversity. The consistently warm (2200K) new exterior LED lighting of the church has achieved 1 tonne of annual CO2e reduction. See the ***video***.





53% Reduction

19,710 kWh

4 Tonnes of CO2e

€8,475
(43c/kW)

2.4 Billion lumens

The towns of Presteigne & Norton are located in County Powys, Wales's largest and most rural county that borders England. A total of 380 lighting columns were refurbished with 2200K LED luminaires, with about half of them programmed to switch off and the rest to dim by 50% after midnight. The project which led to the first International Dark Sky Community in Wales has reduced the annual CO2 emissions by 4 tonnes. See the ***link***.

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DARK SKY
IRELAND