

LIGHTING GUIDE



MONT-MÉGANTIC
**INTERNATIONAL
DARK SKY
RESERVE**



TABLE OF CONTENTS

4	LIGHT POLLUTION
6	THE MONT-MÉGANTIC INTERNATIONAL DARK SKY RESERVE
8	THE IMPACTS OF LIGHT POLLUTION
16	WHITE LIGHT
18	BEST LIGHTING PRACTICES
30	TAKING ACTION
32	TECHNICAL APPENDIX

STARGAZING

It's one of humanity's very first activities, and certainly one of the most inspiring. When we stargaze, we're present for what is literally the greatest show in the world!

Yet today, this spectacle that unites us across cultures and history is critically endangered. 99% of the North American population is affected by the impacts of light pollution. Most children who grow up in cities and suburbs have never seen a real starry sky.

Is the legacy we want to leave future generations really a world without stars?

The starry sky is not just for astronomers. It belongs to all of us: our natural and cultural heritage.

Stargazing creates memorable moments, whether with family, friends, a romantic partner or on your own. It's an opportunity to see and feel the vast mysteries of the world from the shores of a lake or around a fire, or simply from your balcony, backyard or window.

We thank you for adopting the lighting practices presented in this guide and for doing your part to preserve the spectacle of the starry sky, so that future generations can look up and stand rapt in awe!

SÉBASTIEN GIGUÈRE

Philosopher of science and artisan of the Dark Sky Reserve

LIGHT POLLUTION

Light pollution refers to the excessive or inappropriate use of artificial light.

For most people, the natural light of the moon and stars has long been replaced with artificial light. Due to the unrestricted use of artificial light at night and installations that are often disproportionate to our actual needs, **light pollution and its harmful impacts are increasing around the world.**

These impacts can be seen in the modifications of the nocturnal environment, as well as all of the damage caused by artificial light on the visibility of the night sky, on local fauna, flora and ecosystems, and on our health and safety.

Reducing light pollution is as simple as lighting better.

The notion of reducing light pollution is often misinterpreted as removing all lighting at night, which is very far from reality. It is entirely possible to adequately respond to our need for lighting while limiting the negative impacts of artificial light at night.

Before installing or replacing a light fixture, determine if light is really needed. Making sure the light serves a clear and necessary purpose is the first thing to do.

If the light is really **USEFUL**, make sure it follows these **4 principles** to make it dark sky friendly:

ORIENTATION: Opt for a shielded light fixture that directs light only towards the ground, rather than one that sends light upward or towards the horizon.

COLOUR: Use amber and warm-coloured light sources.

INTENSITY: Use just the right amount of light for good visibility without unnecessary brightness.

TIMING: Limit the timing and duration of outdoor lighting so it is in use only when needed.

USEFUL

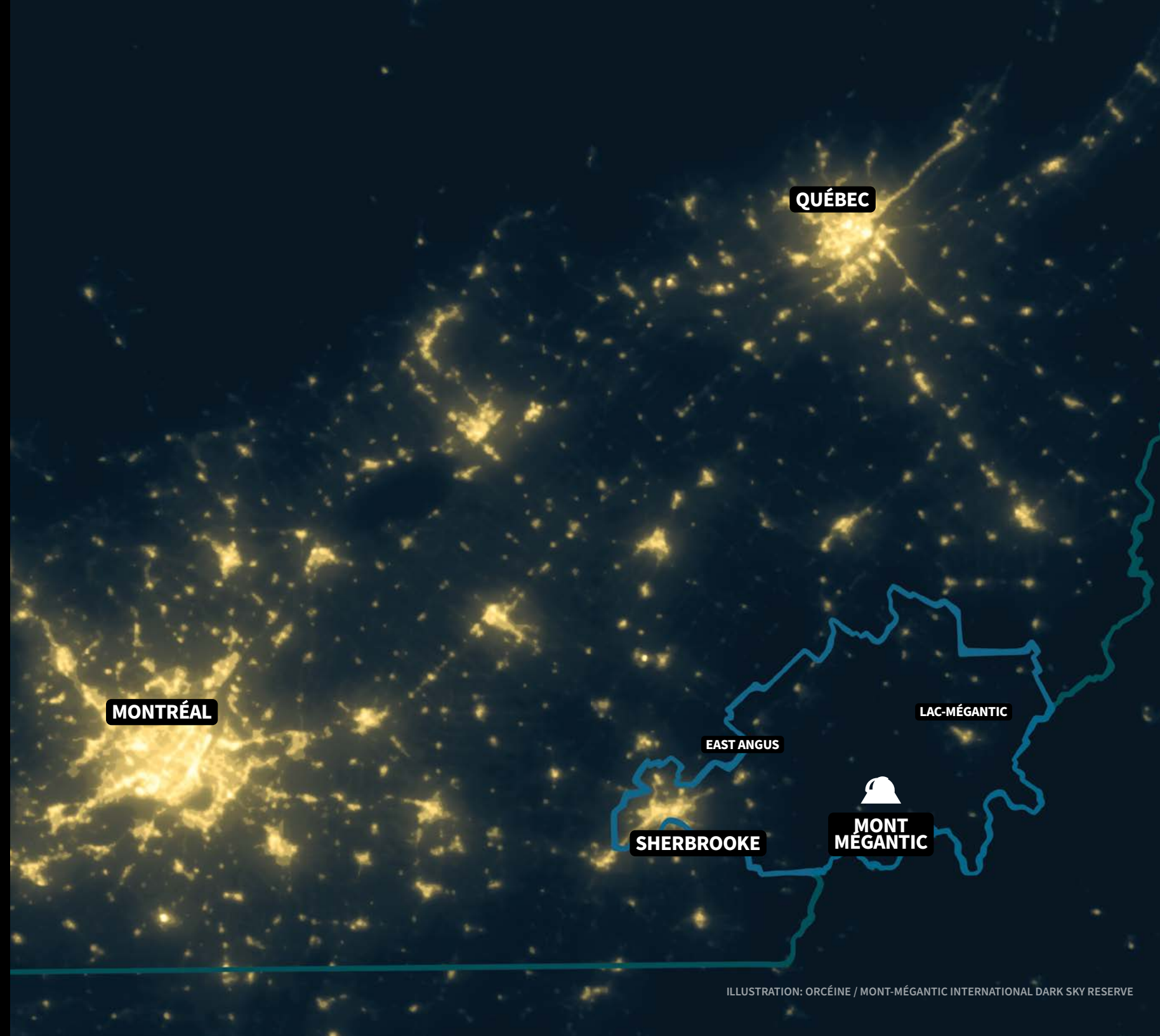


THE MONT-MÉGANTIC INTERNATIONAL DARK SKY RESERVE

As part of various initiatives around the world to reduce light pollution and protect the nocturnal environment, **the region surrounding Mont-Mégantic became the world's first International Dark Sky Reserve, certified by the International Dark-Sky Association (IDA) in 2007.**

Centered around the Parc national du Mont-Mégantic and the astronomical Observatory, the Mont-Mégantic International Dark Sky Reserve currently measures approximately 5,300 square kilometres.

Over 30 municipalities participated in reducing light pollution by passing regulations on outdoor lighting. Just prior to receiving its certification, thousands of public and private luminaires were converted, dramatically reducing light pollution at the centre of the Reserve while simultaneously helping the area save enormous sums on electricity year over year.



THE INTERNATIONAL DARK-SKY ASSOCIATION

The International Dark-Sky Association (IDA) works around the world to protect the night sky for current and future generations.

An international dark sky reserve is a large public or private land that provides an exceptional quality of starry nights and nocturnal environment that is specifically protected for its scientific, natural, educational, cultural, heritage and public enjoyment. Following the example set by Mont-Mégantic, several other reserves were created around the world, although they are still relatively rare given the nature and large scale of their territory.

CIVIL MOBILIZATION

Protecting the starry sky and nocturnal environment cannot be done without broad participation from the population. From its inception, the Mont-Mégantic International Dark Sky Reserve has enjoyed great support from citizens and elected officials.

By managing public lighting and enforcing the regulation on outdoor lighting, municipalities have a crucial role to play to ensure the future of this unique area.

Citizens of the Dark Sky Reserve not only have their part to play in protecting the night, but they are also the first to benefit from its outcomes.

THE IMPACTS OF LIGHT POLLUTION



SAFETY AND GLARE

Appropriate lighting helps us see and be seen when we have work or other obligations at night, thereby ensuring everyone's safety. However, it is a misconception that bright lights increase our safety, or that dim ones are dangerous.

Studies have shown that different strategies for removing or reducing road lighting did not have a significant effect on the number of collisions at night. Other studies have also demonstrated that there is no correlation between lighting at night and crime.

Artificial light can certainly help create a false feeling of safety, without actually increasing it. In fact, bright and poorly directed light creates glare, among other adverse effects. Poorly designed lighting systems actually decrease visibility and increase the risks of an accident.

To ensure good visibility, it's best to shield light sources and use warm lighting to minimize glare. That way, the eye can adjust to the ambient light and see better the surroundings.

HUMAN HEALTH AND SLEEP

Like most organisms on Earth, humans have a circadian rhythm. This cycle, which acts as a roughly 24-hour internal clock, regulates a multitude of important processes inside of our bodies. Melatonin, a hormone released at night by a gland located in the brain, is responsible for orchestrating all of these processes.



Medical research has demonstrated that artificial light at night deregulates the release of this hormone, modifying our sleep cycles and negatively influencing our immune systems as a result.

It is the blue part of light that can have an effect on our body.

The World Health Organization has officially recognized that disruptions to the human internal clock can be linked to health problems, from insomnia to cancer, depression, diabetes and obesity.

As such, it is very important to reduce the amount of light in our sleep environment and limit intrusive lighting as much as possible to prevent negative health impacts. When lighting is needed at night, it's important to prioritize warmer or amber-toned light sources.

THE IMPACTS OF LIGHT POLLUTION

WILDLIFE AND ECOSYSTEMS

The global increase in light pollution has led to an increasing encroachment on ecosystems. A growing number of studies confirm that all kinds of species are affected by exposure to artificial light at night and the alteration of natural cycles of darkness.

One thing remains clear: night is essential to life.

Plant life is all regulated by cycles of light and darkness: from germination to fruiting, or leaves dropping in the autumn. Excessive lighting disrupts these natural cycles, leading to consequences on species that depend on them.

Some species of bats are attracted to light and others avoid it, creating major changes in their collective nocturnal activity and their diet.

In bird species, changes in migration corridors, an obsessive attraction to light and disturbances in reproductive cycles are all examples of the impacts of artificial light on their natural behaviours.

Insects are especially affected by light fixtures, which attract and disorient them until they reach exhaustion. Any impact on insect populations naturally leads to repercussions on the many species that eat them and on the essential task of plant pollination.

In some reptiles and amphibians, such as salamanders and frogs, excessive light at night has a negative impact on their reproduction and destabilizes their populations. Aquatic species, such as fish, are affected by light and darkness at each stage of their life cycle: egg development, hatching, feeding, migration and spawning.

Large mammals are affected by light sources that act as barriers and split up their territories, creating changes in their movements and interactions.

THE IMPACTS OF LIGHT POLLUTION

ENERGY CONSUMPTION

In North America, the energy wasted by poor lighting systems totals over 3 billion dollars a year. When this energy is produced using fossil fuels, not only are we wasting energy, but we are also contributing to increased greenhouse gas emissions.

Using good lighting practices can easily reduce the energy used by more than 50%.

The sources of energy waste are manifold: light lost towards the sky, inadequate intensity, unnecessary light fixtures, lighting outside of periods of use, and more. This means the potential for savings is enormous. **By opting for better luminaires that direct their light where it is needed, it's possible to obtain the same levels of illumination at a considerably lower cost.**

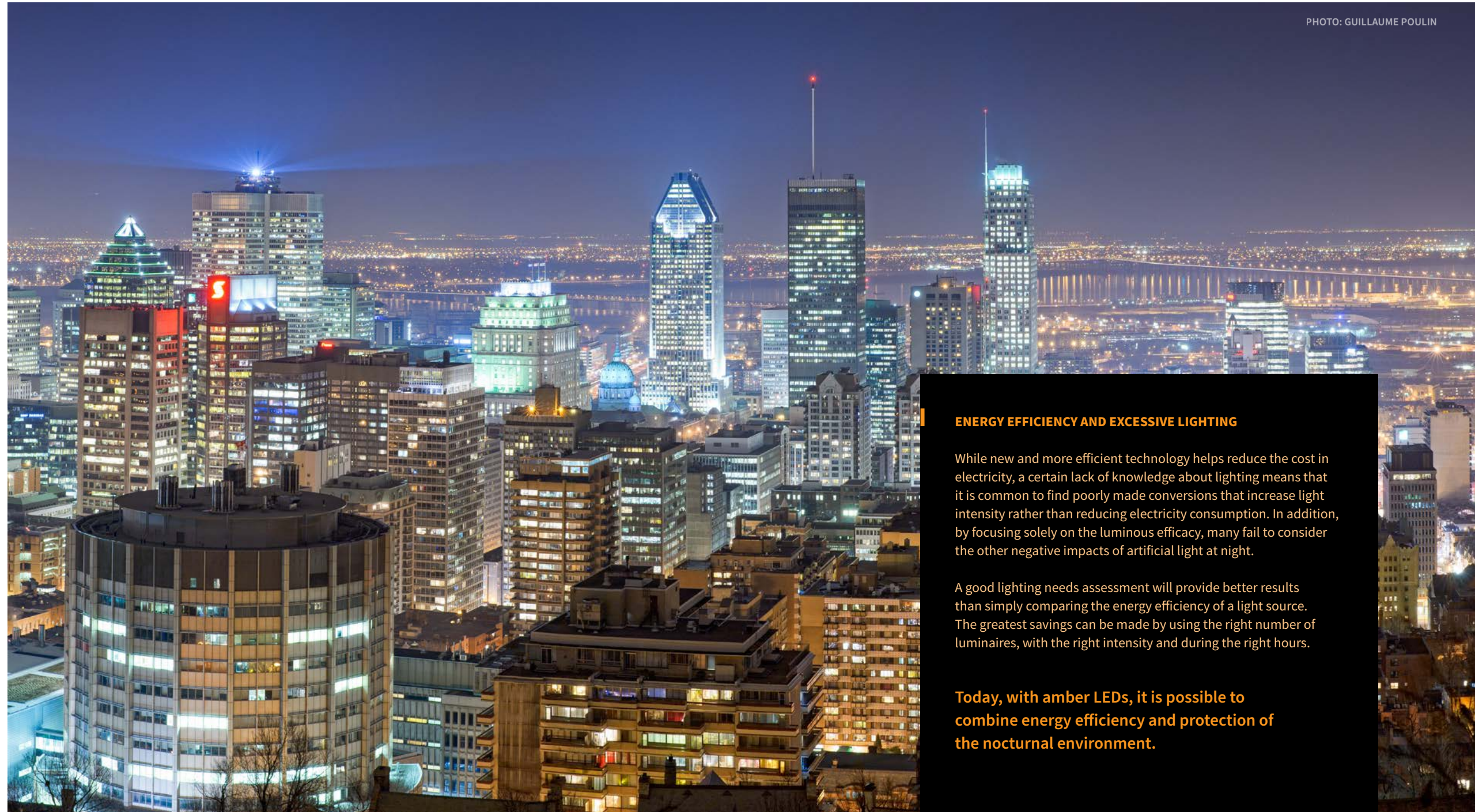


PHOTO: GUILLAUME POULIN

ENERGY EFFICIENCY AND EXCESSIVE LIGHTING

While new and more efficient technology helps reduce the cost in electricity, a certain lack of knowledge about lighting means that it is common to find poorly made conversions that increase light intensity rather than reducing electricity consumption. In addition, by focusing solely on the luminous efficacy, many fail to consider the other negative impacts of artificial light at night.

A good lighting needs assessment will provide better results than simply comparing the energy efficiency of a light source. The greatest savings can be made by using the right number of luminaires, with the right intensity and during the right hours.

Today, with amber LEDs, it is possible to combine energy efficiency and protection of the nocturnal environment.

THE IMPACTS OF LIGHT POLLUTION

LOSS OF DARK SKIES FOR SCIENTIFIC RESEARCH

Astronomers were among the first to notice the effects of light pollution when stars started to disappear. As the sky became less dark, stars, nebula, and galaxies became invisible, drowned out by light pollution.

How can we explore our universe and its origins if this great portal to knowledge is closing?

Many of our astronomical observatories are threatened by light pollution. The David Dunlap Observatory, the largest in Canada, was even forced to close its doors. Indeed, it was the threat of an increasingly light-polluted sky above the Mont-Mégantic Observatory that led to the dark sky reserve project.

Sky glow, caused by artificial light emitted toward the sky and the horizon, reduces the visibility of the stars. Suspended particles in the atmosphere (dust, aerosols, droplets) and gas molecules reflect and scatter this light.



PHOTO: RÉMI BOUCHER

LOSS OF OUR NATURAL HERITAGE

Over 99% of the Canadian population lives in a place where the night sky is affected by light pollution. For over three-quarters of us, light pollution is significant enough that we cannot see the Milky Way, nor thousands of other stars that are normally visible to the naked eye.

Artificial light has become so present in our nocturnal environment that the eyes of nearly half of the Canadian population no longer experience an adaptation to true darkness, which completely changes our relationship to the night, and that of the species that surround us.

Deprived of the beauty of the night sky and nocturnal landscapes, city-dwellers must travel far from urban centres in order to clearly see the Milky Way. In the world's large cities, fewer than 2% of stars are bright enough to be seen. The view of the pure and wondrous starry sky that our ancestors had is now reserved for only the most remote areas.



PHOTO: GUILLAUME POULIN

WHITE LIGHT

THE HARMFUL EFFECTS OF BLUE LIGHT

Light sources that appear white emit a significant proportion of blue light.

Blue light is an important issue for dark skies. Because it is more scattered by the atmosphere than warmer colours, blue light creates more sky glow and reduces the quality of astronomical observations.

Impacts on wildlife and ecosystems are also strongly linked to the spectrum of the light. Amber and warm-toned light generally has fewer impacts on species than white light.

In humans, blue light creates more glare and causes the pupil to constrict, reducing visibility. This glare can have significant negative consequences on safety. Because blue light leads to negative impacts on health and disturbs our circadian rhythm, it should be kept to a minimum in our nocturnal environments.

By choosing light sources with amber or warm-toned colours that emit a low proportion of blue light, it's possible to considerably reduce our impact on the natural environment, our health and the night sky.

BUG LIGHTS TO HELP INSECTS!



You can find yellow «bug light» bulbs in stores that can be used in most outdoor light fixtures. These bulbs emit very little blue light and thus are not especially attractive to insects. White light sources, in contrast, can attract hundreds of insects on a nightly basis. These insects will fly or crowd around the lights until they drop from exhaustion. Choosing yellow, amber or warm-toned bulbs means leaving the insects in peace!

Do LEDs automatically reduce light pollution?

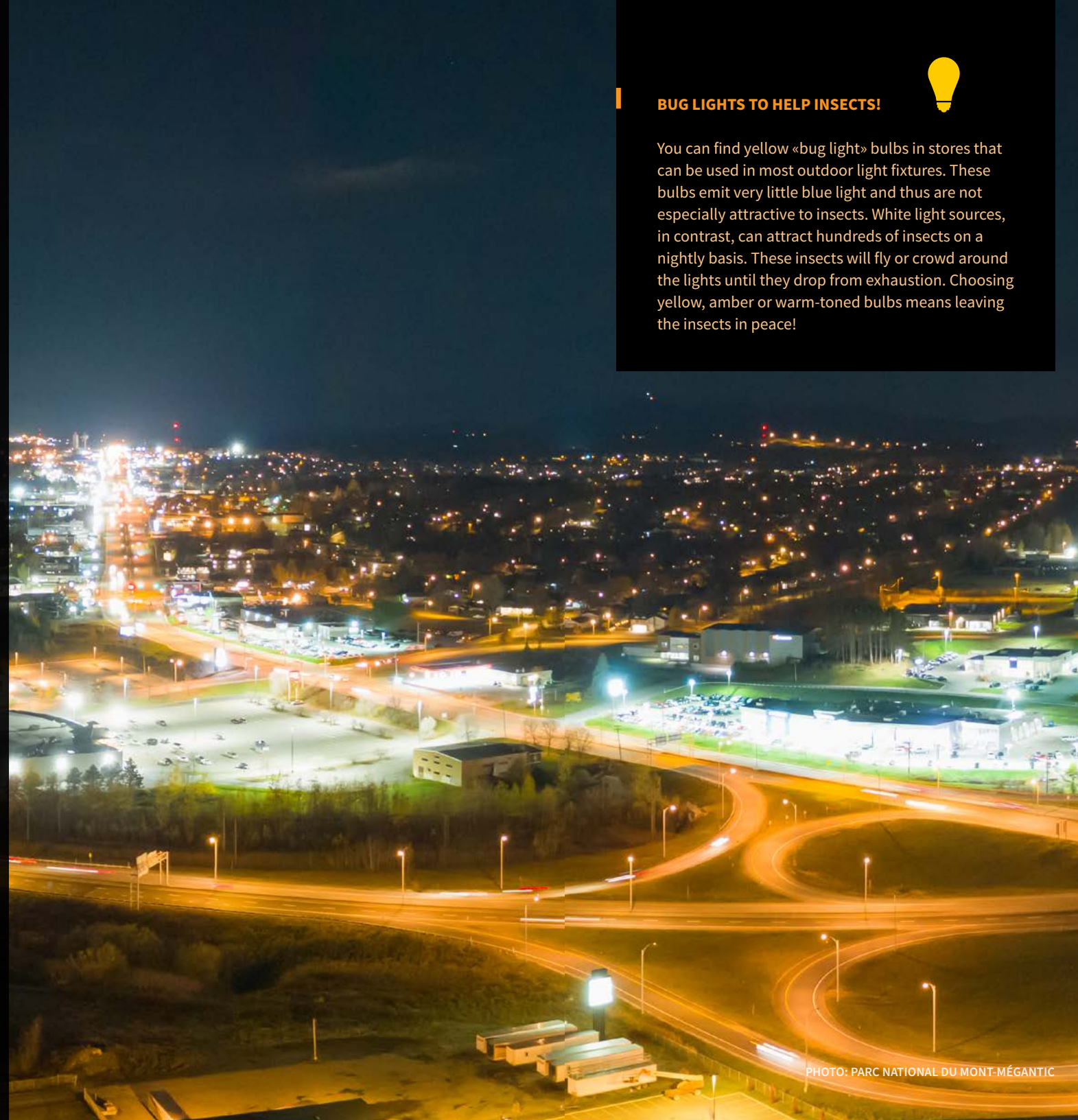
No. LEDs can reduce energy consumption, but don't necessarily reduce light pollution. Most LEDs sold on the market are too white and can actually increase light pollution.

Benefit from all the advantages of LEDs without the inconvenience of white light

Luckily, it's possible to choose amber LEDs that can significantly reduce the impacts of artificial light at night.

Several municipalities in the Dark Sky Reserve use luminaires equipped with amber LEDs that emit very little blue light. These luminaires are also available from lighting specialists in the area and are used by numerous businesses, industries and institutions.

In the International Dark Sky Reserve, regulations require that the majority of lighting be warm-toned, or a colour temperature of no more than 2200 K, which corresponds to 10% or less of blue light. Colour temperature, expressed in kelvins (K), is used to designate the tone of a light source. It is easily found on the packaging or spec sheet of a light source.



BEST LIGHTING PRACTICES



USEFUL

All lights should serve a clear purpose. Make sure that any lighting is both relevant and needed. This is a great way to avoid excessive lighting and wasted energy.



ORIENTATION

Opt for a shielded light fixture in which the light is directed only towards the ground. No light should be sent above the horizon or outside of the property.



COLOUR

Use amber and warm-toned light sources. A colour temperature of no more than 2200 K is ideal.



INTENSITY

Use the right amount of light for adequate and uniform illumination. With fewer strong contrasts, visibility increases.



TIMING

Limit the timing and duration of outdoor lighting. Install a timer, a motion detector, or simply turn off the lights in late evening.

BEST LIGHTING PRACTICES

REGULATION SUMMARY

ORIENTATION

Lighting device must be shielded and installed horizontally. Light is directed only towards the ground.

COLOUR

Amber light (2200 K or less) can be used for all types of lighting applications. White light (3000 K or more) use is restricted.

INTENSITY

Maximum illuminance levels vary based on lighting applications. Specific values are identified in the regulations

TIMING

Most lights must be turned off in late evening, but some can remain on all night depending on their type of use.

COMMERCIAL PARKING LOTS

Colour: ≤ 2200 K

Timing: Lights-out at 22:00 (23:00 in Sherbrooke) or outside of business hours.

ROADWAYS

Colour: ≤ 2200 K

Timing: Can remain on all night.

BUILDING ENTRANCES

Colour: ≤ 2200 K

(≤ 4000 K in Sherbrooke).

Timing: Can remain on all night.

PEDESTRIAN AREAS

Colour: ≤ 2200 K

Timing: Can remain on all night.

BUILDING PERIMETERS

Colour: ≤ 2200 K

Timing: Can remain on all night.

HOUSING

Colour: ≤ 2200 K

Timing: Can remain on all night.

ILLUMINATED SIGNS

Colour: ≤ 4000 K for the light source. The use of white in the image is restricted.

Timing: Lights-out at 22:00 (23:00 in Sherbrooke) or outside of business hours.

COMMERCIAL DISPLAY AREAS

Colour: ≤ 3000 K

Timing: Lights-out or dimmed at 22:00 (23:00 in Sherbrooke) or outside of business hours.

BEST LIGHTING PRACTICES

HANDLING AND LOADING AREAS

Colour: ≤ 2200 K

Timing: Lights-out or dimmed at 22:00 (23:00 in Sherbrooke) or outside of business hours.

BUILDING ENTRANCES

Colour: ≤ 2200 K (≤ 4000 K in Sherbrooke).

Timing: Can remain on all night.

SPORTS FIELDS

Colour: ≤ 4000 K (exemption in Sherbrooke).

Timing: Lights-out at 22:00 or when not in use.

HOUSING

Colour: ≤ 2200 K

Timing: Can remain on all night.

ROADWAYS

Colour: ≤ 2200 K

Timing: Can remain on all night.

ARCHITECTURAL ILLUMINATION

Colour: ≤ 3000 K (exemption in Sherbrooke).

Limit use of blue and violet light.

Timing: Lights-out at 23:00 or outside of business hours.

EXTERNALLY ILLUMINATED SIGNS

Colour: ≤ 4000 K (≤ 3500 K in Sherbrooke)

Timing: Lights-out at 22:00 (23:00 in Sherbrooke) or outside of business hours.

GAS PUMPS

Colour: ≤ 4000 K

Timing: Lights-out at 22:00 (23:00 in Sherbrooke) or outside of business hours.

REGULATION SUMMARY

The regulations in force are available through the municipalities and RCMs, or on the Dark Sky Reserve website (meganticdarksky.org).

Installing one or more high-intensity light fixtures within the Reserve requires a certificate of authorization from the municipality.

BEST LIGHTING PRACTICES

REGULATION SUMMARY SPECIFIC PROVISIONS



▲ SPORTS FIELDS

Sports fields lighting must be designed with luminaires pointed downwards and equipped with external visors, in order to eliminate light sent skyward or outside of the field. The colour of light sources can be of a maximum of 4000 K (exemption in Sherbrooke), and lighting must be switched off outside of operating hours.



▲ ARCHITECTURAL LIGHTING

In the Granit and Haut-Saint-François RCMs, it is possible to illuminate heritage buildings and monuments by using downward-facing lighting or lighting directed towards surfaces that has been designed to eliminate glare and light trespass. White light sources must be under 3000 K in colour temperature. Coloured lighting is permitted; however, the use of blue and violet light must be limited. Light sources must be switched off at 23:00 (exemption for monuments).

In Sherbrooke, architectural lighting refers to exterior lighting that highlights the facade of a building, works of art, or other objects of cultural significance. Coloured lighting is permitted, but the sources must not emit any upward-facing light. All light sources must be switched off or dimmed by at least 50% at 23:00.

The intensity and quantity of light used is regulated and specific values are identified in the regulations.



◀ EXTERNALLY ILLUMINATED SIGNS

Among the different types of illuminated signage, this option generally produces less light pollution when done properly and should be prioritized. Light sources must have a colour temperature of 4000 K or less (3500 K or less in Sherbrooke) and must be downward facing. The light must be turned off at 22:00 (23:00 in Sherbrooke) or outside of business hours.

DIGITAL SIGNAGE

Digital signs (not illustrated) are prohibited in the closest zone to Mont-Mégantic («zone 1» in the regulations) and their use is strictly controlled in all other municipalities. The requirements and arrangements for digital signage, including message characteristics and maximum screen brightness, are enumerated in the regulations.

◀ INTERNALLY ILLUMINATED SIGNS

Internally illuminated signage is prohibited in the closest zone to Mont-Mégantic («zone 1» in the regulations) and is strictly controlled in all other municipalities. Light sources must have a colour temperature of no more than 4000 K. The use of white backgrounds is prohibited, except for channel letter signage. The light must be turned off at 22:00 (23:00 in Sherbrooke) or outside of business hours. The requirements and arrangements for illuminated signage, including light intensity, are enumerated in the regulations.

HOUSING ▶

Residential lighting combines safety with quality of life by using light sources of 2200 K or less (up to 3000 K for low-intensity light sources) and using light fixtures that send light downward. While it is preferable to switch these lights off in late evening, lighting for properties, yard entrances and landscaping can remain lit all night. If a specific use requiring lighting does not respond to these criteria, a motion detector can be used. Temporary holiday lighting is also permitted.

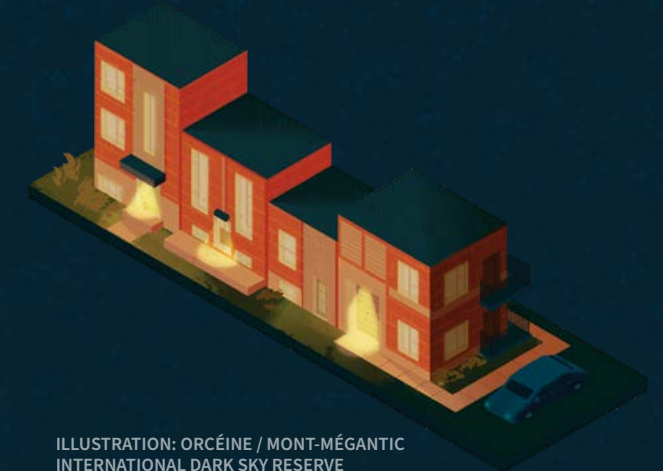


ILLUSTRATION: ORCÉINE / MONT-MÉGANTIC
INTERNATIONAL DARK SKY RESERVE

BEST LIGHTING PRACTICES

SENSITIVE ENVIRONMENTS

The quality of the nocturnal environment is important for all natural areas in the region. With two national parks, a vast swath of public land, several regional parks, ZECs (controlled harvesting zones), agricultural land and a great deal of forests, the quality of the night sky is dispersed throughout the Dark Sky Reserve. Even in urban areas, parks are home to considerable biodiversity and this is why you can find Canada's first Urban Night Sky Place in Sherbrooke.

Wetlands, lakes and waterways also represent areas that are very sensitive to light at night and require special attention. Multiple studies have demonstrated that artificial light disrupts the movements, reproduction, relationships and populations of the fish, amphibians, insects and birds.

Many secondary homes are located along lakes or in wooded areas. Citing security reasons, owners of these properties will often leave powerful exterior lights on all night when not present. This causes harm to the environment and quality of life in nearby residences, without providing real benefits in reducing crimes. Shielded lighting equipped with a motion detector is a far better solution to limit intrusive light and brings attention when needed.

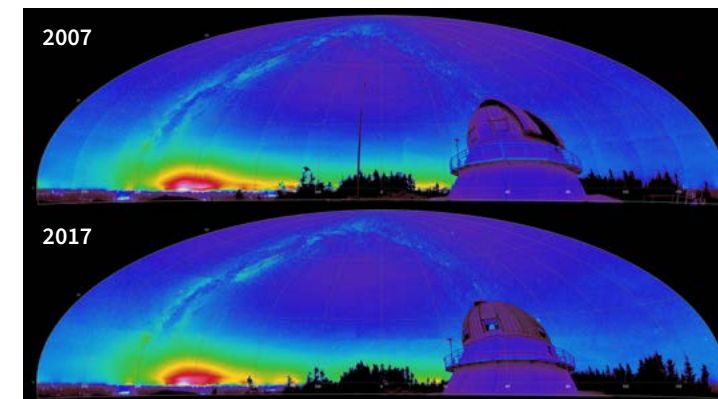
Lights installed near bodies of water can be seen and cause adverse effects at great distances.

MONITORING LIGHT POLLUTION

For several years, instruments at the summit of Mont-Mégantic have measured the quality of the night sky at the heart of the Reserve. Located near the observatories, two photometers take continuous measurements of the luminosity of the night sky. Similar instruments are also installed in other locations in the area. Both short-term variations, such as those due to clouds or the moon, and variations due to artificial light changes can be identified and measured.

The Dark Sky Reserve team also use a mobile instrument, the Sky Quality Camera, that can be deployed in specific sites at any given time. This camera is able to measure the luminosity of the sky in all directions and thus determine the origin of the skyglow.

Light-pollution monitoring can also be done at the source, using inventories of public and private light fixtures throughout the Reserve. By continuously improving the ratio of good luminaires throughout all municipalities and enforcing the regulations on outdoor lighting, even more residents of the Dark Sky Reserve will be able to reap the benefits of good lighting practices.



HIGH-QUALITY SKY

While light pollution has steadily increased around the world, the quality of the night sky at Mont-Mégantic has remained excellent throughout its first decade of existence.

Very precise measurements were carried out in collaboration with the US National Parks Service right after the certification of the Dark Sky Reserve and 10 years later. While the initial large-scale lighting conversion program decreased light pollution by a significant amount, the smaller but continuous efforts resulted in an improvement in night sky quality over the first 10 years, despite the increasing population in the area!

BEST LIGHTING PRACTICES

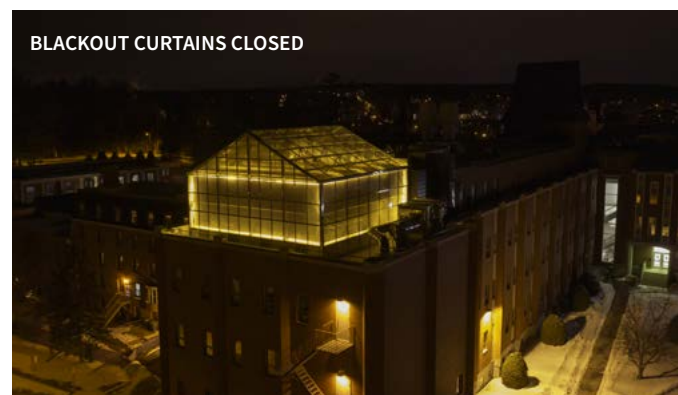
EXAMPLES OF GOOD LIGHTING PRACTICES

Thousands of problematic luminaires, both public and private, were replaced after the creation of the Reserve. This included reducing intensity, changing white light sources for amber ones, eliminating light sent upward, etc. Good lighting practices can reduce harm caused by artificial light, all while increasing safety and saving on energy. Many businesses, municipalities and institutions have adopted better practices and act as leaders in the region.



▲ FACTORIES AND LOADING AREAS

Replacement of problematic luminaires with fully shielded amber light sources. Improved uniformity in light levels.



▲ GREENHOUSES

Use of blackout curtains to block light from escaping outside.



◀ COMMERCIAL PROPERTIES

Amber LED luminaires are used to create a warm and uniform lighting. Parking lot lighting is turned off at night.



◀ GAS STATION

The main building is lit without excess, and white lighting is only used in the gas pump area.



◀ ROADWAYS

Roads are lit with amber LED luminaires to keep impacts on the nocturnal environment to a minimum and create a welcoming ambiance in residential neighbourhoods.

Reducing light pollution is as simple as lighting better.

TAKING ACTION

Is your property well lit?

Evaluate each of your outdoor light fixtures by answering the following questions and help us reduce light pollution.

START HERE



Is the light really necessary?

NO: Great job, you have found an unnecessary source of light pollution! Remove or disable the light fixture.

YES: If you have decided that the light fixture is necessary, let's make sure that it's used properly and does not create problems.

NO: White light sources create more glare and contain a large proportion of blue light, which increases their negative impacts. You can replace the light source with an amber or warm-coloured bulb.

YES: Fantastic! Yellow, amber or red lighting is ideal to reduce the impact of lighting on the nocturnal environment, human health and skyglow.

Is the light source warm-coloured?



NO: Having lights on all night is often unnecessary and wastes a considerable amount of energy. Contrary to common myths, it has never been scientifically demonstrated that lighting reduces the risk of thefts. Turn off your light when not needed or add a motion detector.

YES: Great! Turning off lights before going to bed and outside of waking hours helps to eliminate light pollution for a part of the night.

Is this light turned off when not needed?



NO: If the light is brighter than it needs to be, replace the bulb or light fixture with one that has fewer lumens. It will reduce glare and help in seeing better. A dimmer switch can also help adjust brightness when needed.

Is the amount of light appropriate for the intended task?

YES: Terrific! Using the lowest light level needed is a simple and direct way to reduce the amount of light pollution.

Does the light fall only where it is needed?

NO: Look if you can install a proper shielding, re-orient the light towards the ground, or maybe use a differently shaped light bulb to correct this. In some cases, you might need to replace the light fixture and opt for one with a better design.

YES: Bravo, your light fixture is oriented correctly! Make sure that none of your fixtures are sending light towards the sky or adjacent properties.

CONGRATULATION!
Your efforts are saving dark skies and helping the stars shine brighter!

Did your lights come up short in the test? Looking for product suggestions?

Visit the Mont-Mégantic International Dark Sky Reserve website for recommended light fixture models: meganticdarksky.org



TECHNICAL APPENDIX

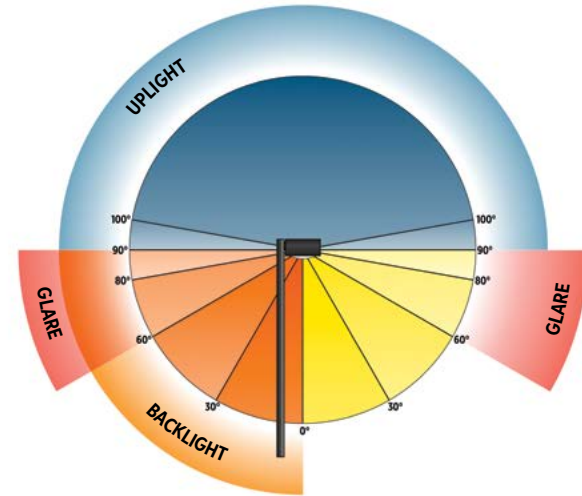
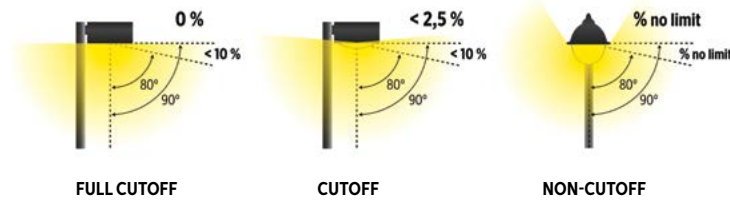
CUTOFF CLASSIFICATIONS

This type of classification help us to easily identify the proportion of light sent skyward and towards the horizon.

Cutoff classifications use two zones defined with respect to the nadir of the luminaire (the angle pointing directly downward, or 0°). These two zones are: light emitted in the 80° to 90° zone, which is more likely to create glare, and light emitted above the horizon (90°), which contributes to skyglow.

- Full cutoff, with 0% luminous intensity above the horizon and <10 % between 80° and 90°,
- Cutoff, with <2.5 % above the horizon and <10 % between 80° and 90°,
- Non-cutoff, with no limitation.

Within the Reserve, only full cutoff luminaires can be used for all applications. Cutoff luminaires are only permitted if they are mounted at a low enough height and located in certain areas detailed in the regulations.



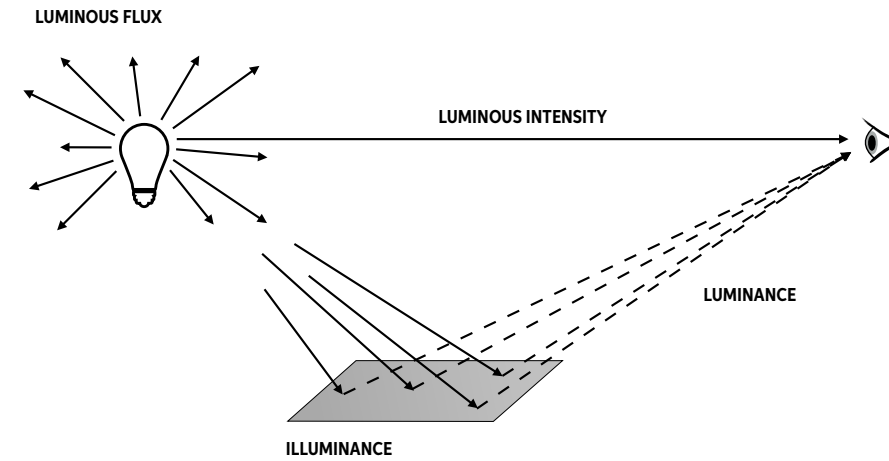
BUG SYSTEM

BUG rating seeks to replace the older cutoff classifications to better characterize a luminaire based on the amount of light emitted in lumens in a larger number of angular zones. The ratings go from 0 to 5, with lower values representing a lower amount of light. These values can be found in the spec sheet of the luminaire and are different for the variants of the same model (intensity, distribution, etc.).

B - Backlight: Light emitted behind a fixture, opposite to the area where light is intended. In some cases, backlight can help illuminate a sidewalk that runs along a road, but is more often wasted and contributes to light trespass.

U - Uplight: Light directed above the horizontal plane of the fixture. This light directly contributes to skyglow and wastes a significant amount of energy. U0 and U1 are the only Uplight values permitted in the Dark Sky Reserve.

G - Glare: Light emitted at high angles. It can create serious safety issues, intrusive lighting and also contributes to skyglow. Lower values should be used, with special attention for light fixtures with high mounting heights.



UNITS OF MEASURE

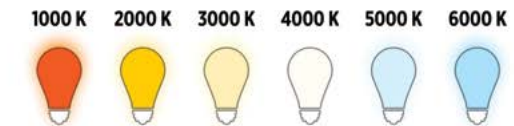
Luminous flux – Lumens (lm): Photometric measure of the amount of light emitted by a light source in all directions. Luminous flux is measured in lumens (lm).

Illuminance – Lux: Photometric quantity of light that reaches a surface. Illuminance is measured in lux (lumens per square meter) or in foot-candles (lumens per square foot). 1 foot-candle = 10.76 lux.

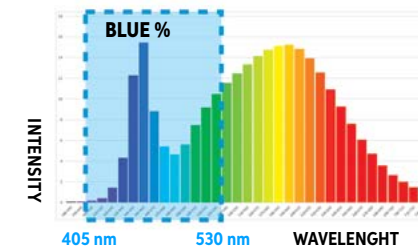
Luminous intensity – Candela (cd): Photometric measure of the perceived power emitted by a light source in a particular direction. Its measurement unit, the candela, is weighted based on the sensitivity of the human eye to light and measures luminous intensity in a given direction.

Luminance – (cd/m²): Photometric measure corresponding to the luminous intensity per unit area, often described as the brightness. It is based on the sensitivity of the human eye to light and is measured in candelas per square meter (cd/m²) or in nits. 1 cd/m² = 1 nit

Colour temperature – kelvins (K): Unit designating the colour appearance of a light source, based on a theoretical reference source heated to a particular temperature. Colour temperature is measured in kelvins (K).



Blue light percentage (%): Proportion of radiant flux emitted in a range of wavelengths between 405 and 530 nm in proportion to the radiant flux emitted in the wavelength range of 380 nm to 730 nm. This proportion is measured in percentage (%).

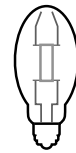


TECHNICAL APPENDIX

TYPES OF LIGHT SOURCES



Incandescent: Incandescent light bulbs emit light by circulating electric current through a tungsten filament which is heated until it glows. Its lower luminous efficacy and limited lifespan have made it a less popular choice recently. However, some still prefer it for its excellent colour rendering and the warm ambience it creates. Halogen bulbs are a more efficient variant with a longer lifespan due to its encapsulated filament in a small internal bulb containing halogen gas.



Metal-halide: An improved version of older mercury-vapour lamps. Its efficiency and higher colour rendering make it an attractive choice for applications that require intense brightness, such as sport fields and interior lighting for warehouses or large-scale retail spaces. It emits a high proportion of blue light.



Fluorescent: Available in tube form or in CFL bulbs. Operates through the principle of fluorescence. An electric current is passed through a mercury vapor which emits ultraviolet radiation that is converted into visible light by a fluorescent powder coating the inside of the tube. Very effective for interior lighting.

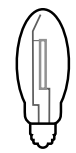
LED - light-emitting diode: Semiconductor device that emits light when electric current is run through it. Different types of LED lights exist, some emitting monochromatic colour and some emitting a larger spectrum thanks to the luminous conversion of blue or violet light using phosphors. Its high luminous efficacy has made it a very popular choice in recent years. However, white LED emit a high proportion of blue light.



High-pressure sodium: One of the most widely used choices for roadway and public lighting over the past decades. This lighting has good luminous efficacy and a solid lifespan, but its colour rendering is more limited. Because they are slow to come to full brightness, these lights are not compatible with most smart controls.

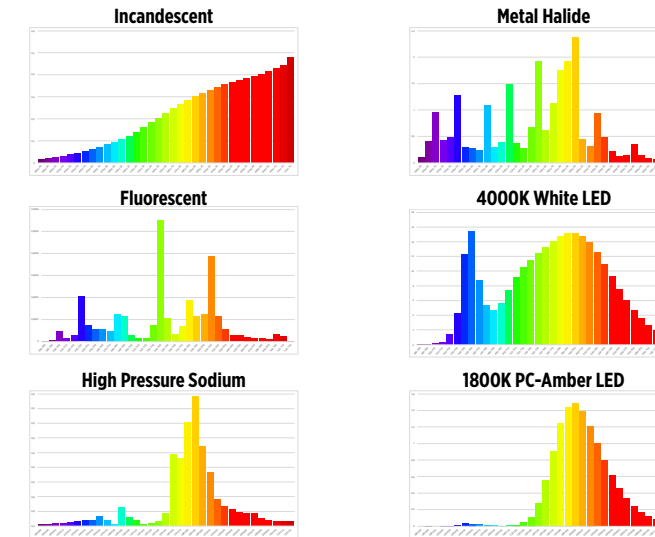


PC Amber LED: The Phosphor-Converted Amber LED is a type of LED that fully converts its blue light into shades of yellow. This conversion gives it a slightly lower luminous efficacy compared to a white LED, but it manages to eliminate almost all of its blue light emissions. In addition, it provides better colour rendering than monochromatic amber LEDs and high-pressure sodium lamps.



LIGHT SPECTRUM

The spectrum of a light source allows us to identify the intensity of radiation for each wavelength. Visible light refers to the portion of the electromagnetic spectrum that can be perceived by the human eye, covering a range of wavelengths from about 380 to 780 nanometers (nm).



COLOUR RENDERING INDEX

The colour rendering index (CRI) refers to the capacity of a light source to reveal the colours of illuminated objects. It is measured with values between 0 and 100. The higher the CRI, the more that lighting allows us to distinguish between different colours of reference.

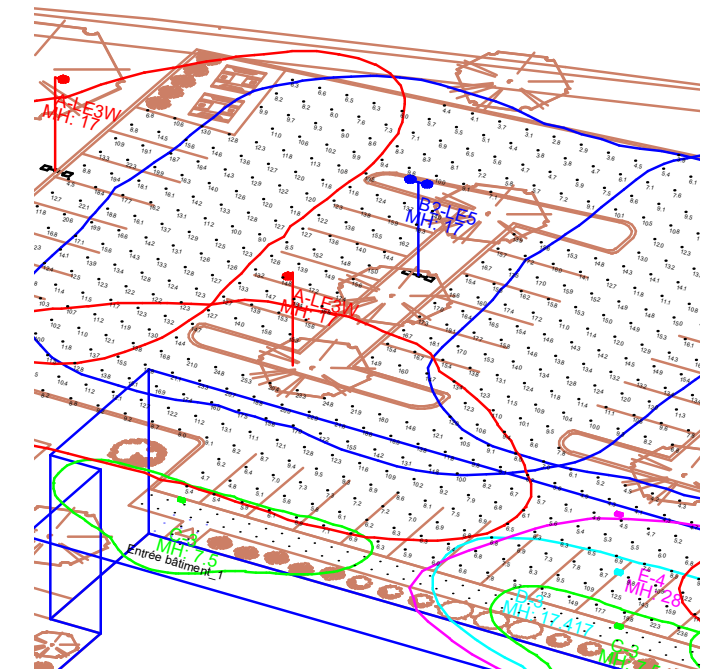
White light sources tend to have a higher CRI value, but they also contain a high proportion of blue light, which has a greater impact on light pollution. As such, it is better to consider CRI at a secondary level when choosing a light source, after more important characteristics like spectrum and colour temperature.

PHOTOMETRIC FILE

The photometric file of a luminaire describes its primary characteristics. Among others, it will include its consumption of electricity, its luminous efficacy, its cutoff classification, and the quantity of light emitted in different angle zones.

PHOTOMETRIC LIGHTING PLAN

A photometric lighting plan (sometimes called point-by-point) is a map of the light levels for a certain area, generally produced during project planning. Different light fixtures are placed in a virtual space with relevant buildings and surfaces. The illuminance is calculated for multiple points of the area, based on the characteristics of the lights fixtures and the surfaces.





The Mont-Mégantic International Dark Sky Reserve wishes to thank its partners, who take an active role in helping to mobilize an entire region to protect its nocturnal environment.

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