

PROTECTING THE BEAUTIFUL NIGHT SKY



Photo by Ben Caruthers

**A COMMUNITY GUIDE FOR
PREVENTING LIGHT POLLUTION**





Skyglow over a city.

WHAT IS LIGHT POLLUTION?

Light pollution is any adverse or unintended effects from the use of artificial light at night, including light trespass, glare, skyglow, reduced visibility at night, and energy waste. Light pollution is a growing problem caused by excessive lighting and poor lighting design.

TYPES OF LIGHT POLLUTION:

Light Trespass: When light falls where it is not intended, needed, or wanted. Use fully shielded fixtures (see Figure 2) to eliminate light trespass.

Glare: Intense, blinding light that reduces visibility of objects around you and causes eye discomfort (Figure 3). Direct lights downward, use shielding, and use the lowest appropriate light intensity.

Skyglow: The night time brightening of the sky above and near urban areas (Figure 4). Skyglow is one of the most well-recognized kinds of light pollution, since it results in “losing the stars” from our night time field of vision. Use shielded fixtures and the lowest light intensity sufficient for public safety.

Clutter: The grouping of light sources in proximity, which can cause confusion and interfere with safe driving (Figure 5).



Figure 2: Light trespass is not just a nuisance, but can affect our ability to get a good night's sleep. Sleeping disorders can trigger other health issues, including high blood pressure, heart ailments, and obesity.

Figure 3: Badly designed light fixtures are responsible for causing glare. Glare impairs vision and can reduce both pedestrian and driver safety. Note the contrast between the brightly lit area right under the light, and the sudden transition to relative darkness toward the bottom right. A pedestrian attempting to cross the street from the far sidewalk, which is shrouded in darkness, is at risk of being invisible or only partly visible to drivers.





Figure 4 (Left): Badly designed light fixtures and intense lighting gives rise to skyglow, which can be seen many miles away from a city. In this image we see skyglow from Kirksville (about 5 miles away, far left in photo) and La Plata (about 20 miles away, bottom right in photo).

DARK SKY LIGHTING BASICS



Figure 5: Light clutter is a result of having too many light sources in a small space.

Shielding of Fixtures: Downward pointed, fully shielded lighting keeps unwanted and unnecessary light from shining onto adjacent properties or into the sky, contributing to skyglow. Outdoor lighting should be “fully shielded,” meaning no light emitting above a 90-degree angle (see Figure 6). Fully shielded lighting can either be purchased, or existing lights can be retrofitted with shielding.

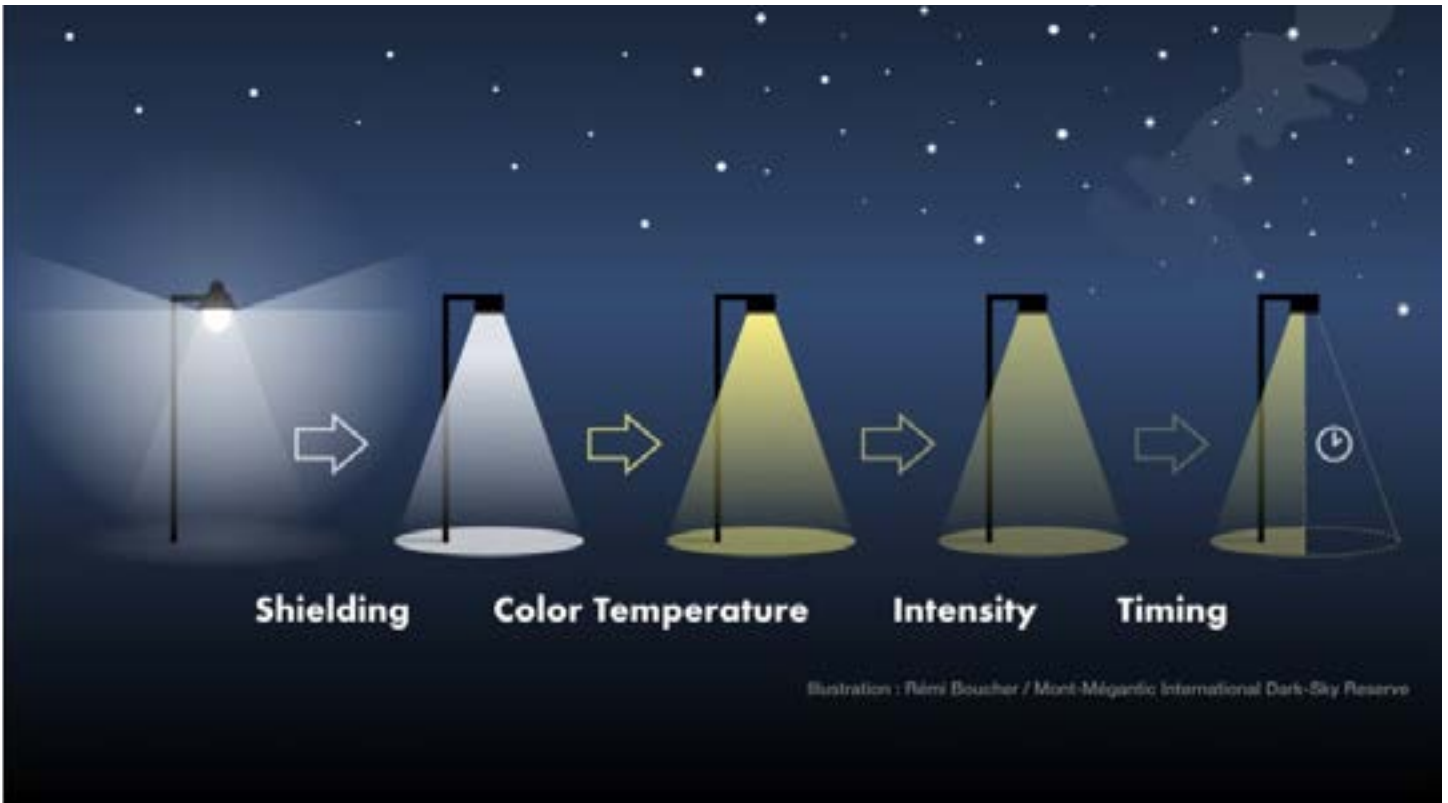


Figure 6: This diagram shows improvements in outdoor lighting, starting from bright, blue-white lights on an unshielded light fixture (far left), to a fully shielded light, to a warmer colored light, to a warmer light with lowered intensity, to a fully shielded, warm light of appropriate brightness on a timer (far right).

Amount of Light: Excessive lighting is a waste of energy and creates nuisance conditions. Light should be directed only onto the areas where it is truly needed, and only the lowest adequate lighting intensity should be used. Excessive light intensity is “overkill” and a waste of energy. Timers, motion sensors, dimmer switches and light cutoffs can be used for light fixtures when not needed, further reducing energy use (Figure 6).

Lighting Color: Blue light is harmful for wildlife and for human health, and contributes more to light pollution. Warmer, or amber-colored lights, are better for people and the environment. Warm lights are those with a temperature of less than 3000 Kelvin. Look at product packaging to determine the temperature, and use lights close to 2000 K, and certainly less than 3000 K (Figure 7).

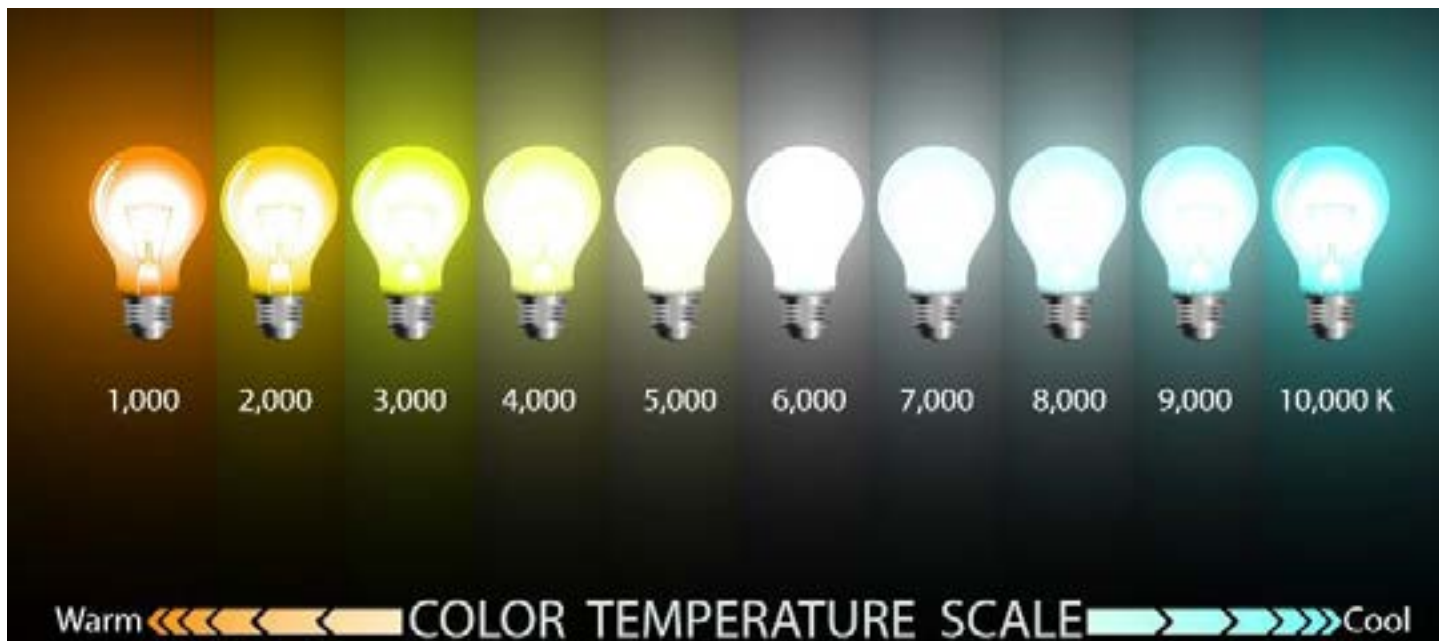


Figure 7: Amber colored light (2700K or less) are least disruptive to the environment and almost all living beings, and are preferred over lights above 3000K, which contain significant amounts of blue light.

PUBLIC SAFETY

“Bright” lighting does not necessary equate with “safe lighting.” The appropriate use of dark-sky friendly lighting actually improves overall safety. Overly bright, glaring lights create sharp contrast between light and darkness, making areas outside of the illuminated area difficult to see (see Figure 8). Sharp contrast between light and darkness creates deep shadows that make it easier for burglars to hide. Glare from overly bright streetlights causes driver discomfort and impairs driver visibility.

There is a tendency to overlight property for safety and security. Many people think this improves safety, but there is no scientific evidence to support this opinion. Our night vision works better in low light. We are better able to distinguish shapes in darkness, when our vision has adapted to lower light conditions, keeping us safe. Our pupils constrict when looking at a bright light at night and we tend to look away. Lower lighting levels, warmer light (< 3,000 K), and better coverage of areas needing illuminated are more efficient ways to enhance safety and security with lighting.



Figure 8: A classic demonstration of “brighter does not mean safer”. Unshielded, bright lights cause deep contrasts and shadows that make it harder to see.

ENERGY SAVINGS

Sixty percent of outdoor lighting is wasted energy. We have all seen images of city lights from space. Consider this—almost all the light that a satellite sees is wasted energy, because it is radiating out into space where it is not needed. For every \$100 spent on operating a dusk-to-dawn light, \$45 is wasted on light that never reaches the ground (Figure 9).



Cities are realizing the benefits of reducing and eliminating this energy waste through better lighting design and standards. Today, there are many energy-efficient lighting products that, when combined with proper design, can significantly reduce energy costs.

Light Emitting Diodes (LEDs) are replacing conventional lamp types for outdoor lighting. The improved quality and lower prices of LEDs make them efficient alternatives to conventional lamps. But some LEDs, especially early generation ones, emit an excessive amount of blue light, which increases glare and light pollution. Today, a new generation of “warmer color” LED products with temperatures below 3000K are available.

Figure 9: The amount of energy wasted due to bad and inefficient lighting.

LIGHTING FOR NATURE

Almost all wildlife and even humans and plants are affected by artificial light at night because the blue wavelengths of bright white light disrupt circadian rhythms—the night and day cycles associated with physiological changes. Even insects and pollinators are in decline partially due to artificial lights. Artificial light at night makes it harder for fireflies to find a mate because they must blink brighter to be seen.

Several major bird migration paths go through Missouri (Fig. 10). These ancient migration paths now bring birds over cities. Every year, millions of birds die during migration due to artificial lights. Most birds migrate at night to save energy and avoid predators, using the moon and stars to navigate. Artificial lights disorient birds and cause them to circle until they die from exhaustion or hit a structure, such as a building. Each year, one billion or more birds are killed in the U.S. by colliding with buildings (Figure 11). Lights out Heartland (Fig. 12) is a program working to reduce the negative impacts of artificial light at night on birds. For more information about Lights out Heartland, see the website, <https://www.lightsoutheartland.org>.

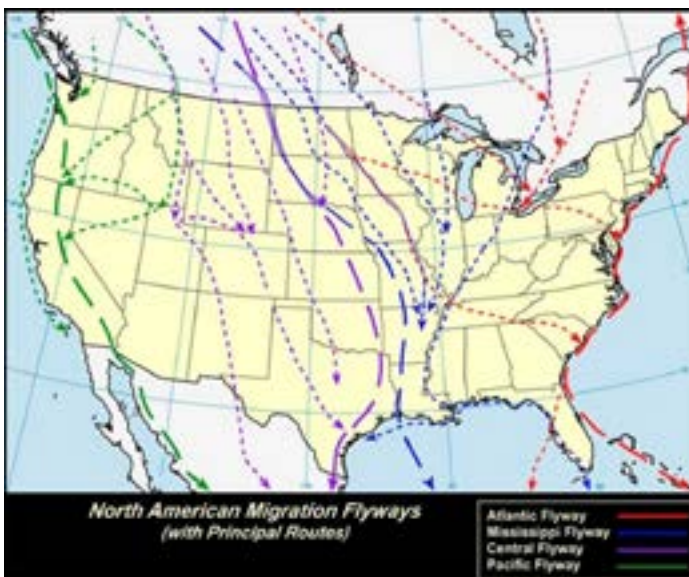


Figure 10: The major migration flyways over the United States. Migratory birds tend to follow rivers and coastlines, putting both Kansas City and Saint Louis along high traffic flyways.



Figure 11: Birds killed by collisions with high-rise buildings. Many of our largest cities in the Midwest, including Kansas City, Saint Louis, and Springfield, are along the Mississippi-Missouri Flyway. Bright lights in cities create an ecological trap for birds.



Figure 12: Lights Out Heartland Logo

CULTURAL TRADITIONS AND THE BEAUTY OF THE NIGHT SKY

Our ancestors grew up under dark skies, and the magic and thrill of brightly colored stars, planets and the moon were not lost on them. Over the last few decades, the amount of light pollution has grown much faster than the population, largely because we have become conditioned to believe that more and brighter lighting is always better. Today, more and more people are re-connecting with the truly awesome night sky. As more people become aware of what they're missing in areas with overly bright night skies, there is more interest in efforts to curb excessive lighting at night.

NIGHT SKY TOURISM

More and more, tourists are visiting places where they can enjoy the beauty of a star-studded night sky. As other areas of the country become more urbanized and light-polluted, Missouri will become a “dark sky destination,” where people come for night sky viewing, astronomical observations, and where the beautiful night sky can be seen and appreciated (Figure 13). Many parks are becoming designated as “dark sky parks” (Such as the Buffalo, in Arkansas. In Missouri, the Ozark National Scenic Riverways is currently applying for dark sky park status). But even rural areas or cities can curtail light pollution and protect the value of the night sky for the health and benefits of their citizens.



Figure 13: A Buffalo River at night basking in the glory of the Milky Way (photo by Ben Caruthers).



Figure 14: Artwork by Tyler Nordgren illustrating the National Parks motto of “Half the park is after dark.”

HUMAN HEALTH

Scientific research indicates that artificial light at night has detrimental effects on human health and well-being. Artificial light can disrupt circadian rhythm (night/day physiological processes, such as hormone production), resulting in increased risk of obesity, diabetes, mood disorders, reproductive problems, and cancers.

Five Lighting Principles for Responsible Outdoor Lighting

DarkSky Illuminating

Responsible outdoor lighting is

- 1 Useful**
Use light only if it is needed
All light should have a clear purpose. Consider how the use of light will impact the area, including wildlife and their habitats.
- 2 Targeted**
Direct light so it falls only where it is needed
Use shielding and careful aiming to target the direction of the light beam so that it points downward and does not spill beyond where it is needed.
- 3 Low Level**
Light should be no brighter than necessary
Use the lowest light level required. Be mindful of surface conditions, as some surfaces may reflect more light into the night sky than intended.
- 4 Controlled**
Use light only when it is needed
Use controls such as timers or motion detectors to ensure that light is available when it is needed, dimmed when possible, and turned off when not needed.
- 5 Warm-colored**
Use warmer color lights where possible
Limit the amount of shorter wavelength (blue-violet) light to the least amount needed.

DARK SKY PLANNING AND CITY ORDINANCES

Many cities are examining their ordinances and lighting standards to see if dark sky provisions can be added, or if a new lighting ordinance could be established. DarkSky Missouri stands ready to assist any city that wishes to explore these ideas further. We can provide model ordinances for you to consider. A representative of our organization would be happy to come to your city to meet with leaders about adopting dark sky principles. Contact us through our website at Darkskymissouri.org

Light Pollution is Easy to Fix! Damage caused by artificial light at night is not permanent and can very often be stopped by a simple “flip of the switch.” Following the five principles of responsible outdoor lighting is simple, and is largely common sense. Every person has a responsibility for keeping the stars visible and the night sky beautiful for all of us!



The mission of DarkSky Missouri is to raise awareness about light pollution issues in Missouri, promote quality outdoor lighting, protect our natural environment and our beautiful night sky, and educate the public about reducing light pollution to lower energy costs.