

## **Artificial Nighttime Lighting: The Impacts of Illumination**

By Emily Fang

As technology and society advance, artificial lighting at night (ALAN) has proven to be critical to the lives of people around the world. Today, streetlights are instrumental in the improvement of road safety while indoor lighting allows people to work late into the night, a feat that was previously more challenging. However, the rapid increase in illumination has begun to take a toll both on the environment and humans themselves. Although many feel that ALAN is essential to everyday safety and wellbeing, the current overuse of artificial lighting must be managed more carefully around the world because lowering the current overwhelming light levels in the night sky is the first step towards significant improvements in human and environmental life.

Since the invention of electric lighting in the 19th century, ALAN has greatly increased in popularity. Humans have completely changed how nighttime looks and feels as city streets are illuminated throughout the night and house windows glow for hours after sunset. The International Energy Agency estimates that there are over 300 million streetlights in existence ("Empowering 'Smart Cities'"). As people have come to rely on lights in everyday life, these have undoubtedly improved nighttime safety. The world is now exposed to unprecedented amounts of light each day. According to the International Dark Sky Association, this results in a significant brightening of the night sky, known as skyglow, creating light pollution that blocks the stars from view and brightens the affected area considerably. Consequently, those in areas with significant light pollution have become almost cut off from the sky at night. A lightening world has changed how we view our surroundings as compared to our ancestors.

Only recently has this really become a problem. According to Kaitlyn Tatro, a field technician at Stantec, it is concerning that most people perceive lights positively when "there are real, negative effects associated with increased lighting" (Tatro 65). The majority of people

are not educated on the problems associated with the overuse of light. However, it has become more pressing than ever to understand the price of our perpetual illumination. Kevin J. Gaston, a researcher and professor on biodiversity and conservation at the University of Exeter, note that although nighttime lighting can prevent an increase in vehicle accidents and crime, the sheer amount of wasted light that brightens the night has adverse impacts on humans and wildlife. ALAN has significant impacts on human lives and the health and environmental repercussions have become increasingly concerning with new research.

The increased use of ALAN has an array of adverse effects on the environment, especially on wildlife. After tens of thousands of years of dark nights, animals on Earth find lighting at night to be unwelcome. According to Laura Paddison, an international climate editor, streetlights, homes, and other sources of brightness “spill into the habitats of animals and it scatters into the atmosphere, creating a sky glow that can extend around 150 miles (241km) from large towns and cities”. While humans don’t usually consider wildlife when flicking a switch, it’s important to recognize how domestic lighting can cause harm by spreading into other habitats. According to the International Dark Sky Association, brightness and skyglow may attract various species to dangerous regions or it may frighten animals away from shelter and breeding grounds, creating imbalances in the ecosystem (“Effects on Wildlife”). When animals are repeatedly lured by lights to threatening areas, other species within the ecosystem are impacted by the change, leaving entire habitats in distress. One significant example of this are migratory birds, one of the species most affected by increases in ALAN. During migration season, many are lured towards cities by bright lights, where “the lighting, noise, and tall structures disorient the birds and many cannot find their way out of the maze of buildings, wires, and lights” (Tatro 68). Increased incidents of avian deaths are directly correlated to the rise in lighting.

ALAN also has adverse effects on the physical health of humans. Recent studies show that the impacts of lighting “may be substantial and quite pervasive, foremost because of the effects of exposure to ALAN on melatonin suppression, and its downstream consequences [such as] an increased risk of breast cancer and gastrointestinal and cardiovascular disorders” (Gaston et al 16). Melatonin suppression, in particular, is an overlooked issue. If these impacts were further recognized, it could prevent future issues pertaining to the risks of overuse of ALAN. Lighting can also have unfavorable effects on mental health. In her 2020 article concerning light energy, Kaitlyn Tatro writes that “as stars fade into the background and the light of the galaxy is blocked by the glow of halogen and LED lighting, we risk losing part of our identity” (Tatro 68). Because of the overuse and misdirection of ALAN, the haze of skyglow has decreased people’s ability to see the night sky in which the stars give us a perspective on our place in the universe. The stars connect people with stories of their ancestors who used the stars to guide their path, as well as the placements of celestial bodies in constellations.

ALAN is not without its benefits. Nighttime lighting can “extend the period of any given day that is usable for a wide array of otherwise diurnally restricted human activities” (Gaston et al 15). More can be done daily within a shorter amount of time. For example, finishing homework at night allows for more time to be spent outside, which leads to heightened levels of happiness and satisfaction. These are all indicators of a higher quality of life. Besides elongated daytime hours, artificial nighttime lighting also affects quality of life through architecture and design. Simon Rankel, an interdisciplinary doctoral student in spatial and urban planning at the University of Ljubljana, noted in a study about the future of cities at night that “light usually allows people to experience any space” (Rankel 127). Lighting is an important component of any space as it can elevate and set a tone for a setting. This can significantly increase one’s quality of life through lighting in restaurants, parties, and even homes by lifting one’s mood and influencing human emotions.

ALAN has also proved to be beneficial to nighttime safety in terms of reducing crime and vehicle accidents, and protecting pedestrians. Light sources have been proven to “reduce crime either by increasing surveillance and thus providing deterrence or because they lead locally to increasing community pride and informal social control which in turn reduce crime” (Gaston et al 18). Lighting is one of the most effective ways for towns and cities to decrease crime, and when implemented, ALAN can have a significant impact on misdemeanors in the area. Vehicle accidents are common occurrences at night: The U.S. Department of Transportation (DOT), acknowledges that road safety is related to lighting, especially at night, when “vehicles traveling at higher speeds may not have the ability to stop once a hazard or change in the road ahead becomes visible by the headlights” (“Lighting”). With decreased reaction time at night due to limited vision, vehicle accidents are more common at night. This issue can be tackled through streetlights, as well as installation of headlights, both common artificial nighttime light sources. When towns and cities administer policies for ALAN, they become safer for the average driver. While other factors may play a role in the frequency of vehicle collisions at night, artificial lighting is shown to reduce accident severity overall. This illustrates the importance of ALAN in that, when implemented well, streetlights have the potential to save lives.

After recognizing the trade-offs between the benefits and drawbacks of artificial nighttime lighting, efforts must be made to reduce the unfortunate consequences of ALAN without compromising safety and quality of life. Lighting at night, whether domestic or public, is an integral to maintaining security and welfare. Going outside has become much safer and, since the invention of the lightbulb, it has become almost impossible to imagine an unilluminated nighttime landscape. On the other hand, growing evidence demonstrates the downsides of nighttime lighting, from environmental harm to human health complications. Various animal species have suffered as a result of the development of widespread electric lighting around the globe. Because of little education on the harmful effects of lighting, the

growing dependence upon ALAN, and the general misunderstanding of light pollution itself, it has become increasingly necessary to address the question of how to move forward. Most climate activists and researchers focus on pollution in the air, land, and sea without paying mind to the nighttime sky. Many assume that light pollution is a relatively easy fix compared to other issues because it diminishes as soon as lights turn off. However, it takes considerable effort to truly change the heavy dependence on current lighting systems. At present, a great deal of light is wasted, misdirected, or unnecessarily overused. According to the Dark Sky Association, "30% of this outdoor lighting is wasted, meaning lights are installed in areas they are not needed, are left on when not in use, or are directed upwards such that light is scattered into the atmosphere" (Tatro 67). The current system of lighting keeps streetlights on throughout the night on virtually all roads. Many lights remain switched on in various buildings and homes, even when empty. Besides the environmental and health effects, this overuse of ALAN is financially wasteful since the electricity dedicated to nighttime lighting costs tens of billions of dollars in the United States alone according to a study by Kaitlyn Tatro in *The Journal of Sustainable Development*. If this wasted lighting was more controlled, it would be more feasible to implement ALAN policies as it would be less consequential from an environmental, health, and ecological standpoint. However, considering the growing differences in international and even just national politics, implementing new policies would be a difficult and costly challenge, especially with competing government priorities and the further education on ALAN required.

This is not to say that it's impossible to lessen the damaging consequences of ALAN while maintaining safety and quality of life. Some countries have taken notice of the dilemma, passing legislation to minimize light pollution. In particular, "France introduced laws on outdoor lighting in 2019, leading to a 6% decrease in light pollution, and the same year Croatia passed a law restricting lighting levels" (Paddison 2021). Evidence shows that if effort is made by politicians, gradual change is possible. Changes can be made to streetlights, in relation to the

direction of the beams and maintenance on less crowded streets. Downward facing beams (Figure 1) reduce the amount of light directed towards the sky, therefore reducing the harmful skyglow surrounding cities and towns, while keeping the roads safe. As technology advances, motion sensors can be implemented on quiet roads. Besides streetlights, ALAN could be reduced a great deal through policymaking in large American cities such as New York City and Los Angeles which glow brighter than anywhere else. Although many feel that they have no part in light pollution, individuals can contribute to decreasing the harmful effects of lighting as well. This includes closing curtains at night so that light doesn't escape or turning lights off when not needed. As awareness of light pollution grows, further changes can be made to our perception of how light can be used to minimize environmental and health consequences while ensuring that safety and quality of life remain unaffected.

Lighting is more widespread than ever before, illuminating the path towards societal development as well as the path towards health and environmental decline. Even as the world seems to become safer with the increase of ALAN, research has exemplified the adverse effects on wellbeing and wildlife, showing that change is needed to ensure balance between safety and maintaining a dark sky. Lighting reduces crime; cuts vehicle accident fatalities; and increases quality of life by boosting mood through an extended daytime. The issue is that ALAN

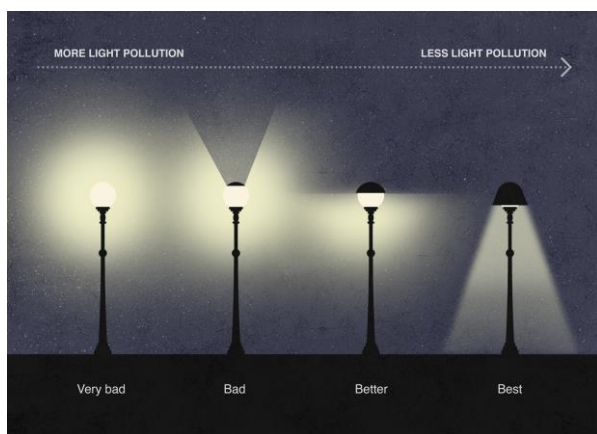


Figure 1: downward facing streetlights direct less light into the night sky, decreasing skyglow and light pollution

is severely damaging to wildlife and likely to human health as well, both significant causes for concern. It has become increasingly apparent that action must be taken by both the government and the public to make a change to light pollution, an extremely overlooked aspect of our lives.

*Emily Fang is a rising senior at Hopewell Valley Central High School who enjoys studying statistics and global challenges/issues. Emily is also an avid tennis player and volunteers as an art teacher for students with special needs.*

## Works Cited

- "Empowering 'Smart Cities' toward net zero emissions." *International Energy Association*, 22 July 2021, [www.iea.org/news/empowering-smart-cities-toward-net-zero-emissions](http://www.iea.org/news/empowering-smart-cities-toward-net-zero-emissions). Accessed 8 May 2023.
- "Light Pollution." *International Dark-Sky Association*, 10 Dec. 2020, <https://www.darksky.org/light-pollution/>. Accessed 16 Apr. 2023.
- "Light Pollution Effects on Wildlife and Ecosystems." *International Dark-Sky Association*, 10 Dec. 2020, <https://www.darksky.org/light-pollution/wildlife/>. Accessed 16 Apr. 2023.
- Kevin J. Gaston, et al. "Benefits and Costs of Artificial Nighttime Lighting of the Environment." *Environmental Reviews*, vol. 23, no. 1, 2015, pp. 14-23. *JSTOR*, [www.jstor.org/stable/envirevi.23.1.14](http://www.jstor.org/stable/envirevi.23.1.14). Accessed 12 Apr. 2023.
- "Lighting." *Safety*, [safety.fhwa.dot.gov/provencountermeasures/lighting.cfm](http://safety.fhwa.dot.gov/provencountermeasures/lighting.cfm). Accessed 18 Apr. 2023.
- Paddison, Laura. "The Argument for Switching off Lights at Night." *BBC Future*, BBC, 24 Feb. 2022, <https://www.bbc.com/future/article/20210719-why-light-pollution-is-harming-our-wildlife>. Accessed 17 Apr. 2023.
- Rankel, Simon. "Future Lighting and the Appearance of Cities at Night:." *Urbani Izziv*, vol. 25, no. 1, 2014, pp. 126-41. *JSTOR*, [www.jstor.org/stable/24920905](http://www.jstor.org/stable/24920905). Accessed 16 Apr. 2023.
- Tatro, Kaitlyn. "Light Energy." *Consilience*, no. 22, 2020, pp. 65-72. *JSTOR*, [www.jstor.org/stable/26924963](http://www.jstor.org/stable/26924963). Accessed 11 Apr. 2023.