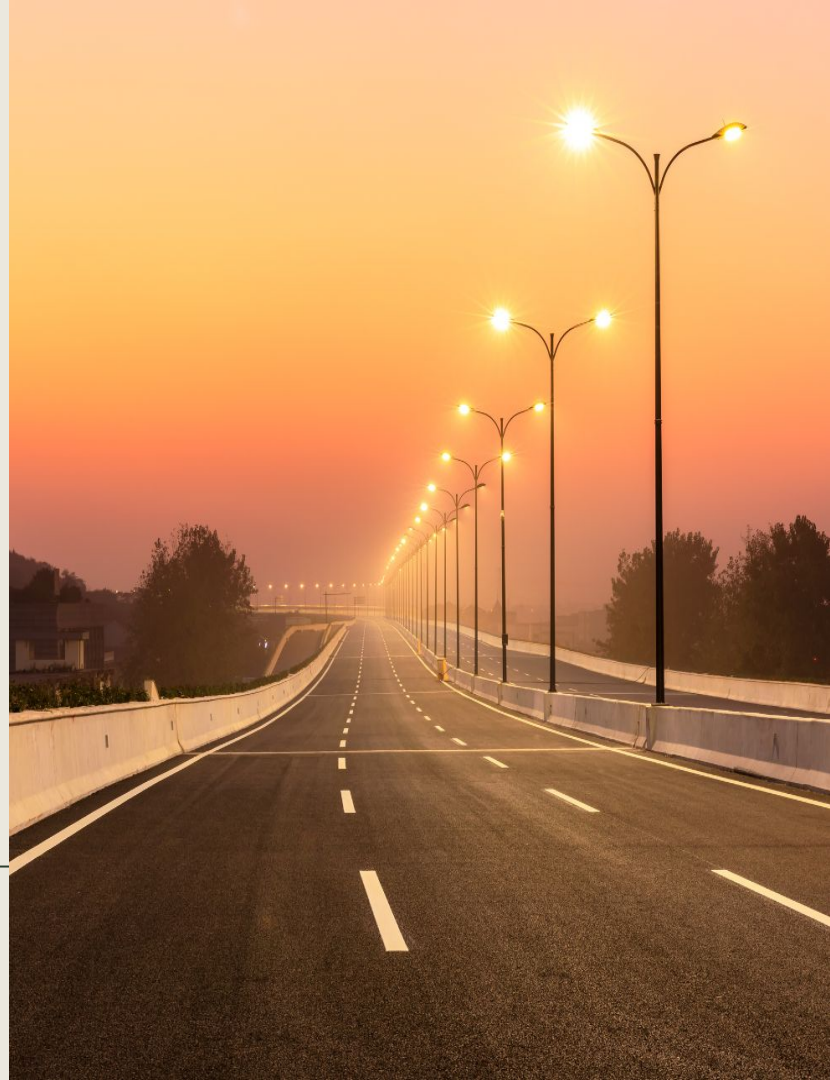


LED Street Lighting: A guide for public awareness

By Malcolm Kuo



What is Light Pollution

**excessive or inappropriate use of artificial light outdoors,
which disrupts the natural darkness of the night sky
(National Geographic)**

What is Light Pollution

Light pollution takes four forms:

- Glare: blinding brightness that reduces visibility
- Light Trespass: unwanted light spilling into homes
- Clutter: Overly bright, chaotic lighting
- Skyglow: brightening of night sky



How big is light pollution

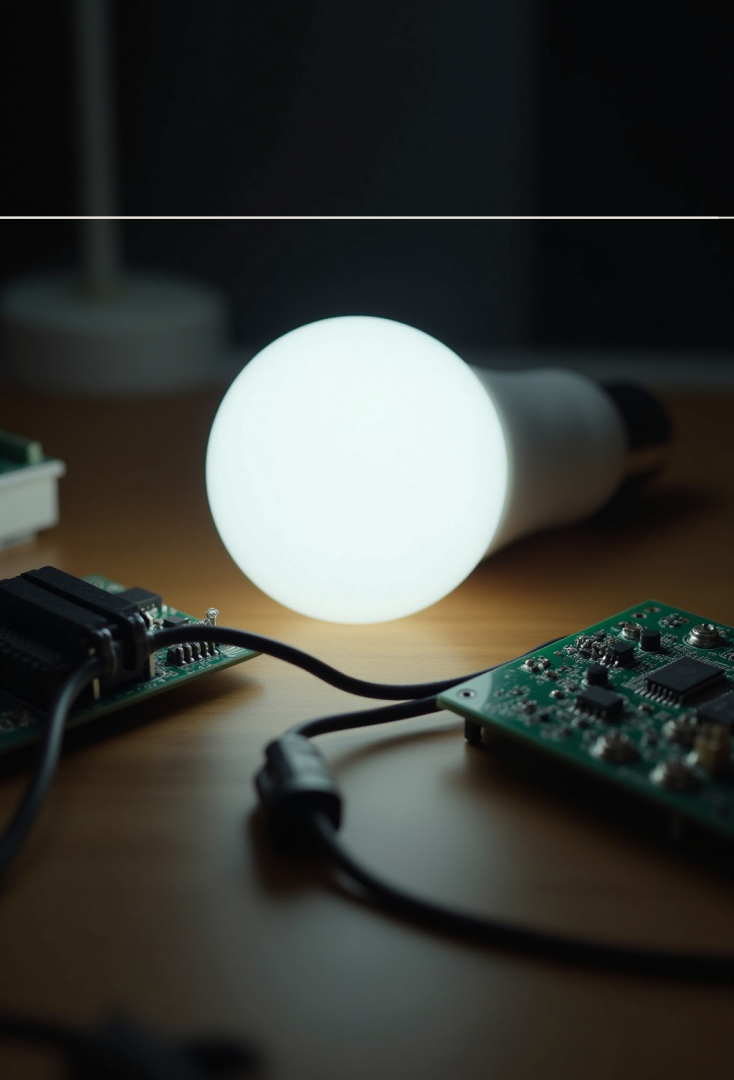
- 99% of U.S./Europe lose access to the natural night
- 1/3 of humanity can't see the Milky Way from where they live
- Night sky brightness rising 9–10% per year

(Falchi et al., 2016; Kyba et al., 2023)

Why Light Pollution Matters

- Light pollution effects **more than** just the night sky
 - disrupts human sleep and health
 - Affects communities comfort
 - harms nocturnal wildlife and entire ecosystems
 - obscures the night sky, erasing cultural and scientific heritage
- It's growing rapidly—but is one of the **easiest** forms of pollution to fix
 - Only requires smarter lighting design and awareness

01



LED Technology

LED basics

- LED stands for Light emitting diode
- emits light when electric current passes through them.
- LEDs are flat surface emitters, which produce light through a flat surface. This causes the light to be uneven, causing discomfort.



Spherical Emitter



Flat Surface Emitter

Comparison to traditional lights

Feature	LED Streetlights	High-Pressure Sodium (HPS)
Color Temperature	Cool/neutral/warm options (2700K–5000K)	Warm amber (~2200K)
Efficiency	Very high (60–100+ lm/W)	Moderate (50–70 lm/W)
Lifespan	10–20 years	~2–5 years
Light Directionality	Highly directional	Omnidirectional
Instant On/Off	Yes	Delayed warm-up/cool-down
Smart Features	Dimming, sensors, remote control	Not compatible

LED Color and Spectrum

Correlated Color Temperature (CCT) measured in Kelvin

- 2700K = Warm white
- 4000K = Neutral white
- 5000K+ = Cool blue-white

Blue light content increases with CCT





02

Negative Impacts of LED streetlights



Human Health

- High-intensity LEDs can cause nausea and discomfort
- Glare affects driving and pedestrian safety; older adults are more vulnerable
- Glare causes shadow zones (“ambush effect”)

(Scotti, 2020)



Human Health

- Blue light (esp. ~479nm) suppresses melatonin 5x more than high-pressure sodium lamps
- Linked to poor sleep, obesity, diabetes, cancer
- Nurses' study: 14% higher breast cancer risk for nurses that lived in brighter areas

(American Medical Association, 2024)





Community

- Residents in NYC & Pittsburgh complained about excessive brightness
- Descriptions like "prison yard" and "clinical blue light"
- Some covered windows with garbage bags to sleep

(Evans, 2015; Edgar Snyder & Associates, n.d.)





Wildlife

- 60% of animals are nocturnal
- Birds rely on stars to migrate; disoriented by bright lights
- disrupts natural rhythms affect feeding, mating, and survival of key species. such as moths, beetles, and pollinators

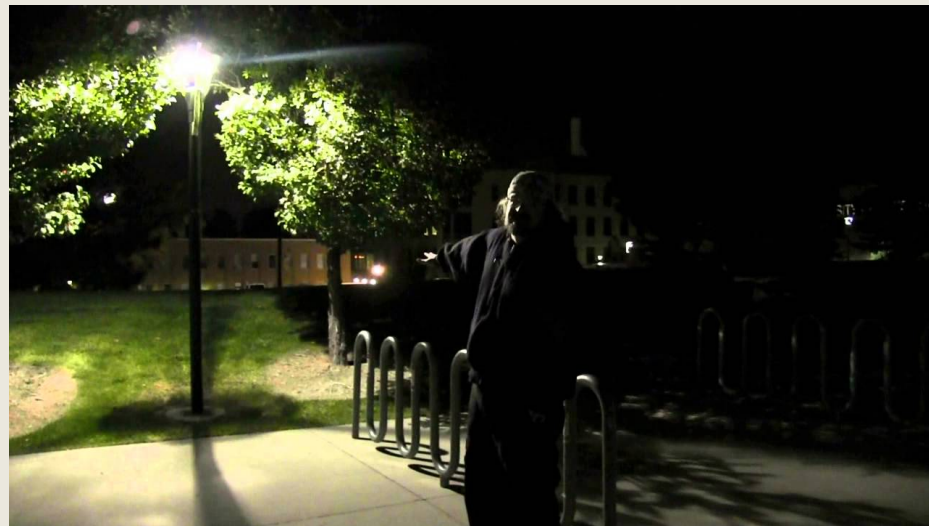
(American Medical Association, 2024; UKCEH, 2021)

Nocturnal Animals



Lighting and Safety Myths

- UK study: Dimming did not increase crime/accidents
- Chicago: More light = more crime in alleys
- Most property crimes occur in daylight



(AMA, 2014; Chicago Department of Transportation, 2000)

03



Current Debates

Design Debates - Color Temperature

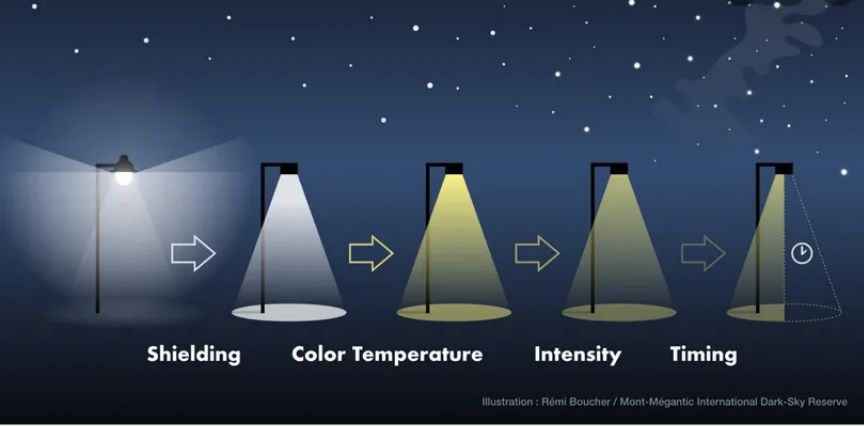
- Lighting Engineers: Prefer 4000K–5000K LEDs for brightness, visibility, energy savings
- Medical Experts (AMA): Recommend $\leq 3000\text{K}$ to minimize melatonin disruption
- Newer Research: Suggests 2700K or lower may be safer (Motta, 2024)
- The Conflict: Efficiency vs. Health & Environmental Protection



04



Recommendations



Recommendations

- Update ordinances to require shielding and 3000K or less for LED streetlights
- Dimming schedules/motion sensors
- Involve public in lighting decisions



Conclusions

- LEDs are powerful tools — but need thoughtful implementation
- Light pollution affects health, safety, and the environment
- Solutions exist and are accessible

Thank You

References

American Medical Association. (2016). Human and environmental effects of light emitting diode (LED) community lighting. https://darksky.org/app/uploads/bsk-pdf-manager/AMA_Report_2016_60.pdf

American Medical Association. (2024). We're all healthier under a starry sky. AMA Journal of Ethics, 26(10). <https://journalofethics.ama-assn.org/article/were-all-healthier-under-starry-sky/2024-10>

Chicago Department of Transportation. (2000). Chicago Alley Lighting Project: A pilot study on improved lighting and its impact on crime reduction. <https://darksky.org/app/uploads/2014/09/Chicago-Alley-Lighting-Project.pdf>

DarkSky International. (n.d.). Light pollution effects on safety. <https://darksky.org/resources/what-is-light-pollution/effects/safety>

Edgar Snyder & Associates. (n.d.). Why are LED streetlights so bright? <https://www.edgarsnyder.com/blog/2017/02/28-led-streetlights.html>

References

Evans, M. (2015, July 20). LED streetlights are giving neighborhoods the blues. IEEE Spectrum. <https://spectrum.ieee.org/led-streetlights-are-giving-neighborhoods-the-blues>

Falchi, F., Cinzano, P., Duriscoe, D., Kyba, C. C. M., Elvidge, C. D., Baugh, K., ... & Furgoni, R. (2016). The new world atlas of artificial night sky brightness. *Science Advances*, 2(6), e1600377. <https://www.science.org/doi/full/10.1126/science.abq7781>

Kyba, C. C. M., Walker, C. E., Zhang, B., Holker, F., & Guanter, L. (2023). Citizen scientists report global rapid increases in skyglow. *Science*, 379(6629), 44–46. <https://www.science.org/doi/10.1126/science.adf4952>

National Geographic Society. (n.d.). Light pollution. National Geographic Education. <https://education.nationalgeographic.org/resource/light-pollution/>

Scotti, D. (2020, October 14). Low-light driving conditions and the dangers of glare. SecurityDriver.com. <https://securitydriver.com/09/episode-150-low-light-driving-conditions/>

UK Centre for Ecology & Hydrology. (2021, May 12). LED streetlights reduce insect populations by 50 percent. <https://www.ceh.ac.uk/press/LED-streetlights-reduce-insect-populations-50-percent>