

Compassionate Lighting for the Future Urban Night

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Learning Objectives

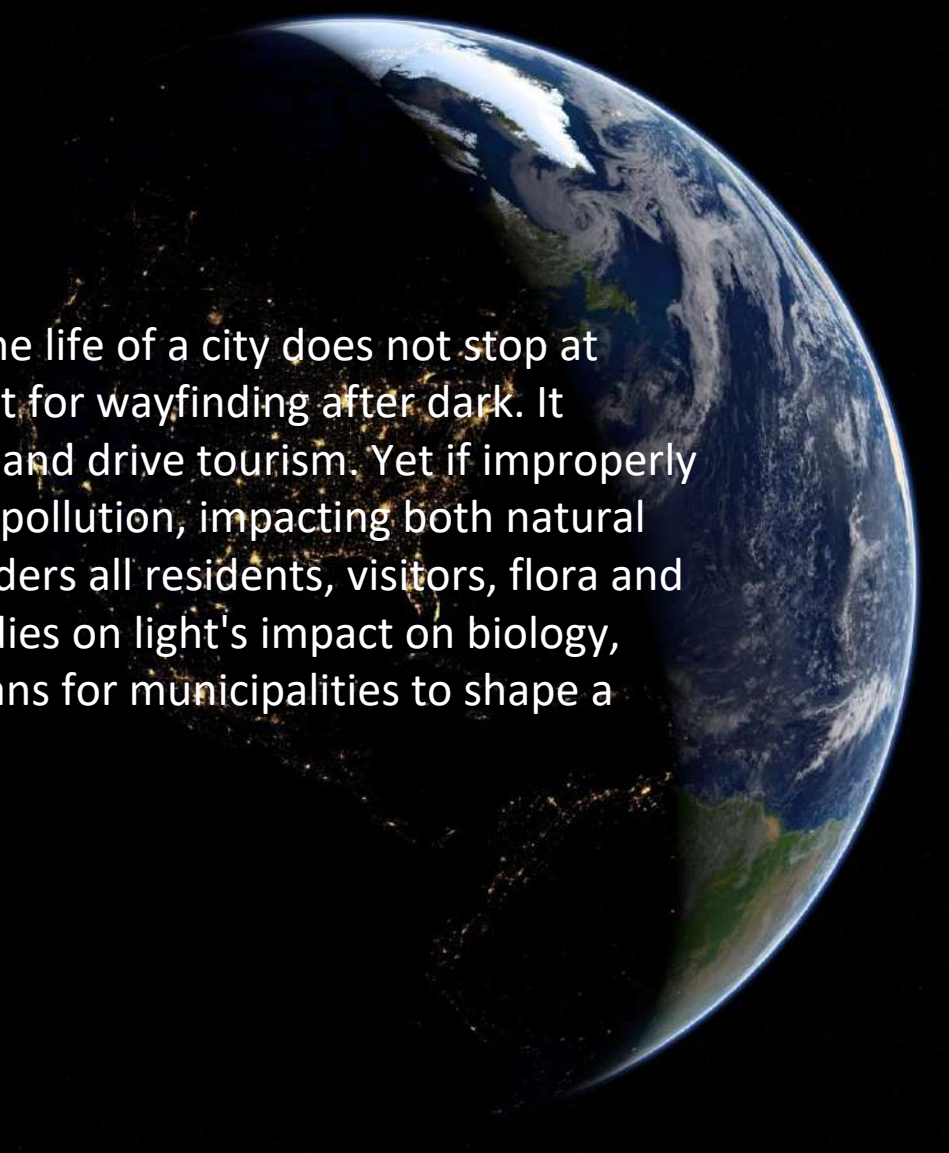
Health - Attendees will learn the effect of light pollution and how to assess the impact on the biology and botany of a city which ultimately impacts the human inhabitants.

Safety - participants will be instructed on the differences between task and security lighting and how to achieve a proper balance for maximum safety. does not need to be at odds with a night experience for residents.

Welfare - The identity of a city skyline does not need to be at odds with a night experience for residents. Attendees will learn how properly designed urban night lighting enhances a city dweller's outdoor experience.

Outreach - Designers will learn to appropriately engage municipalities directly via public outreach, ordinances and other strategies to create a balanced and healthy urban nightscape.



A photograph of the Earth from space, showing the curvature of the planet. The right side is illuminated by the sun, showing blue oceans and green landmasses. The left side is in shadow, with city lights visible as a glowing pattern of yellow and white dots against the dark background of the planet.

By 2050, two-thirds of the world population will reside in cities. The life of a city does not stop at dusk, but continues through the night. Lighting is a key component for wayfinding after dark. It establishes an identity for the city skyline that can unite residents and drive tourism. Yet if improperly applied, lighting can blanket the surrounding landscape with light pollution, impacting both natural ecosystems and the well-being of the population. Our panel considers all residents, visitors, flora and fauna who cohabit in the urban night. We will discuss current studies on light's impact on biology, look at lighting as part of a city's identity, and formulate action plans for municipalities to shape a compassionate night experience for all city life.

Topics:

1. Urban lighting as a shared experience
2. The proliferation of highly efficient lighting
3. LED = overlighting = pollution
4. Equity in lighting
5. Advocacy for darkness



Urban Lighting as a Shared Experience



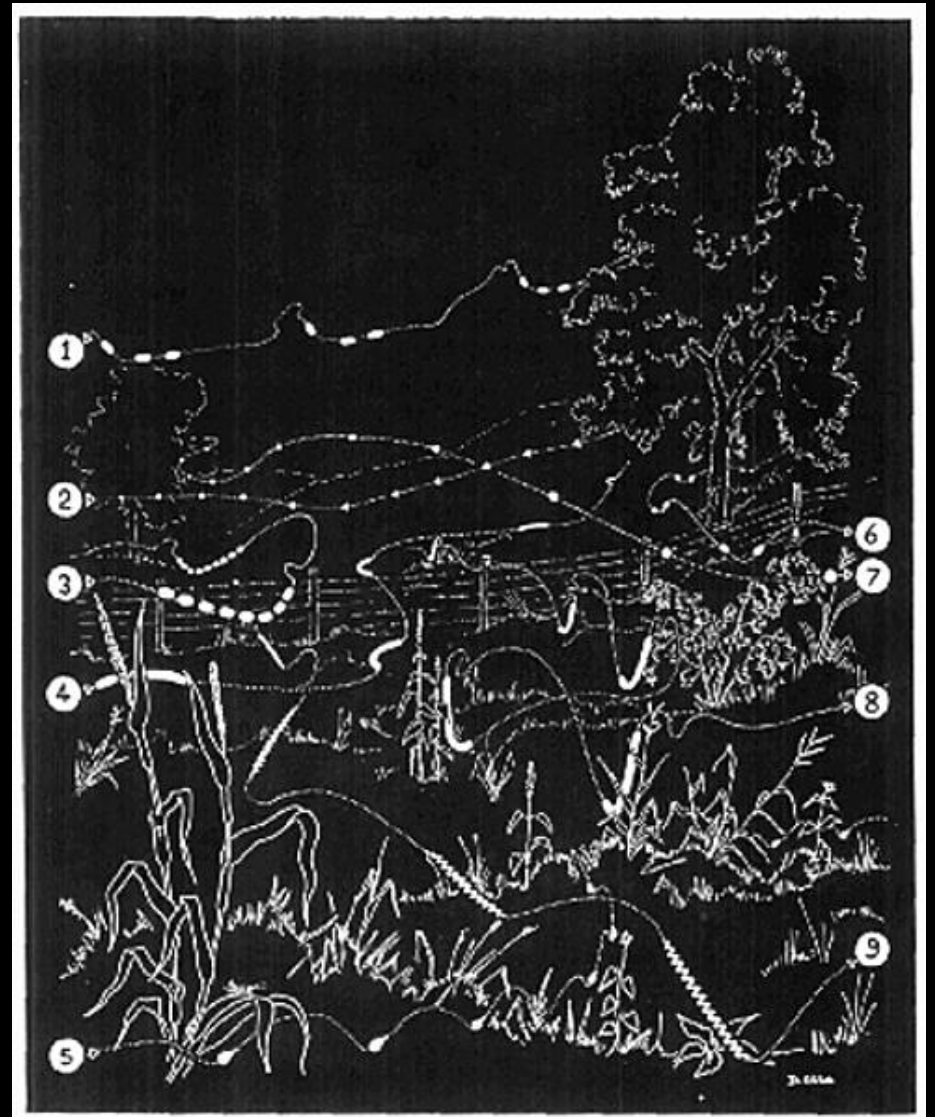
Lighting as a Shared Experience







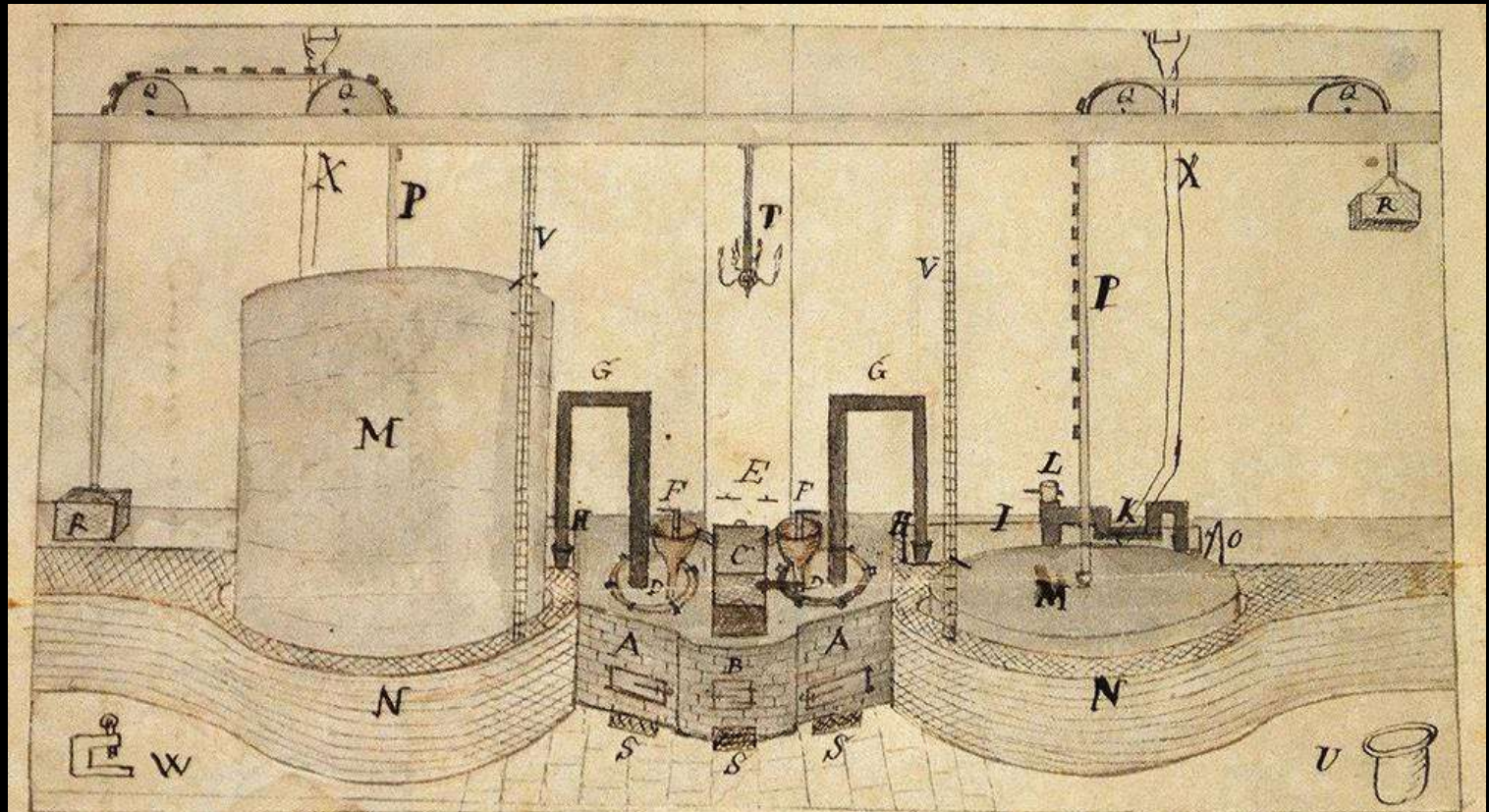
Darkness as a Shared Experience



The Proliferation of Highly Efficient Lighting

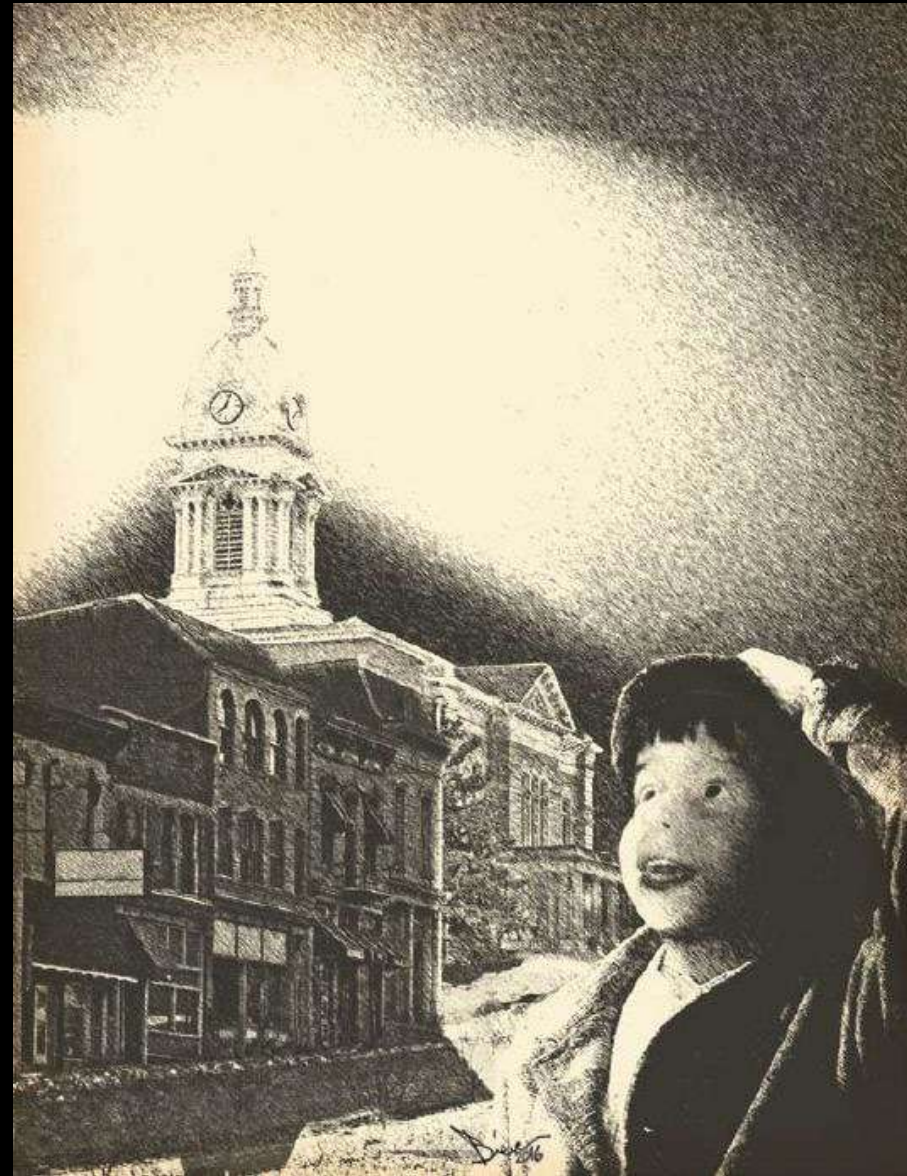
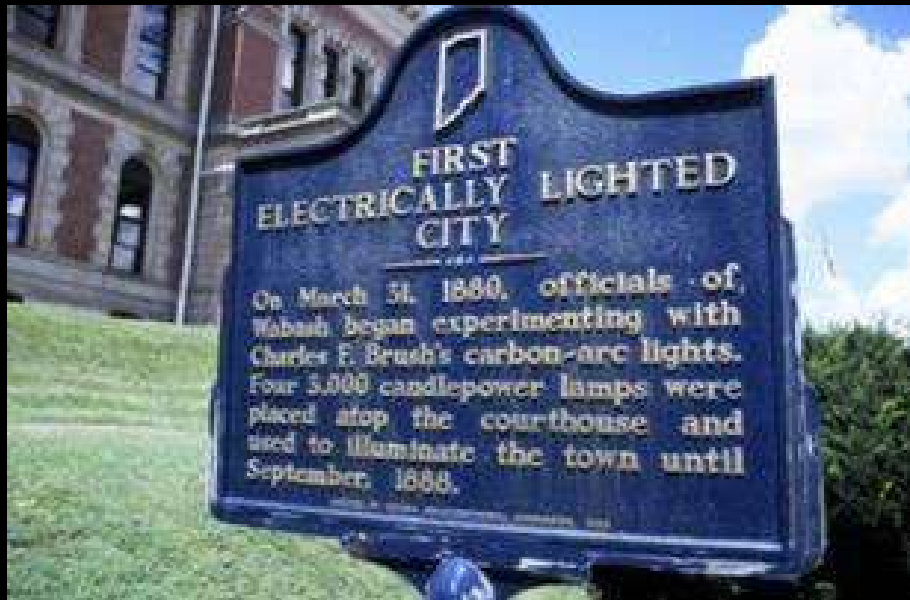






Double-Gas-Apparatus at Newport Light House

A. J. Simpson





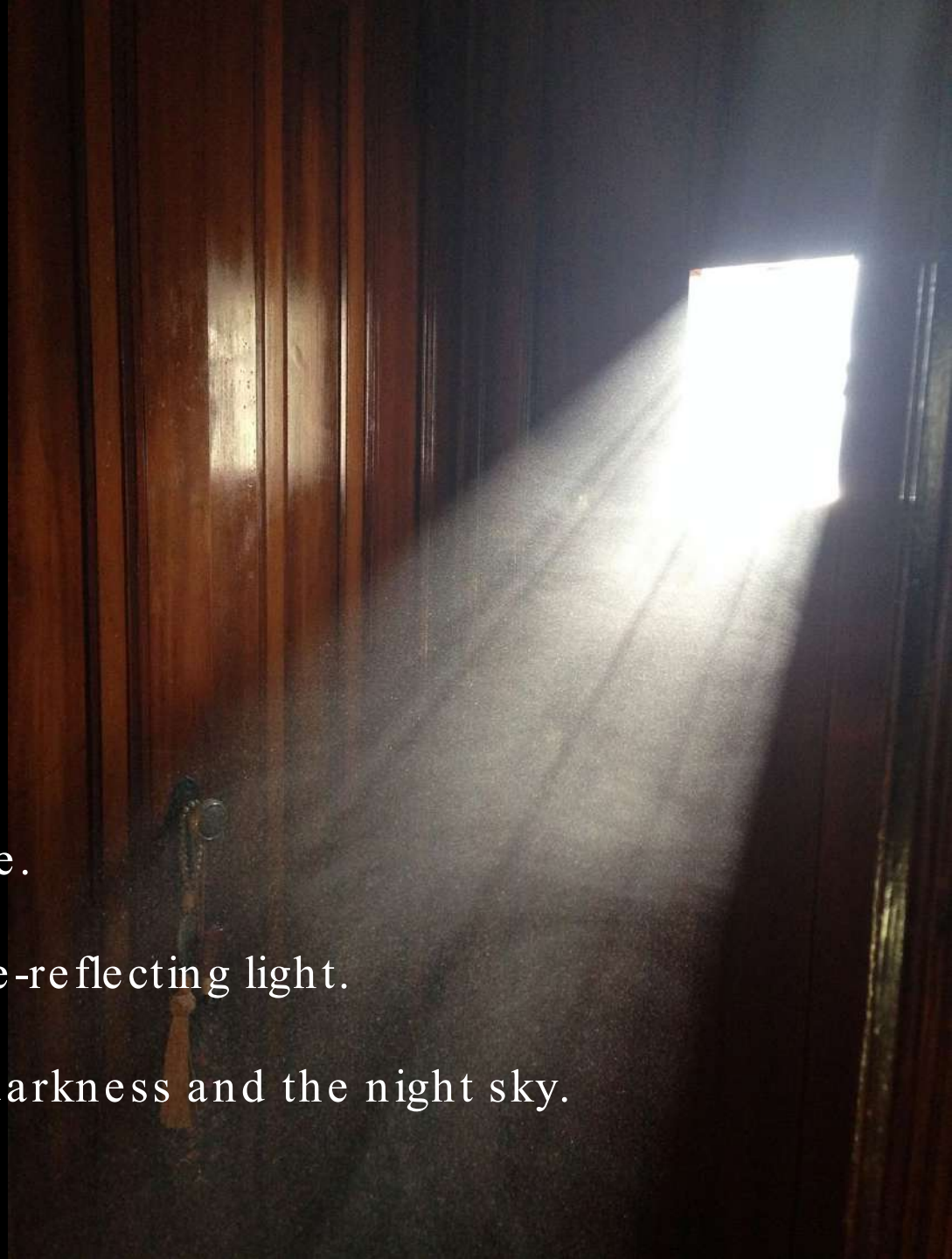


The Mechanics of Light Pollution

The air, seemingly invisible, is filled with soft particulate.

These particles serve as trillions of tiny little mirrors, re-reflecting light.

This re-reflection creates clouds of light that obstruct darkness and the night sky.



The effects of polluting light persist as far as 200 kilometers (about 120 miles) from the source.

1



The Danger of LEDs



They can go
anywhere.

Awareness & Understanding

Bortle Scale

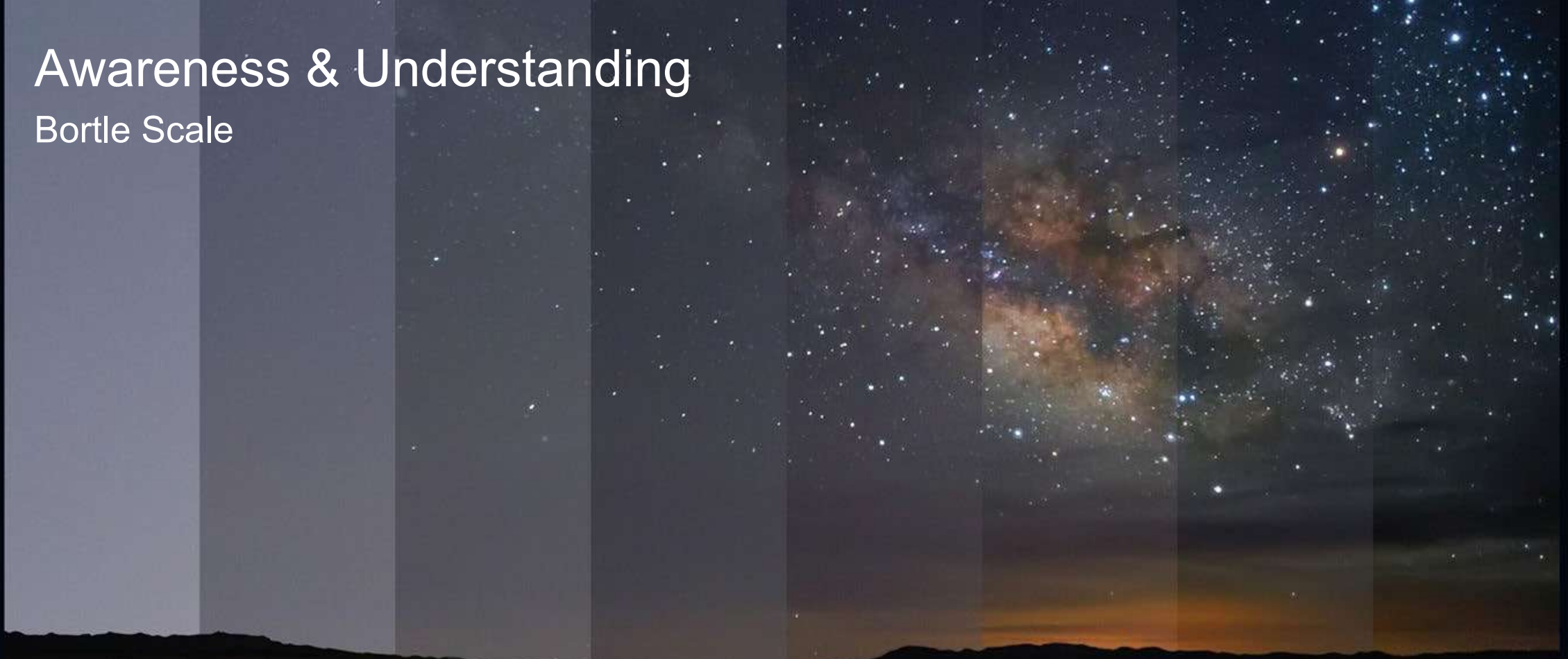


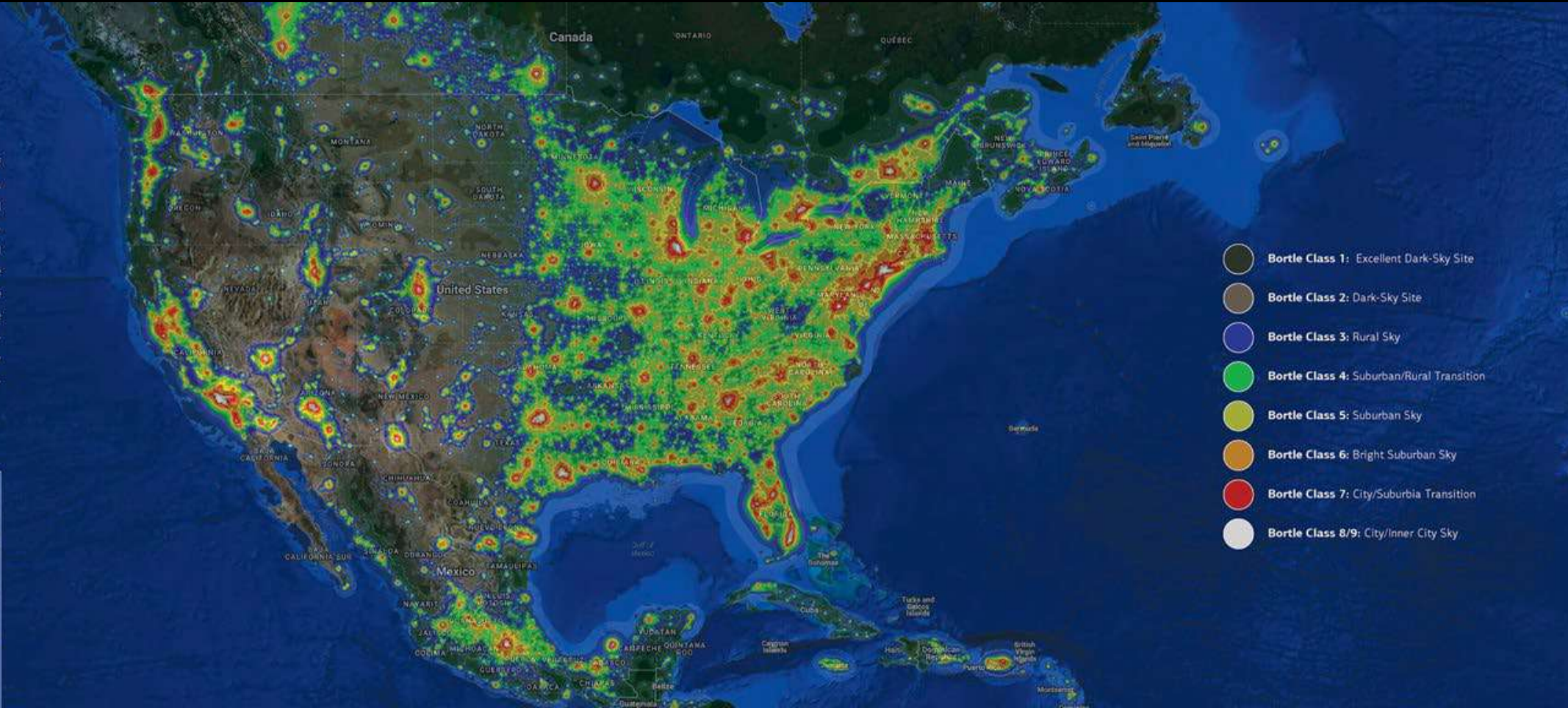
Image courtesy of Harun Mehmedinovic and Gavin Heffernan, Skyglow Project, www.skyglowproject.com

Awareness & Understanding

Bortle Scale

Bortle Scale

The Bortle Scale is a nine-level numeric measure of the night sky's brightness in a particular location. It quantifies the astronomical visibility of celestial objects and the interference caused by light pollution. John E. Bortle created the scale and published it in the February 2001 edition of Sky & Telescope magazine to help amateur astronomers evaluate and compare the darkness of observing sites. The scale ranges from Class 1, the darkest skies available on Earth, to Class 9, daylight-like inner city skies. Throughout this book, Bortle Scale class numbers will appear next to images.



We are at the onset of Light Addiction

Yet, more is less

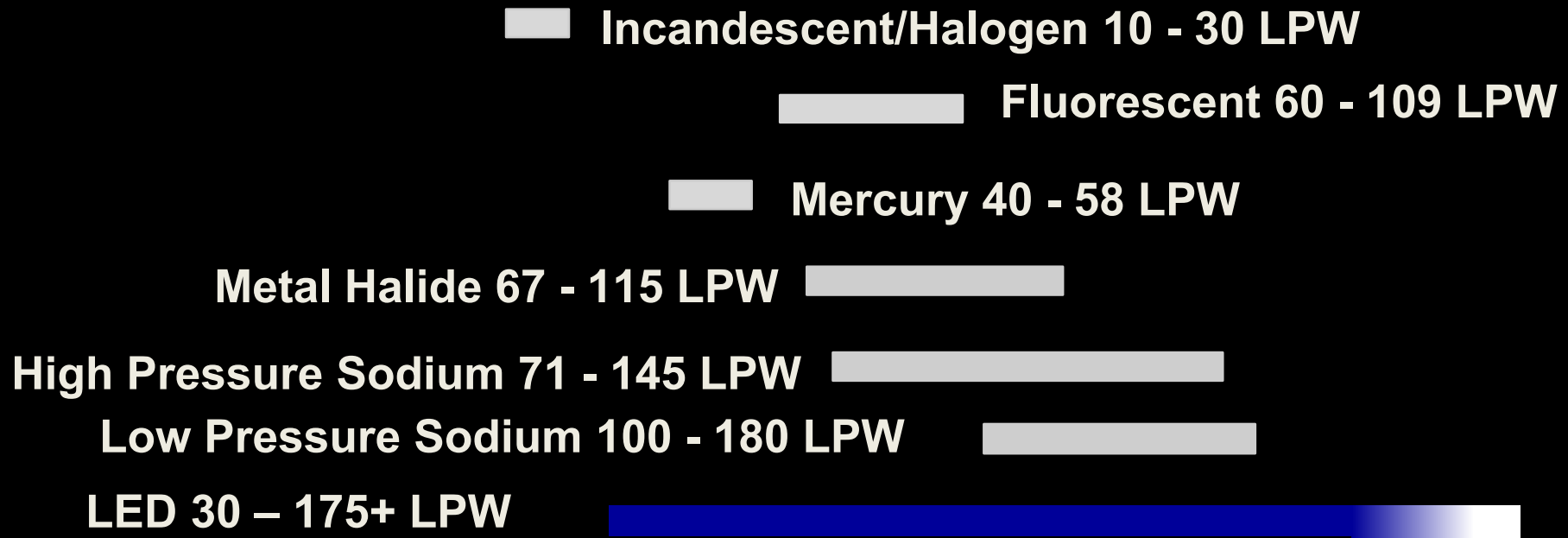


LEDucation®



LED Proliferation

Adoption of LED



Lumens Per Watt - Including Ballast

Energy Efficiency!



More Light for Less Energy!



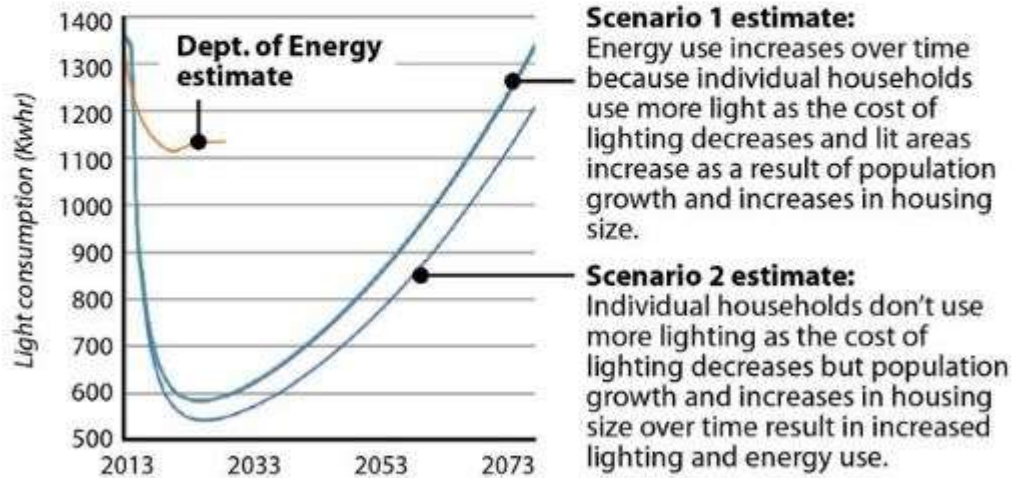
Greater efficiency leads to greater usage

LEDs Reduce Power Usage, For Now

High efficiency LED lights will reduce residential lighting energy requirements in the short term but an increasing amount of lit space and a tendency for individuals to use more light when the cost of lighting decreases will erode energy savings over time.

AVERAGE HOUSEHOLD ENERGY CONSUMPTION FOR LIGHT

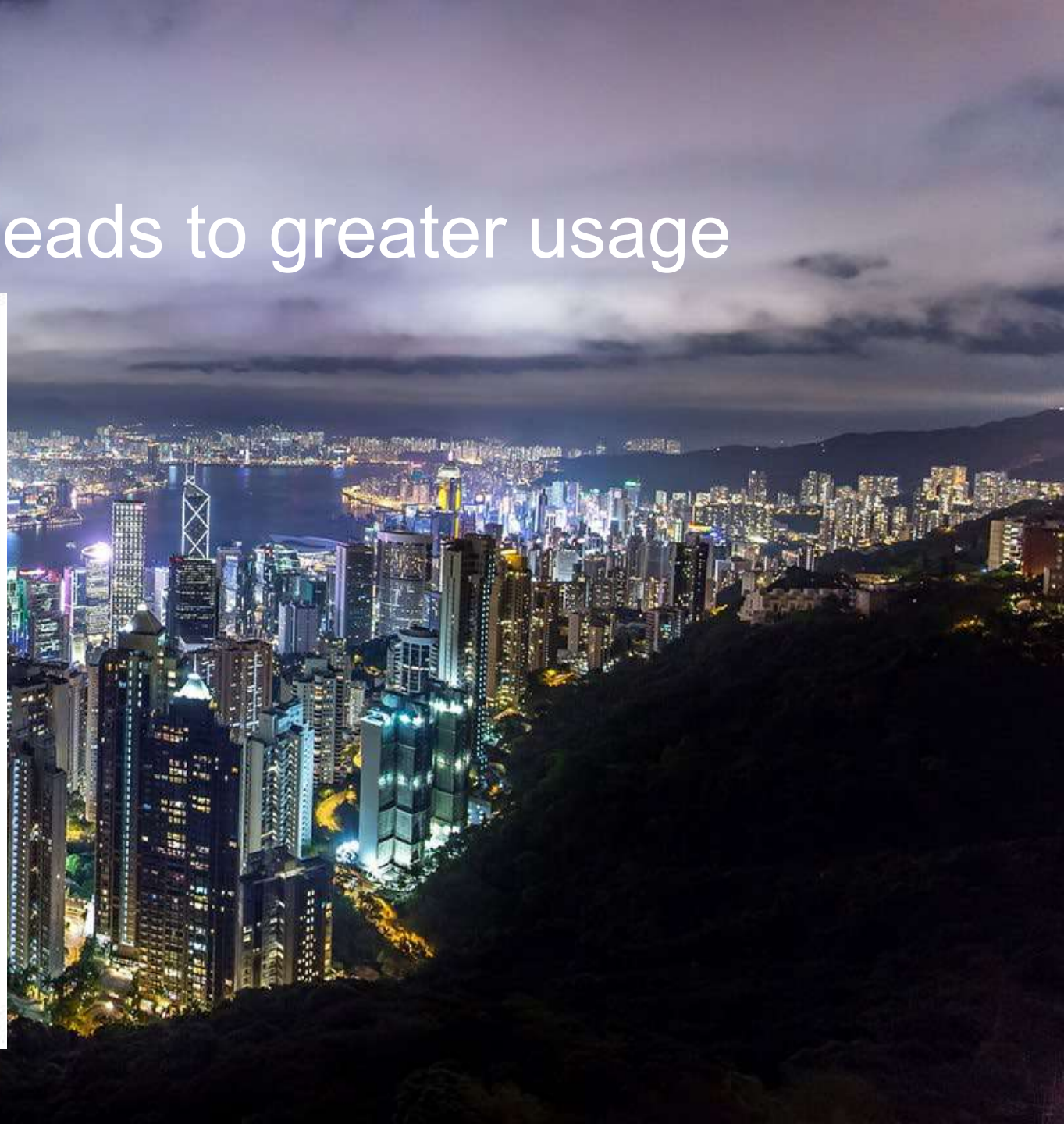
in kilowatt hours, annual estimates (projected)



Scenario 1 estimate: Energy use increases over time because individual households use more light as the cost of lighting decreases and lit areas increase as a result of population growth and increases in housing size.

Scenario 2 estimate: Individual households don't use more lighting as the cost of lighting decreases but population growth and increases in housing size over time result in increased lighting and energy use.

SOURCE: *Emergent Effects of Residential Lighting Choices: Prospects For Energy Savings* by Hicks, Zellner and Theis, *Journal of Industrial Ecology*, University of Illinois at Chicago



LED



LED = Overlighting



LED = Overlighting = Pollution



Should good neighbors share light?



Effects of Light Pollution on Wildlife

- Disorients and distracts animals
- Triggers reproductive behaviors at the wrong periods
- Frustrates behaviors around feeding and pollination
- Alters migration patterns and draws animals off course
- Changes the way that species relate and interact



Two Major Impacts of Artificial Light on Wildlife

Physical

Biological

A View of the Night Sky

TIME

DIRECTION

SEASON

LOCATION

WEATHER



Circadian Entrainment



All Species are Impacted by Light Pollution



Let's Quantify Light



Color Temperature

2200K

4000K



Color Rendering Index

2200K

22 CRI

4000K

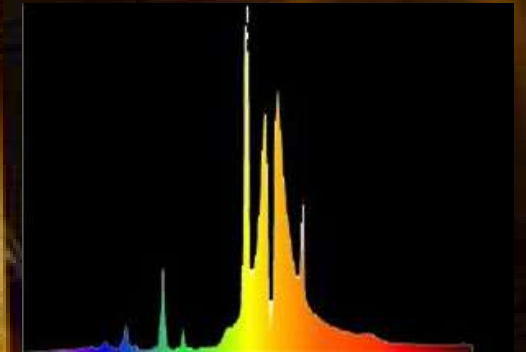
74 CRI



Spectral Power Distribution

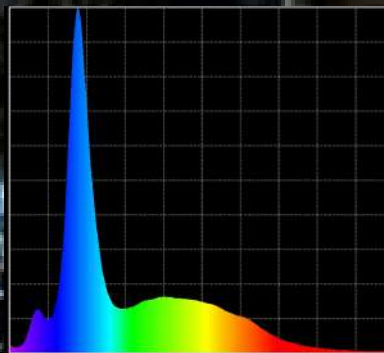
2200K

22 CRI



4000K

74 CRI



Lumens





Lumens



Candela

Lumens



Candela

Illuminance
Footcandles or Lux

Lumens

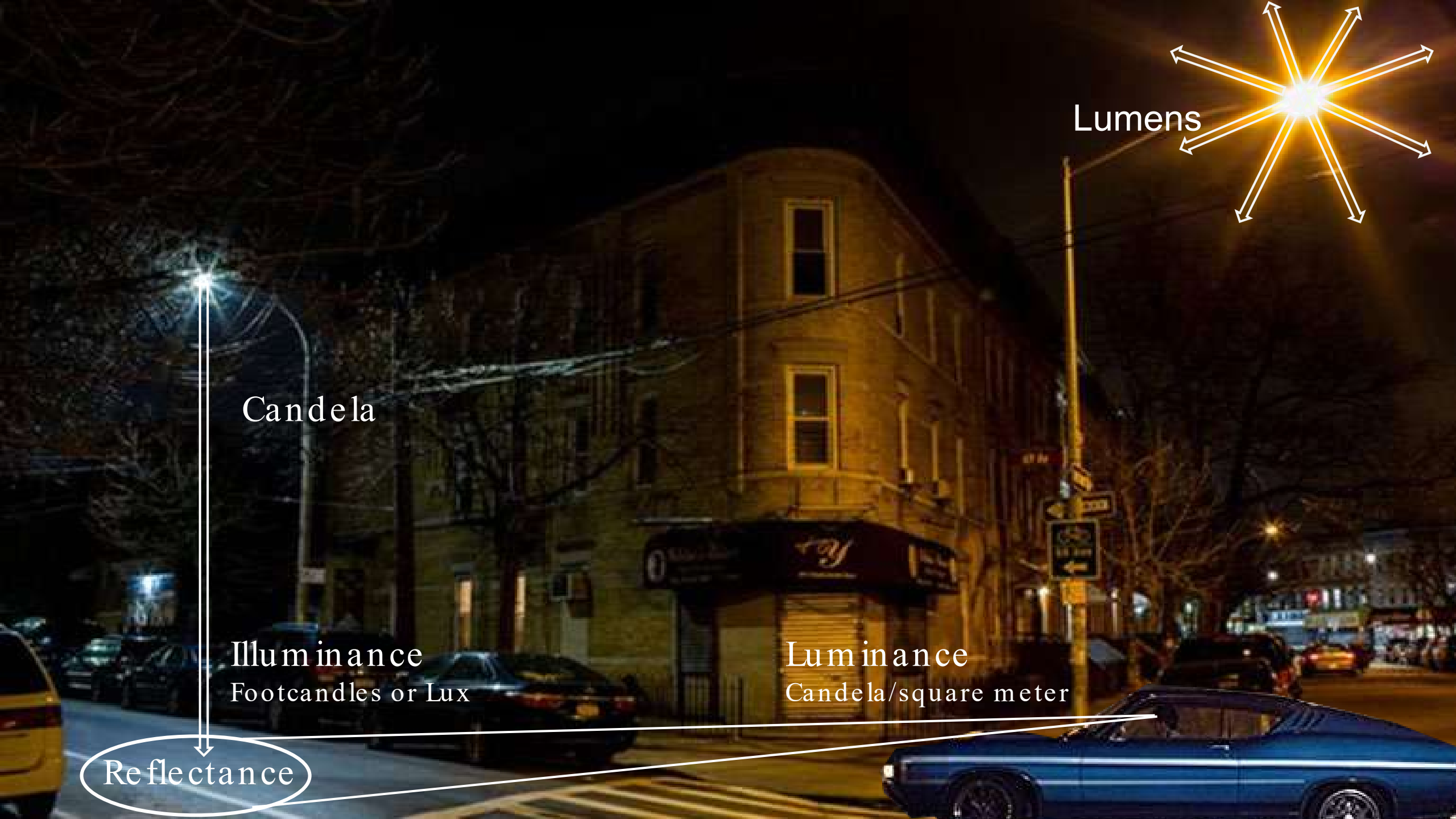


Candela

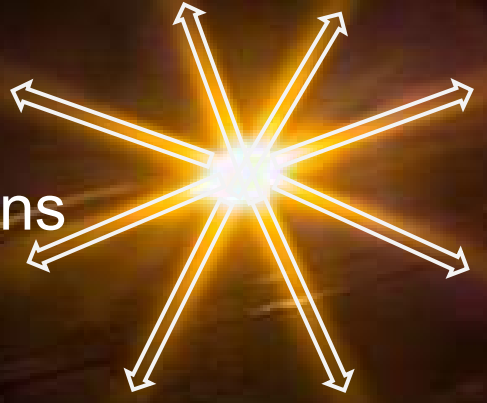
Illuminance
Footcandles or Lux

Reflectance

Lumens



Lumens



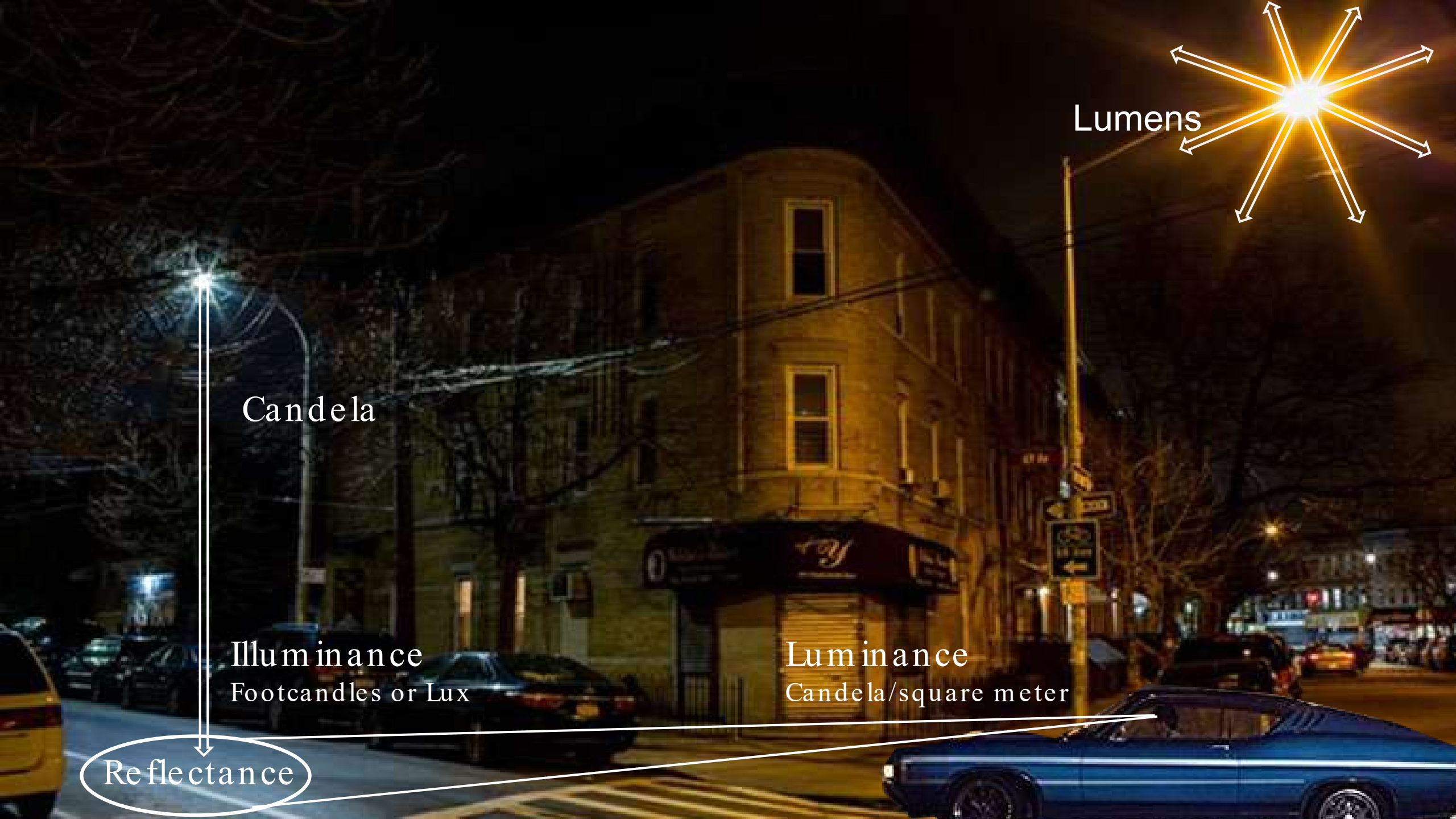
Candela

Illuminance
Footcandles or Lux

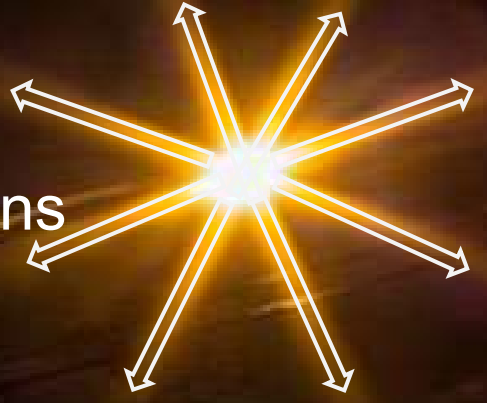
Luminance
Candela/square meter

Reflectance





Lumens



Candela

Illuminance
Footcandles or Lux

Luminance
Candela/square meter

Reflectance



BUG Ratings

Unified Glare Rating (UGR)



Light Loss Factors

Lumen Depreciation

80%

Luminaire Dirt Depreciation

98%

Municipalities often require light loss factors of 70%



Caught Between a Rock and a Dark Place

Municipal ordinances struggle with dual requirements

Municipal Ordinances often include recommendations from IES and MLO.

The ordinances intend to serve both the safety of citizens and reduce light at night.

The city engineer can be unfairly tasked with evaluating cases where the minimum and maximum illumination levels are in conflict.

	<i>Residential Zones or Uses</i>	<i>Nonresidential Uses Within 300 Feet of Protected Residential Uses</i>	<i>Office/ Industrial Uses</i>	<i>Retail and Service Oriented Uses</i>
Special controls	All lights required for security must be on an alternate circuit. All other exterior lighting must be illuminated no earlier than one hour before the start of business and must be extinguished no later than one hour after the end of business.			
Minimum illumination on surface (up to a 50% reduction allowed for the perimeter 25 ft. of parking, loading, access or other surfaced areas along the property line)	1.0 FC	As required for the specific uses	1.5 FC	2.0 FC
Maximum illumination at property line (no limit along public street)	0.5 FC		2.0 FC	

Code of Ordinances, Chapter 21. City of Bloomington, MN

Equity in Lighting



Equity in Lighting

Education®





Refugee Camps





Refugee Camps

A photograph of the Earth from space, showing the curvature of the planet and the glowing lights of cities at night. The image is positioned on the right side of the slide, partially overlapping the text.

Who is responsible for lighting
Grid vs. Off-grid systems?







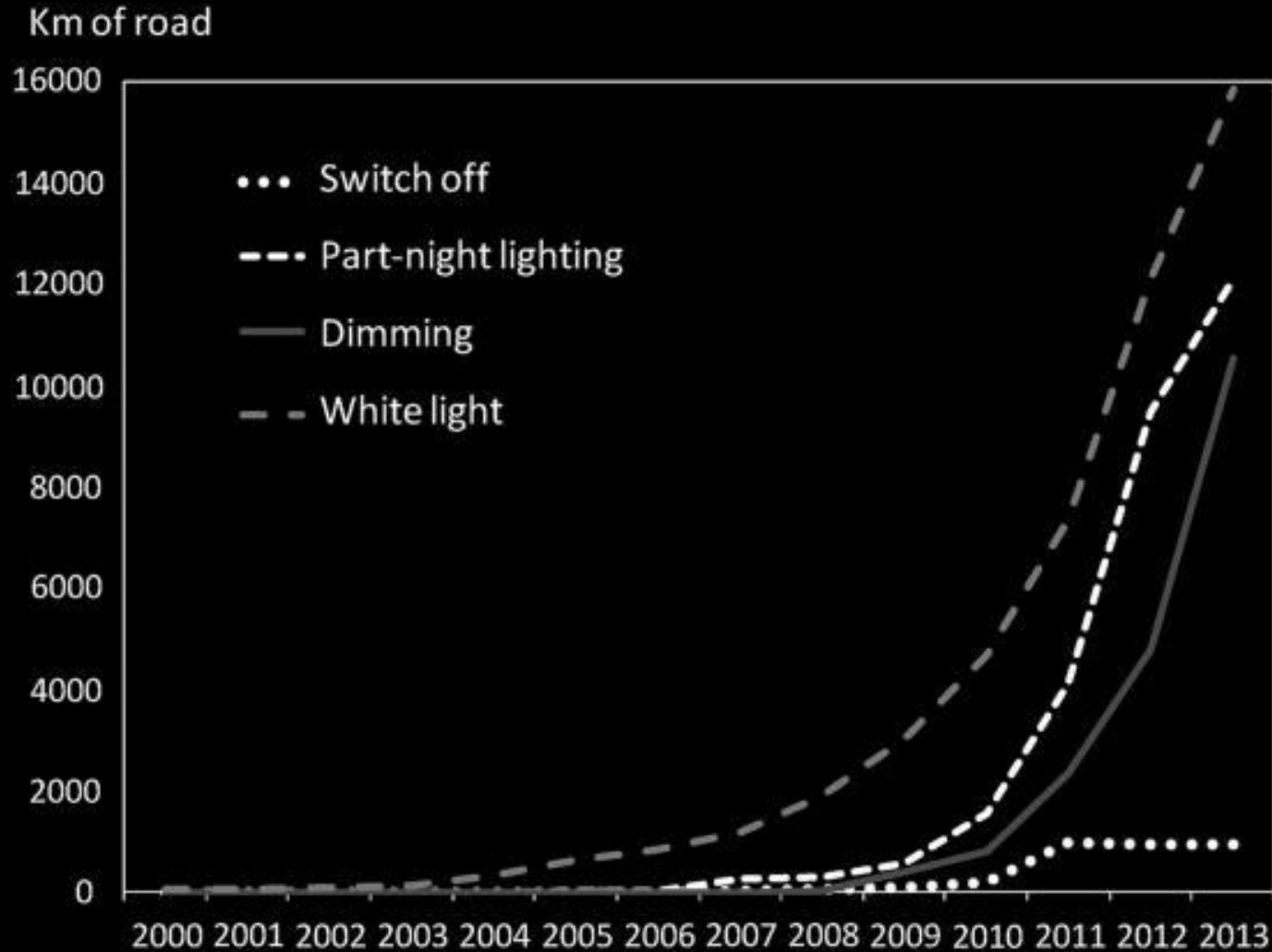
STREET LIGHTING FOR SAFER STREETS?

The effect of reduced street lighting on road casualties and crime in England and Wales: controlled interrupted time series analysis

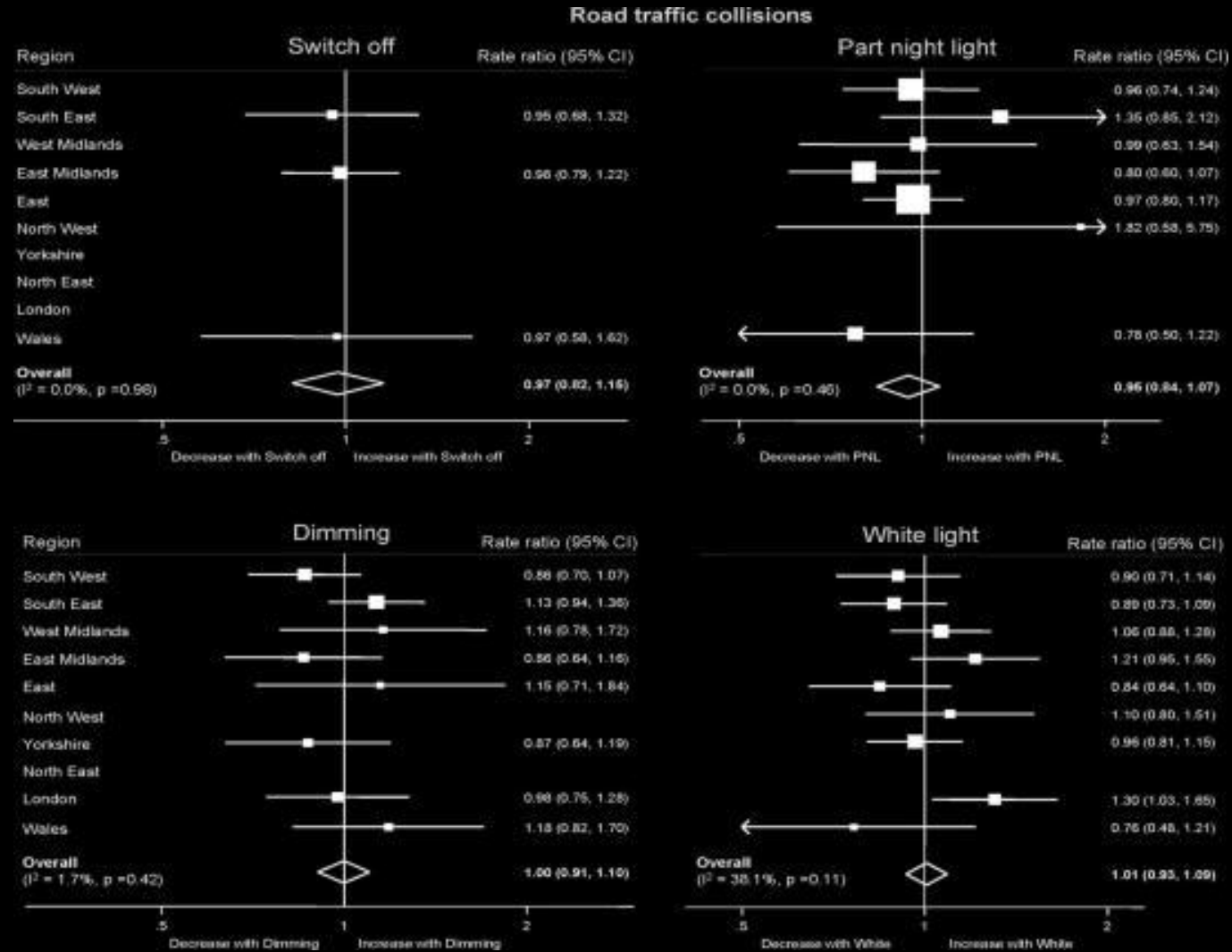
Journal of Epidemiology & Community Health, 2015

Rebecca Steinbach et al. J

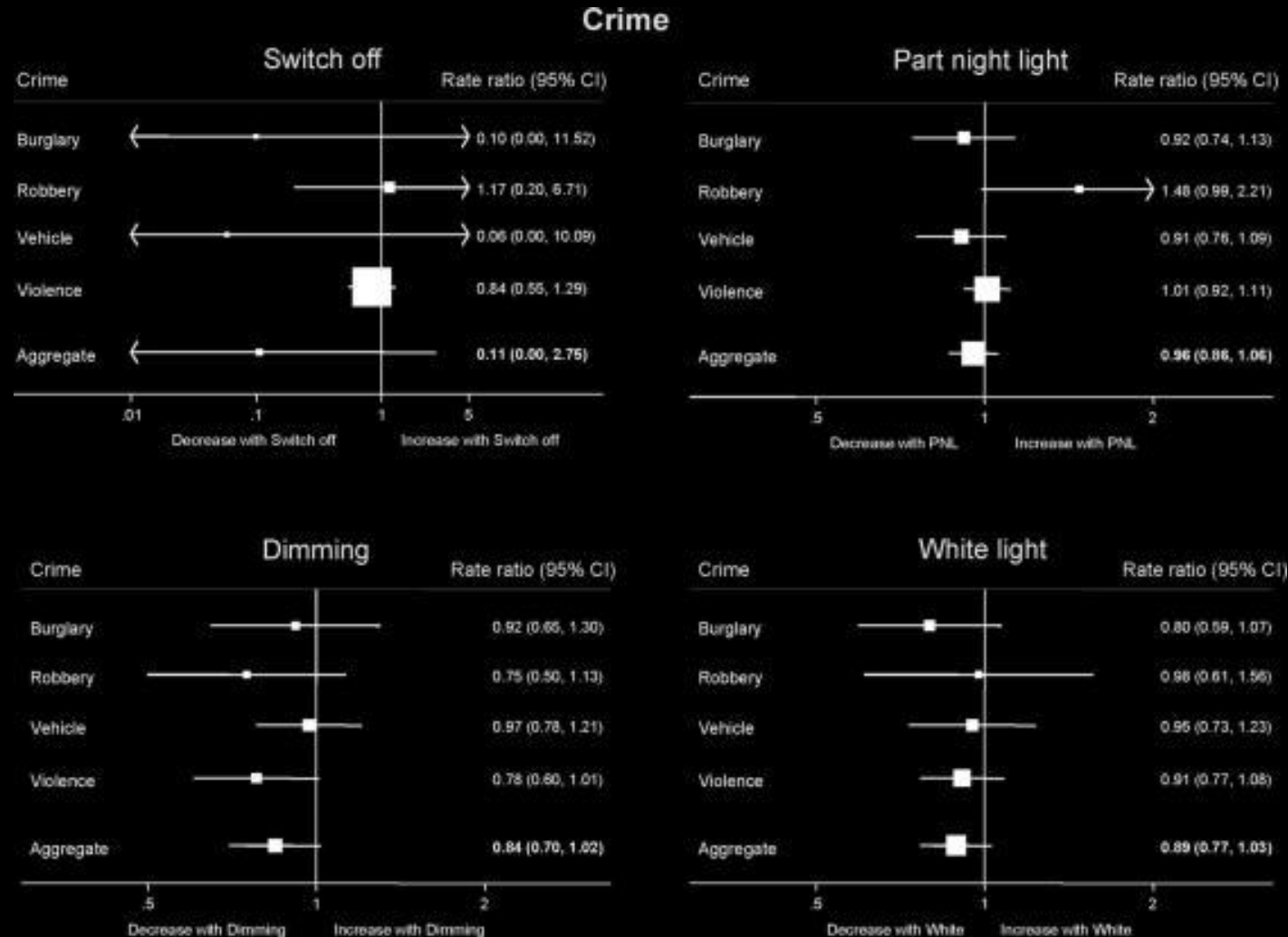
Kilometres of road with lighting adaptation strategies implemented in participating local authorities.



Associations between street light adaptation strategies and night -time road traffic collisions.

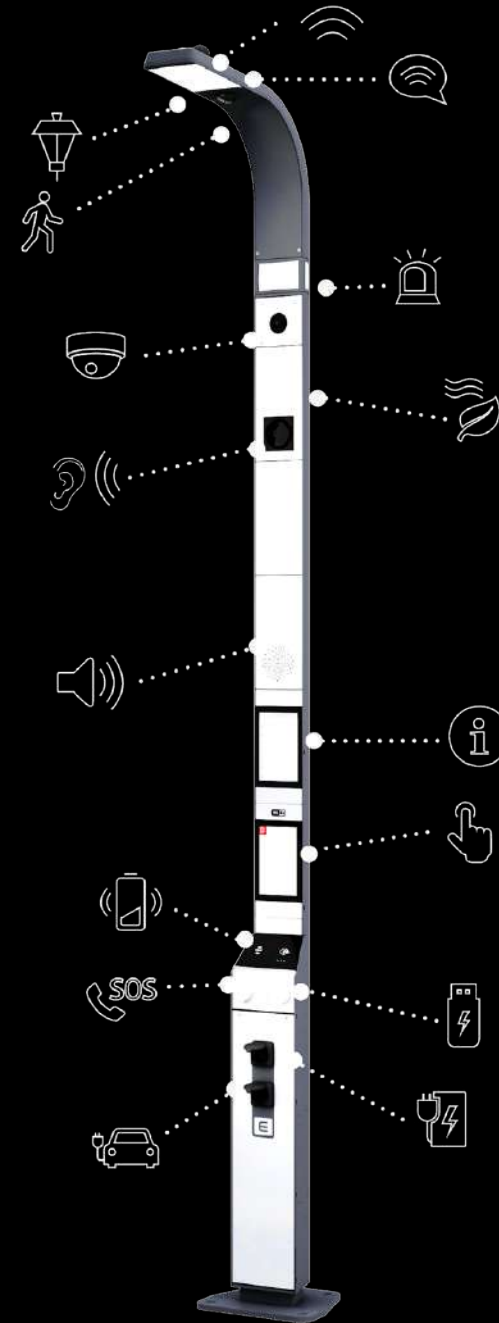


Associations between street light adaptation strategies and crime.



The Smart Pole as an Access Point

- LED Luminaire, dimmable, with diagnostics
- Astronomical Timeclock to run lights on a schedule
- Sensors for daylight, motion, temperature, vibration
- Video monitoring for security
- Speakers for public announcement
- Microphones for interaction (and recording?)
- Air quality sensors
- WiFi and Bluetooth connectivity
- Screens for displaying information and interaction
- Emergency Call Capabilities
- Charging stations for personal devices





Impacts of Exterior Lighting on Pollination

In one study,¹ lit meadows as compared to unlit meadows:

- Received 62% less visits by nocturnal insects
- Had 29% fewer pollinating insects
- Bore 13% less fruits in the plant studied, cabbage thistle



“The habit of feeding at artificial lights is now so common and widespread among bats that it must be considered part of the normal life habit of many species.”¹

1. Rich, C., & Longcore, T. (2013). *Ecological Consequences of Artificial Night Lighting*. Washington: Island Press. Page 43.



LED Color vs. Nature's Intentional Use of Color

LEDs skew color - which draws pollinators to different flowers

Building Façade Lighting – What is really important for human activity?



Vancouver

Further Signs of Light Addiction



Image Courtesy of StartRocket

GOWANUS REZONED

A SURVEY OF URBAN LIGHT
BEFORE. DURING. AFTER.







INDUSTRIAL
WAREHOUSE 27'-32'

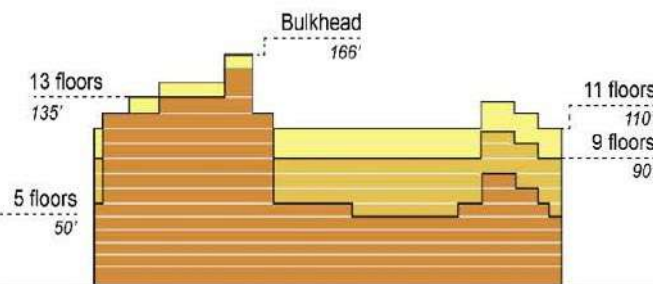


TYPICAL BROOKLYN
BROWNSTONE 40'



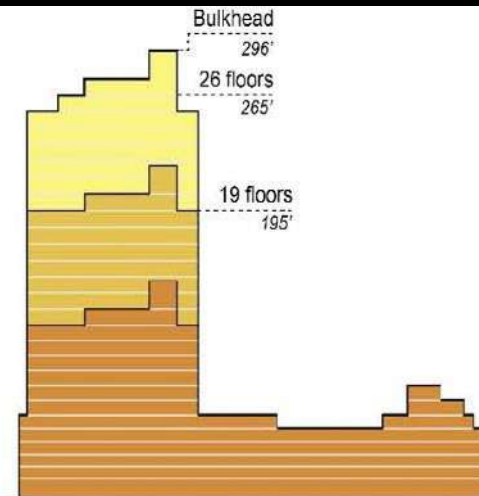
Existing Development
3.6 FAR

323,193 sf of existing Zoning Floor Area



Proposed Development
Lower Bulk Density

- 448,880 Zoning Floor Area (+125,686 sf) at 5.0 FAR
- 538,656 Zoning Floor Area (+215,462 sf) at 6.0 FAR



Proposed Development
Tower Density

- 448,880 Zoning Floor Area (+125,686 sf) at 5.0 FAR
- 538,656 Zoning Floor Area (+215,462 sf) at 6.0 FAR



(2/2/11)

62-653

Lighting

All #waterfront public access areas# shall provide lighting in accordance with the following requirements:

An average maintained level of illumination of not less than one horizontal foot candle (lumens per foot) throughout all walkable areas, and a minimum level of illumination of not less than 0.2 horizontal foot candles (lumens per foot) throughout all other areas, shall be required. Such level of illumination shall be maintained from one-half hour before sunset to one-half hour after sunrise.

The average illumination to minimum foot candle uniformity ratio shall be no greater than 10:1 within a #waterfront public access area#.

Glare shall be controlled to a semi-cutoff standard (not more than five percent of peak foot candle intensity radiating above 90 degrees and 20 percent of peak intensity above 80 degrees). The luminaire shall be equipped with lamps with a color temperature range of 3000 K to 4100 K with a minimum color rendering index of 65.

All lenses and globes shall be polycarbonate or equivalent.

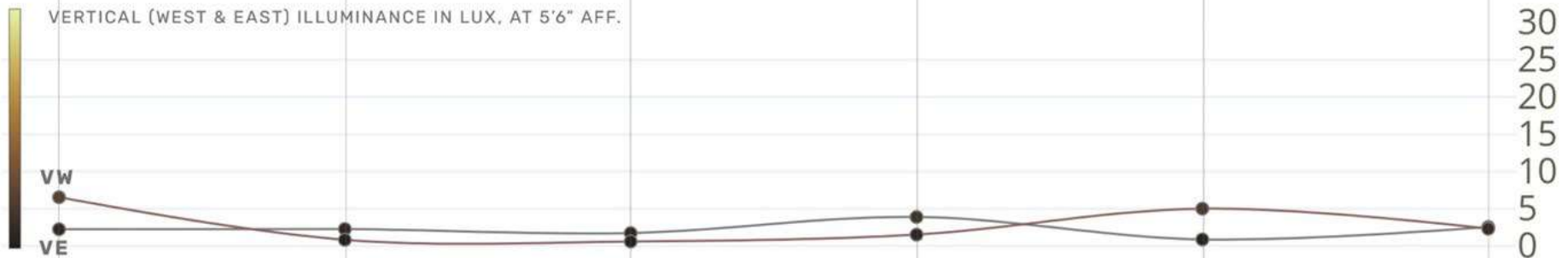
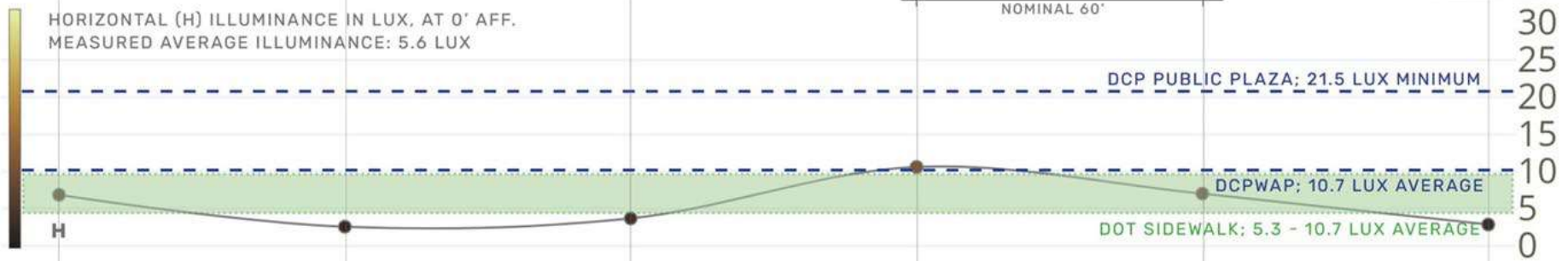
All lighting sources that illuminate a #waterfront public access area# and are mounted on or located within #buildings# adjacent to the #waterfront public access area# shall be shielded from direct view. In addition, all lighting within the #waterfront public access area# shall be shielded to minimize any adverse effect on surrounding #buildings# containing #residences#.

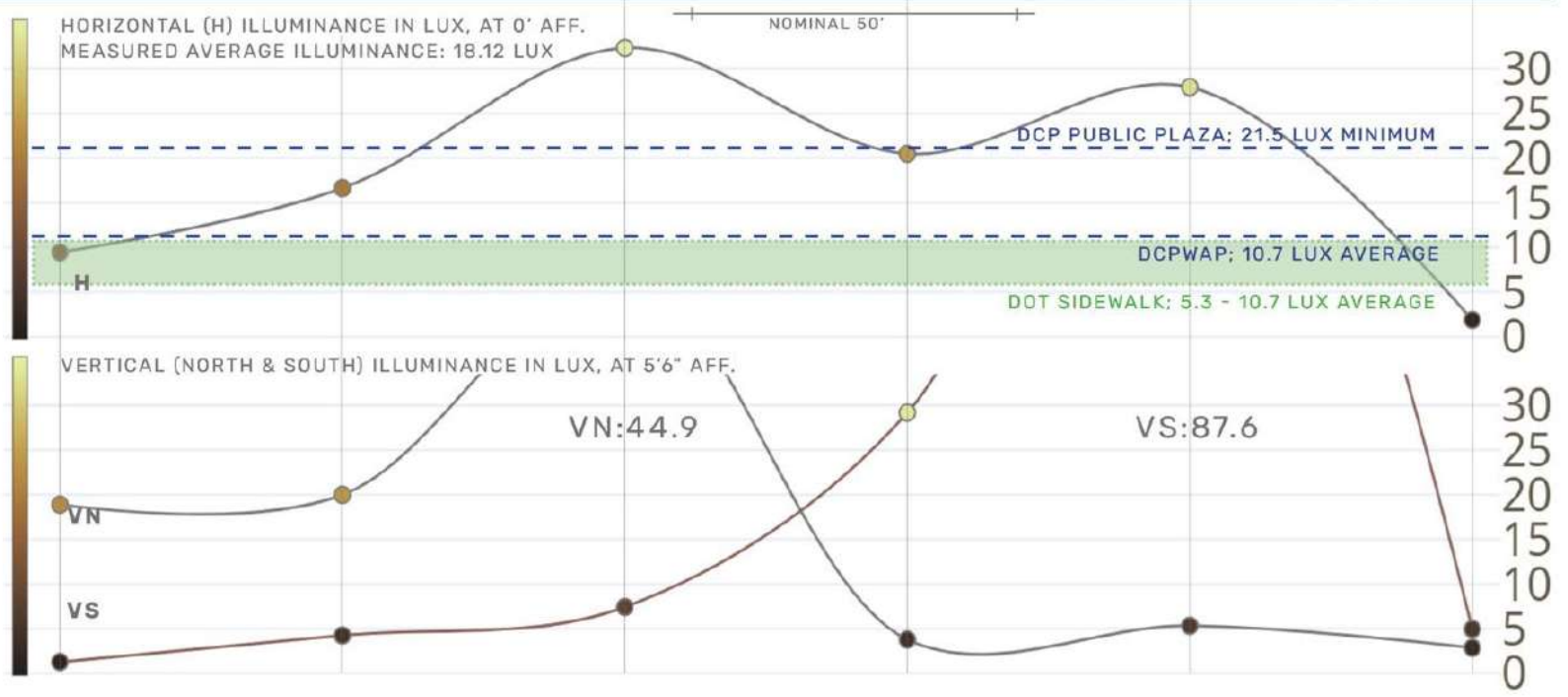
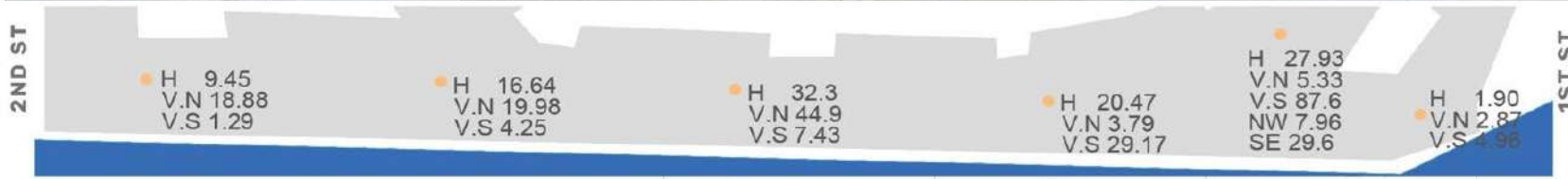






HOYT ST	#9	#11	#13	#15	#17	#19	#21	#23	#25	#27	#29	#31
H 6.86		H 2.58										
V.W 6.54		V.W 0.83			H 10.6			H 7.02				H 2.87
V.E 2.24		V.E 2.27			V.W 1.52			V.W 5.01				V.W 2.32
					V.E 3.89			V.E 0.88				V.E 2.54





BUT WHAT HAPPENS AT NIGHT?

A Lighting Designer's response to NYC DCP's Gowanus Re-zoning Proposal

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98 4th Street, Suite 302
Gowanus, Brooklyn, NY 11231
www.sightestudio.com

This response includes comments developed as an analysis and reaction to the Gowanus Re-Zoning Draft proposed by New York City Department of City Planning (NYC DCP) on January 30th, 2019. The comments are primarily related to lighting, both electric and daylighting, as a lens through which to view the proposal.

General Comments

In reading DCP's Gowanus Framework, the Zoning Draft sections, and the other non-zoning initiative sections, we see that the process of envisioning Gowanus' future relies primarily on factors of density and land-use. The framework proposes a substantial increase in building density and height – going from the current low-rise industrial typology to mid and high-rise mixed-use. This will have an inevitable impact on the way the neighborhood looks and feels at





Advocacy for Darkness



Compassionate Lighting for the Future Urban Night

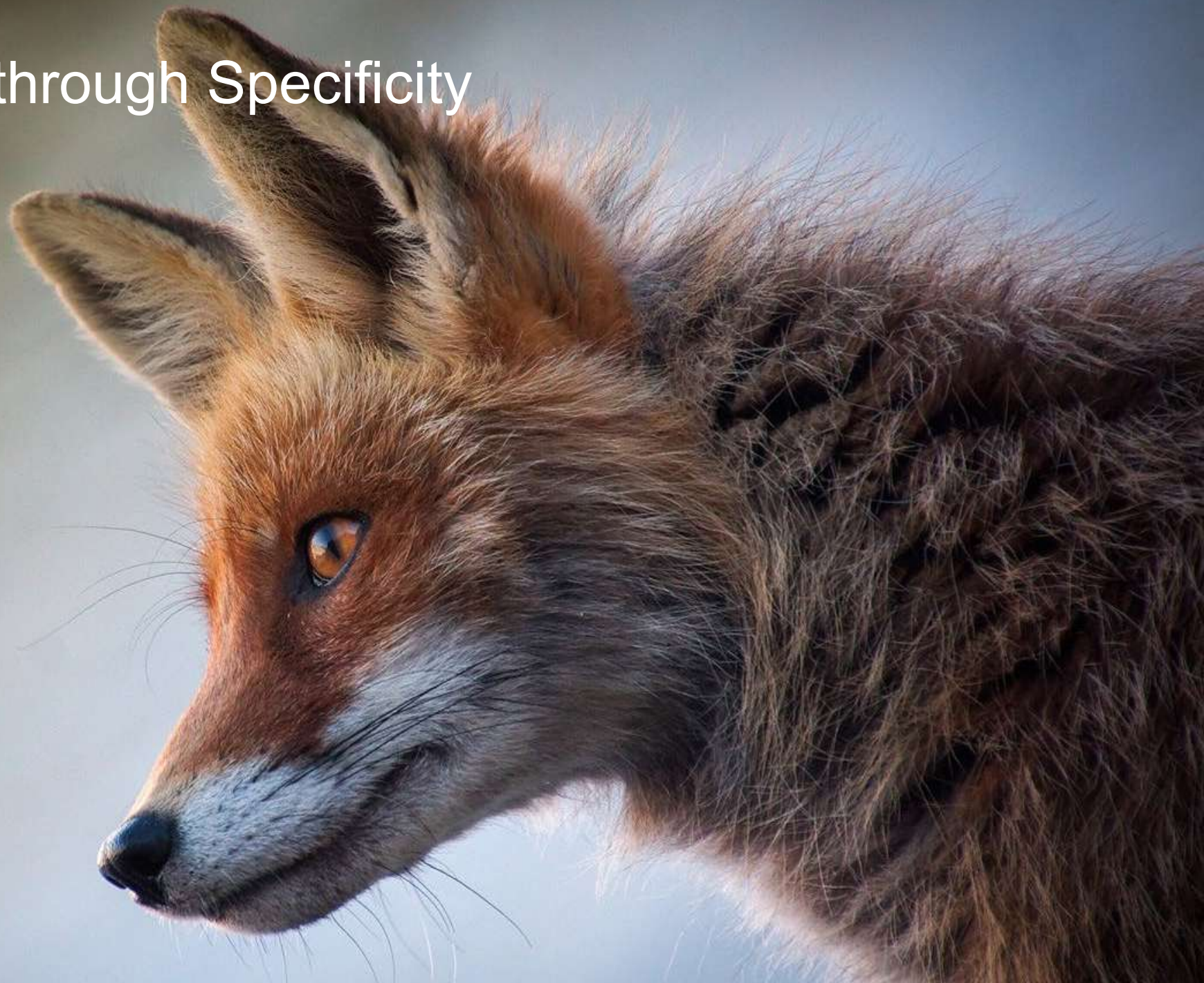
				
<p>Educate on the Impact</p>	<p>Participatory Design</p>	<p>City Planning Meetings</p>	<p>Craft Local Ordinances</p>	<p>Be Vocal for Wildlife</p>
				
<p>Design for Specific Use</p>	<p>Photometric Studies</p>	<p>Dark Sky Compliance</p>	<p>Curate With Controls</p>	<p>Avoid Uplight Always</p>

Removing Barriers – Demystifying

Lighting is an expertise, with many counterintuitive concepts:

- Air is only seemingly invisible
- Water's dark mirrored surface penetrates light far beneath
- Animals and plants, whose voices cannot be heard, have circadian rhythms that are deeply impacted by light pollution
- 'More light is safer' is a concept of convenience

Create Advocates through Specificity



Wildlife as a Parameter

Aqua Building, Chicago

Designed by Studio Gang

- Fritted Glass

Photo Credit: Aqua western facade.JPG. (2016, November 6). *Wikimedia Commons, the free media repository*. Retrieved 02:14, March 16, 2019 from https://commons.wikimedia.org/w/index.php?title=File:Aqua_western_facade.JPG&oldid=212140080.

- Undulating overhangs

Photo Credit: Aqua Tower Chicago.jpg. (2017, November 28). *Wikimedia Commons, the free media repository*. Retrieved 02:07, March 16, 2019 from https://commons.wikimedia.org/w/index.php?title=File:Aqua_Tower_Chicago.jpg&oldid=269777562.


Flagstaff, Arizona

Successful advocacy for Dark Sky conducted over many years:

1958: City-wide ordinance for outdoor lighting

2001: Named the world's first International Dark Sky Place



A photograph of the Earth from space, showing the curvature of the planet, blue oceans, white clouds, and green landmasses. The night side of the Earth is visible, showing city lights as a dense pattern of yellow and orange dots.

Move DOE, ASHRAE and IECC to consider
quantity and quality of light versus
quantity of energy alone.

Shifting Our Philosophy

A person is silhouetted sitting on a large rock in the foreground, looking up at a vast night sky filled with stars and the Milky Way galaxy. The scene is dark, with the light from the stars providing the only illumination.

Reacquaint ourselves with the night

Reaccept darkness as a normal part of life



This concludes The American Institute of Architects Continuing
Education Systems Course



leducation.org

Thank You!

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