

Energy · Quality · ControllabilitySM

Choosing Both Energy Efficiency and Light Pollution Mitigation for Commercial Outdoor Lighting

Wednesday, July 10, 2024

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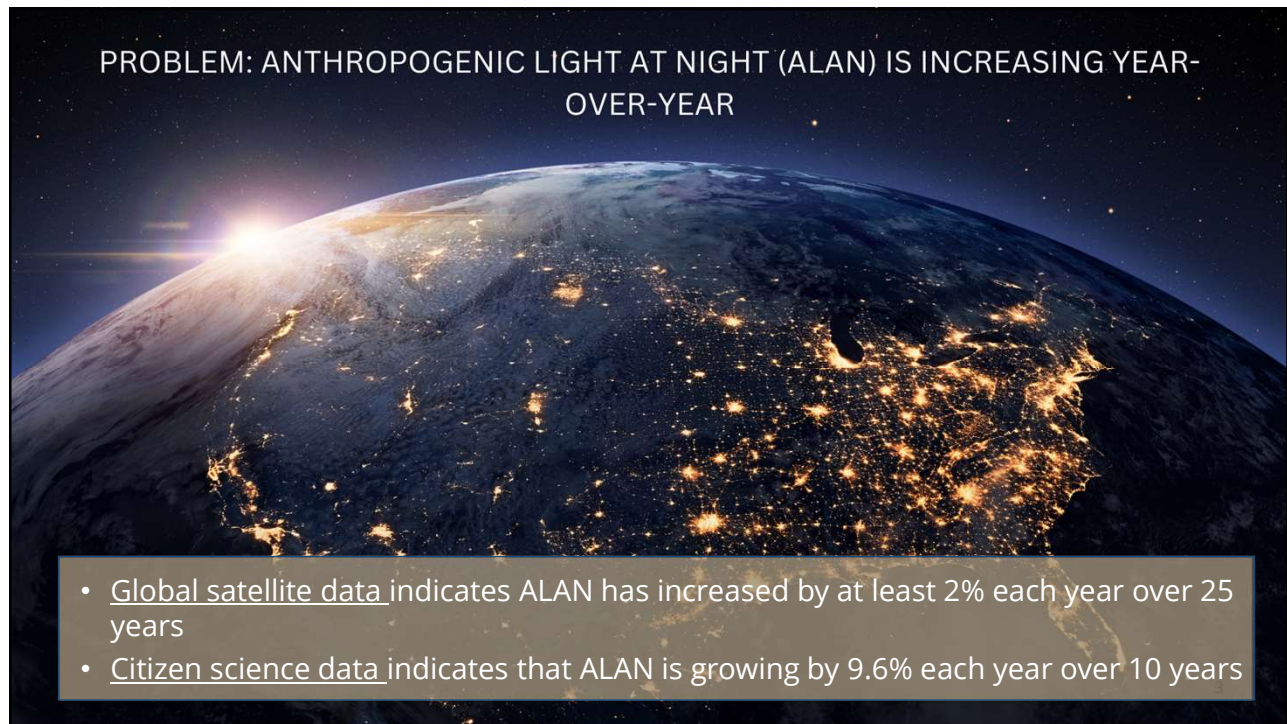


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As an independent nonprofit organization, the DLC provides decision makers with objective data, tools and best practices for quality lighting and controls to **reduce energy, carbon and light pollution**



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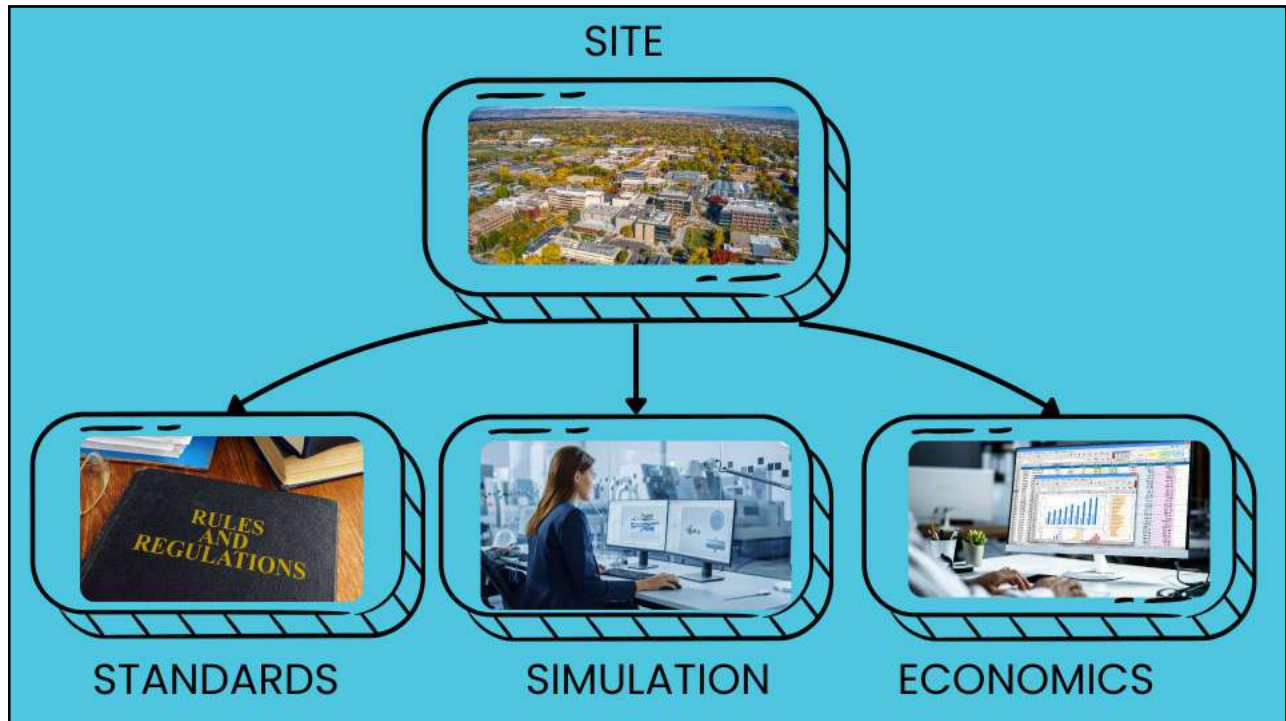


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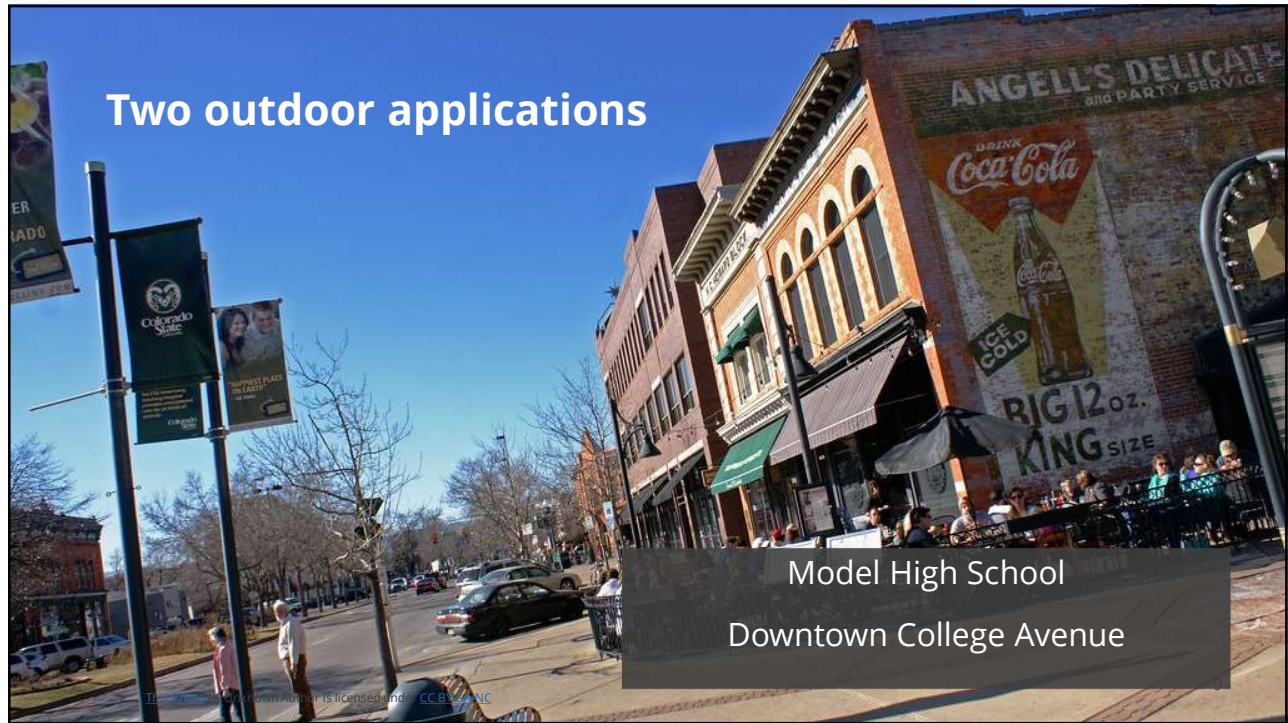
LUNA is the only list of light pollution mitigating fixtures

SSL V5.1 listed	Max CCT: 3000 K	No (or minimal) uplight	Mount included in model #	Comprehensive controls reporting
				

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Two outdoor applications

Model High School
Downtown College Avenue

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Three application scenarios

<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Base case: HID No dimming	Retrofit Scenario 1: DLC v5.1 luminaires (4K), 50% dimming	Retrofit Scenario 2: DLC LUNA V1 luminaires (3K), minimize overlighting, deeper dimming (80%)

Why HID for the base case?

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Energy code requirements

	ASHRAE 90.1-2007 (Base Case Condition-LZ2)	ASHRAE 90.1-2019 (Retrofit Scenarios-LZ2)
Total Allowance (W)	24,673	16,755
Total Site Area (ft ²)	620,975	620,975
Overall LPD Allowance (W/ft²)	0.04	0.027

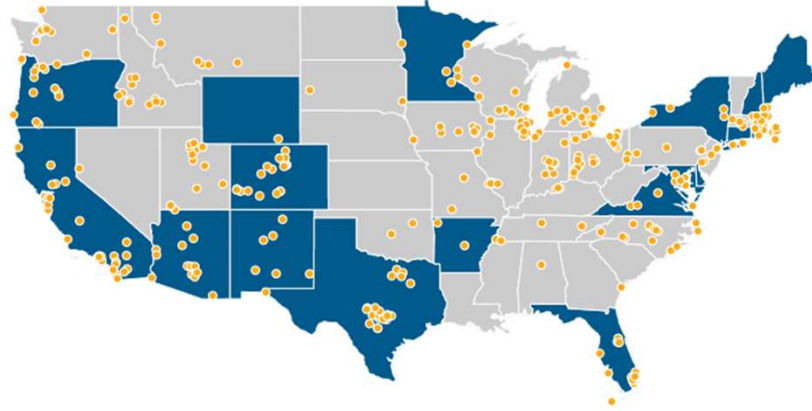
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Outdoor Lighting Requirements

Scenario (pre-curfew)	Standard	Application	Horizontal Illuminance at 0' AFG	Uniformity
Base Case	IES RP-20-14	Parking Lots & Drive Lanes	Min: 0.5 fc	Max/Min: 15:1
Base Case	IES RP-8-14	Walkways	Avg: 0.5 fc	Avg/Min: 4:1
Base Case	Larimer County Urban Area Street Standards (2007)	Local Road, Medium Pedestrian Activity	Avg: 0.9 fc	Avg/Min: 6:1
RS1, RS2	ANSI/IES RP-43-22 (LZ2)	Building Entrance, Drop-Off, Pick-Up	Avg: 1-2 fc	Avg/Min: 5:1
RS1, RS2	ANSI/IES RP-43-22 (LZ2)	Walking Surfaces	Avg: 1-2 fc	Avg/Min: 10:1
RS1, RS2	ANSI/IES RP-8-21	Parking Lots & Drive Lanes	Min: 0.2 fc	Max/Min: 20:1
RS1, RS2	Larimer County Urban Area Street Standards (2021)	Local Road, Medium Pedestrian Activity	Avg: 0.9 fc	Avg/Min: 6:1

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DLC outdoor lighting ordinance map (plus CAN, HI, AL)



<https://www.designlights.org/outdoor-lighting-ordinances/>

POLL 1



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Fort Collins Outdoor Lighting Ordinance



CCT
THRESHOLD



LIGHTING
CONTEXT
AREAS



LIGHT TRESPASS
THRESHOLD

BUG RATING/
UPLIGHT
THRESHOLDS

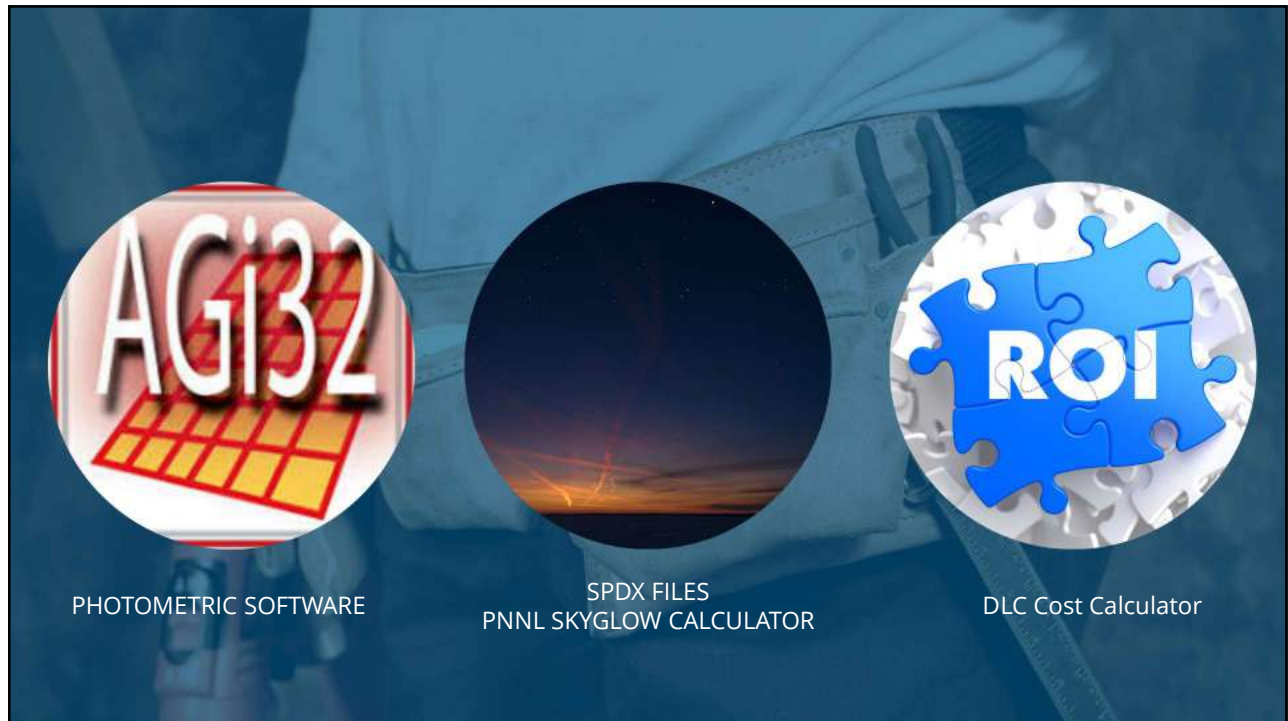
TOTAL SITE LUMEN
THRESHOLDS

https://library.municode.com/co/fort_collins/codes/land_use?nodeId=ART3GEDEST_DIV3.2SIPLDEST_3.2.4EXSILI

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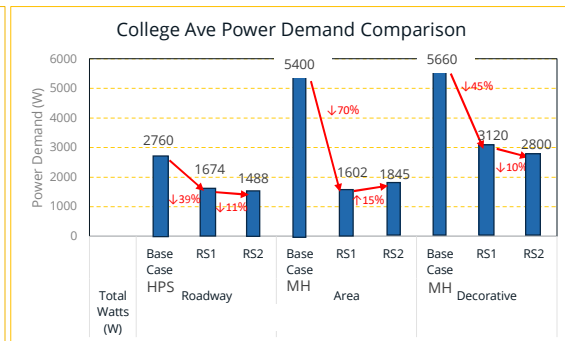
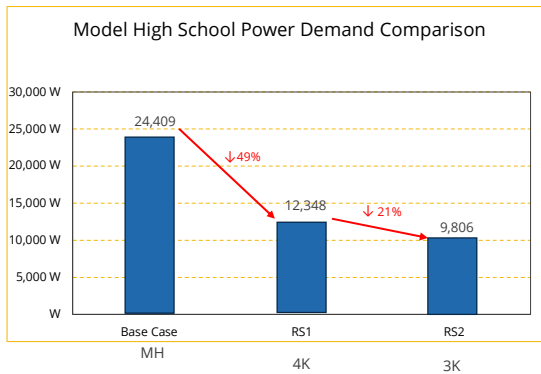


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Installed power savings

RS1 = DLC V5.1 Qualified fixtures

RS2 = LUNA qualified/eligible fixtures + minimizing overlighting

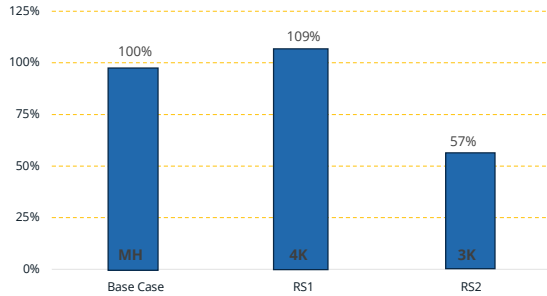


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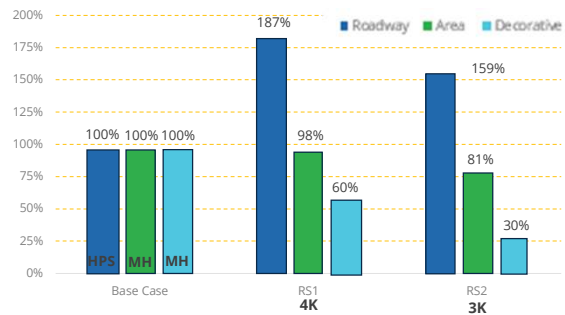
Light pollution mitigation – MLO Performance Method, atmospheric scatter

- Mitigations: minimizing overlighting, upright and blue light scatter

Model High School Light Pollution Comparisons

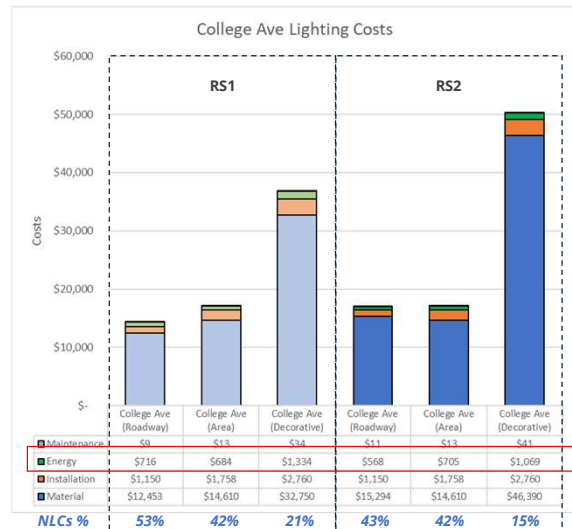
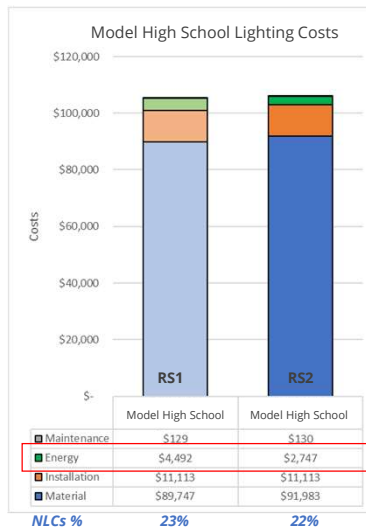


College Ave Light Pollution Comparisons



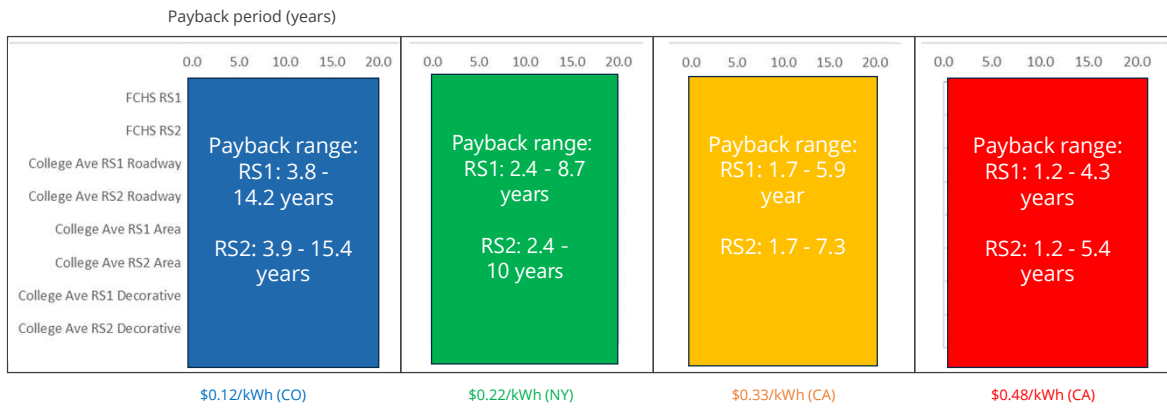
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Lighting and Controls Retrofit Costs (\$0.12/kWh)



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Payback comparisons – includes incentives for Itg+controls

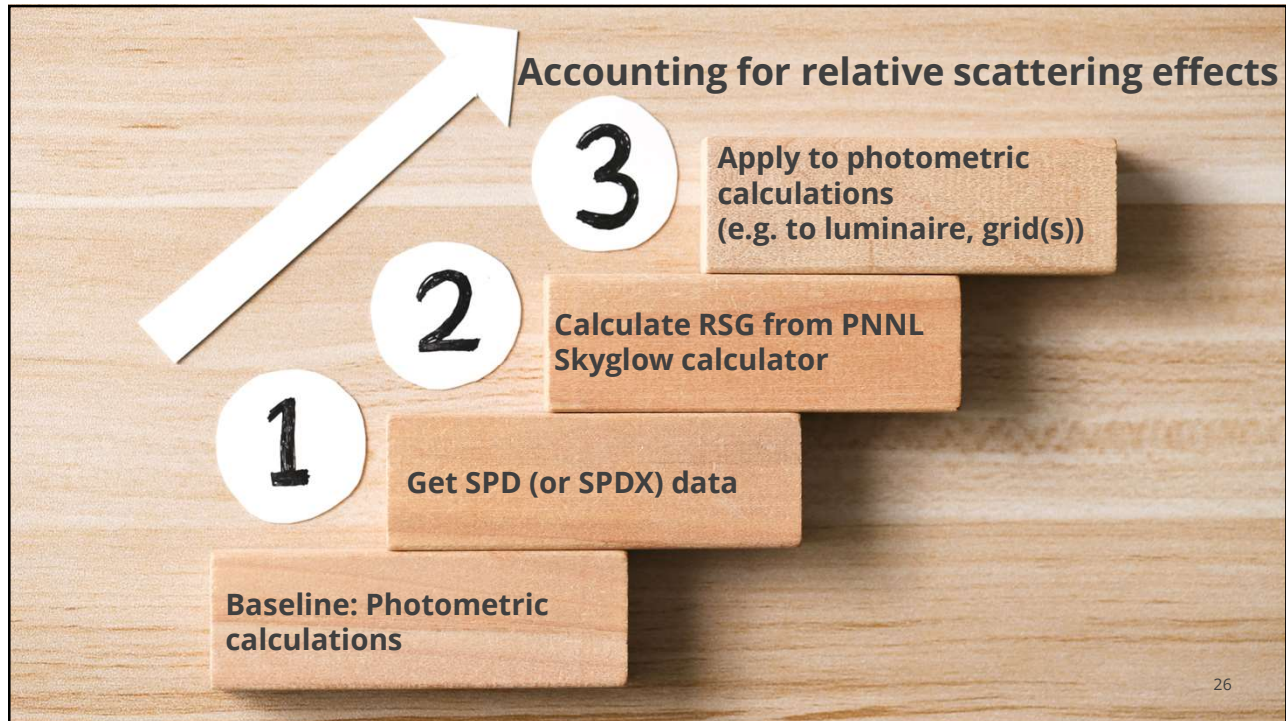


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Beyond photometric analyses



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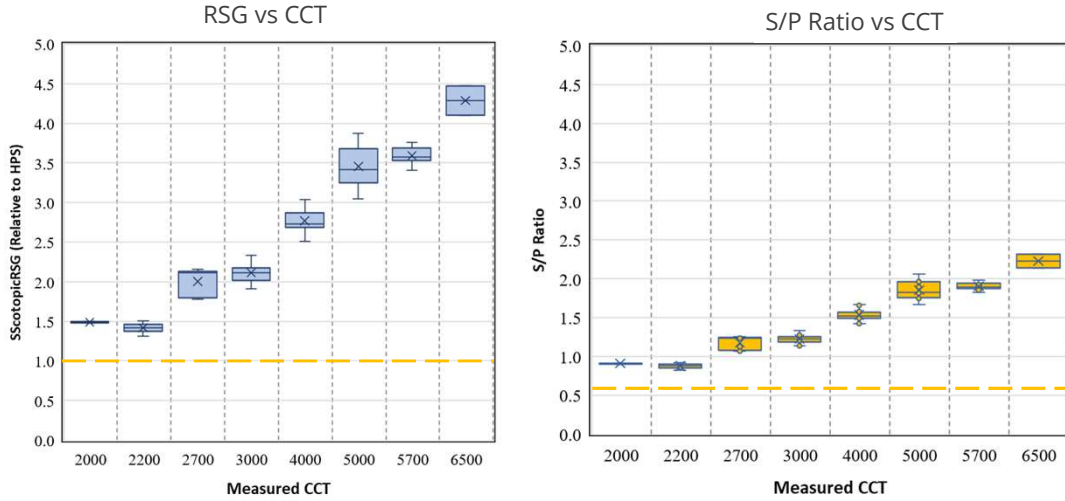
Shortcut method: Use average RSG / SP Ratio

	Technology/CCT	RSG (average)	S/P Ratio (average)
Baseline	HPS	1.0	0.6
	LED (2000K)	1.5	0.9
	LED (2200K)	1.4	0.9
	LED (2700K)	2.0	1.2
	LED (3000K)	2.1	1.2
	LED (4000K)	2.8	1.5
	LED (5000K)	3.5	1.9
	LED (5700K)	3.6	1.9
	LED (6500K)	4.3	2.2

Relationship between RSG and S/P Ratio:
 $RSG = 2.15 * S/P \text{ Ratio} - 0.52$ ($R^2 = 0.9994$)

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Relationship for pc-white LED products



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Cost calculation tool



Light Pollution and Energy Efficiency Cost Calculation Tool

This spreadsheet is used to calculate the payback period and return on investment (ROI) for the lighting application scenarios in the "Choosing Both Energy Efficiency and Light Pollution Mitigation for Commercial Outdoor Lighting" study.

Instructions

- Provide the most accurate estimates possible for the editable fields in this spreadsheet. Sheets containing editable fields have their sheet tabs highlighted with a light yellow/peach color (see key below). This is the same color as the editable fields. Editable fields include fixture quantities, fixture costs, fixture installation costs, cost markups, maintenance costs (material, labor, and markup), factors impacting rebates, and more. Important colors for cells are shown below:
 - Fields that contain estimated quantities that impact the payback period and ROI. Intended to be edited.
 - Fields that contain formulae or fixed reference values. **Do not edit.**
 - Table headers and reference information.
- After accurate estimates have been provided, go to the "Dashboard" tab and modify the master parameters. These include system lifetime, electricity costs, control schedule (i.e., dimming schedule), and LED fixture failure rate parameters.

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Lessons learned

- Conflicting priorities**: Icon showing a crossed-out 'X', a question mark, and two sad faces with lightning bolts between them.
- Reduced power demand**: Icon of a street lamp.
- Reduced light pollution**: Icon of buildings with sun and moon symbols.
- NLCs too expensive for small application**: Icon of a price tag with three dollar signs.
- Longer payback periods**: Icon of a money bag and a plant growing from a dollar sign.
- Compatibility concerns**: Icon of two interlocking puzzle pieces.


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Compliance with outdoor lighting ordinances


<https://www.designlights.org/outdoor-lighting-ordinances/>

POLL 2

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WHITEPAPER: Choosing both Energy Efficiency and Light Pollution Mitigation for Commercial Outdoor Lighting



SCAN ME

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WHITEPAPER: Cost Calculation Tool



SCAN ME

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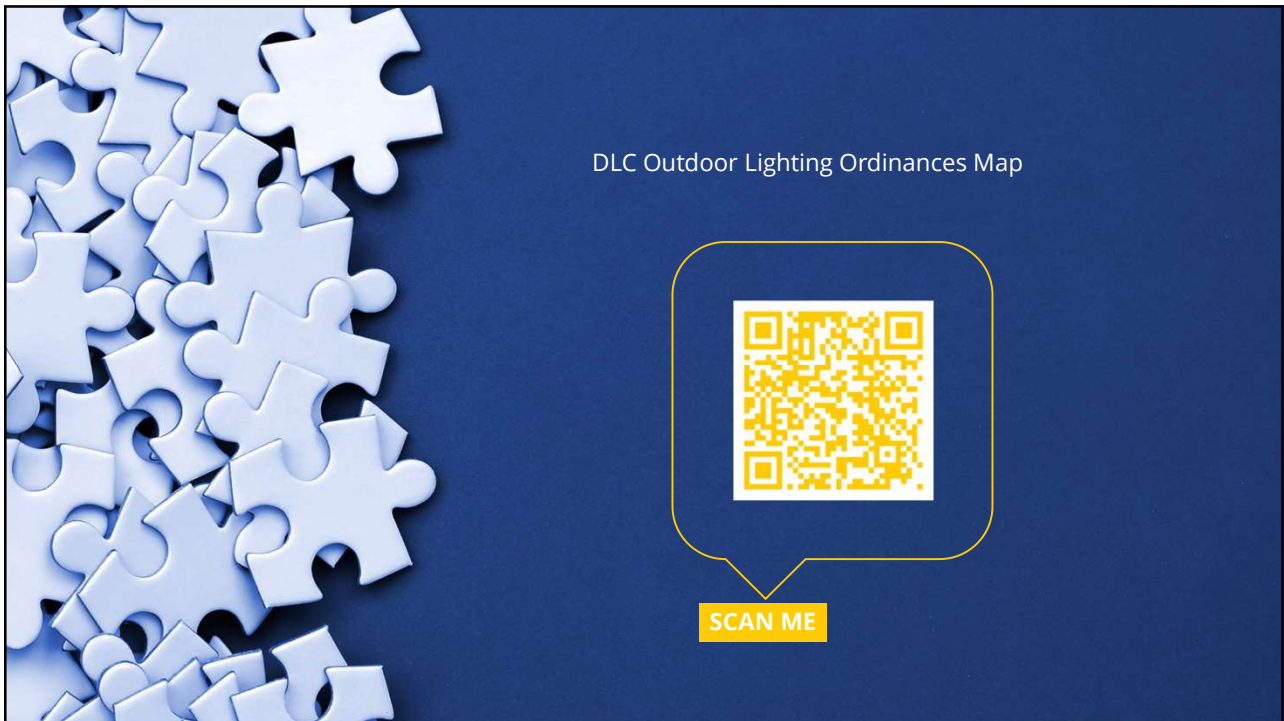


Seven Strategies to Minimize Negative Impacts of Outdoor Light at Night




SCAN ME

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DLC Outdoor Lighting Ordinances Map



SCAN ME

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LEUKOS article: Specifying non-white light sources in outdoor applications to reduce light pollution



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PNNL Sky Glow Simulator



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LIVE
WEBINAR

Next LUNA webinar theme:
muni solutions to minimizing light pollution

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Thank you
Questions?



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