Reduce Energy Use with Dark Sky Lighting

April 3, 2024

SEDAC

SMART ENERGY DESIGN ASSISTANCE CENTER

Providing effective energy strategies for buildings and communities

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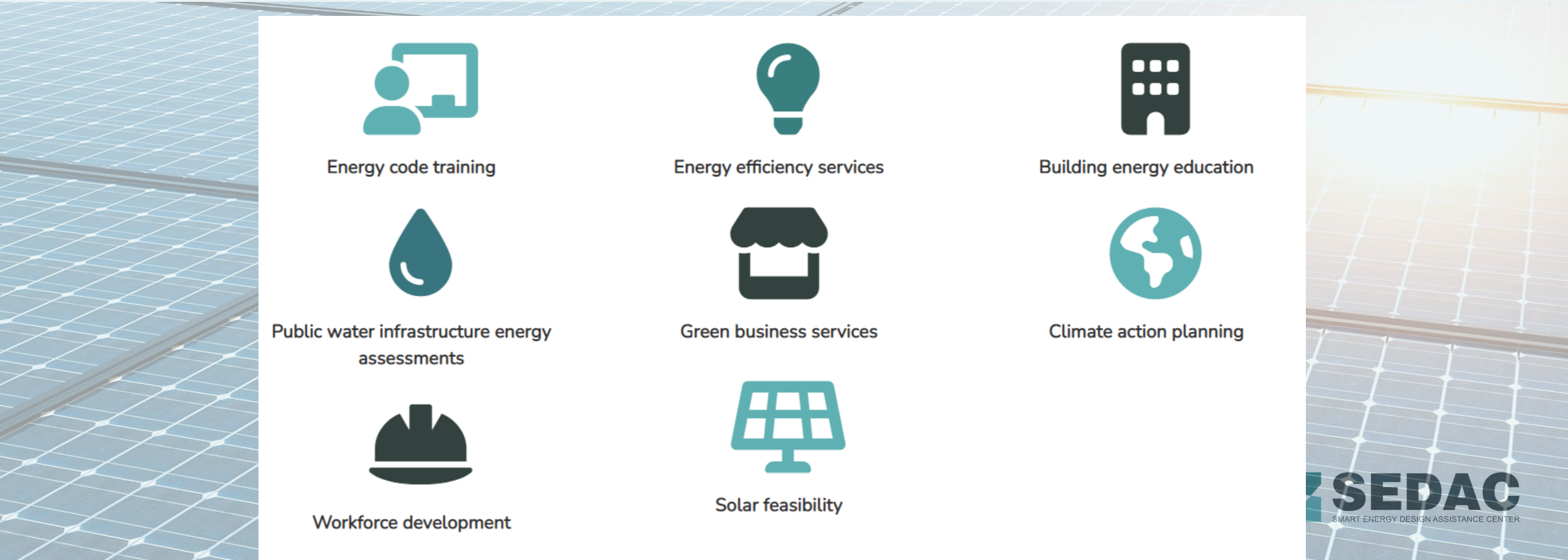
Mission: Decrease the energy footprint of Illinois and beyond.



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Who We Are

We are an applied research program at the University of Illinois that assists buildings and communities in achieving energy efficiency, saving money, and becoming more sustainable.

Our Goal = Reduce the energy footprint of Illinois and beyond.

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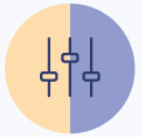
Five Lighting Principles for Responsible Outdoor Lighting

Five Lighting Principles for Responsible Outdoor Lighting

DarkSky

Illuminating Engineering Society

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.	

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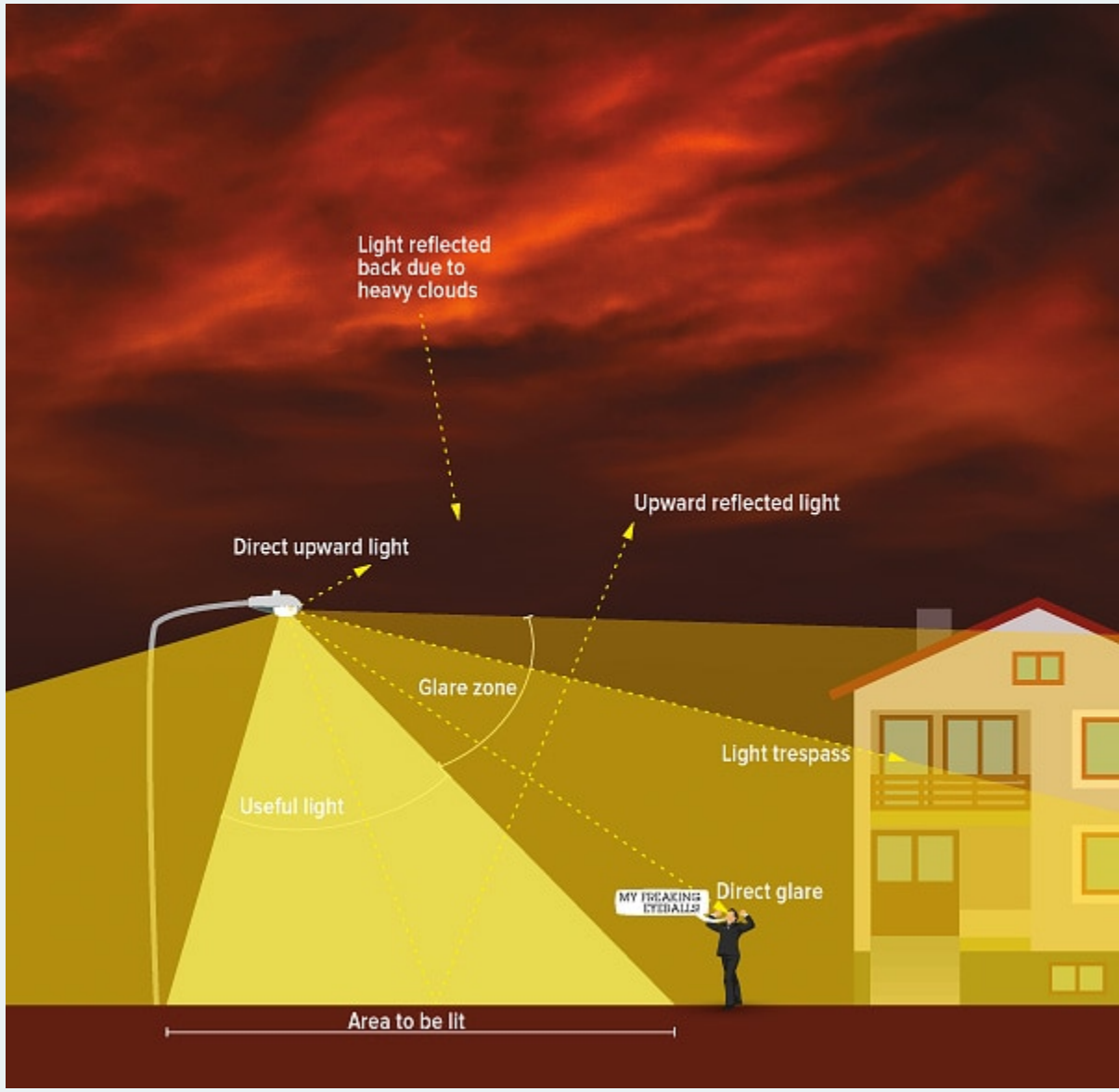
Why Choose Dark Sky Lighting?

- **Minimizes glare**
  - Excessive brightness that can cause visual discomfort or accidents
- **Reduces energy use**
  - Lower lumens ≈ lower wattage = energy savings!
  - Timers or photocells reduce energy use as well.
- **Reduces light trespass + pollution**
  - Light only what you need – not your neighbor's property!



What is Dark Sky Compliant Lighting?

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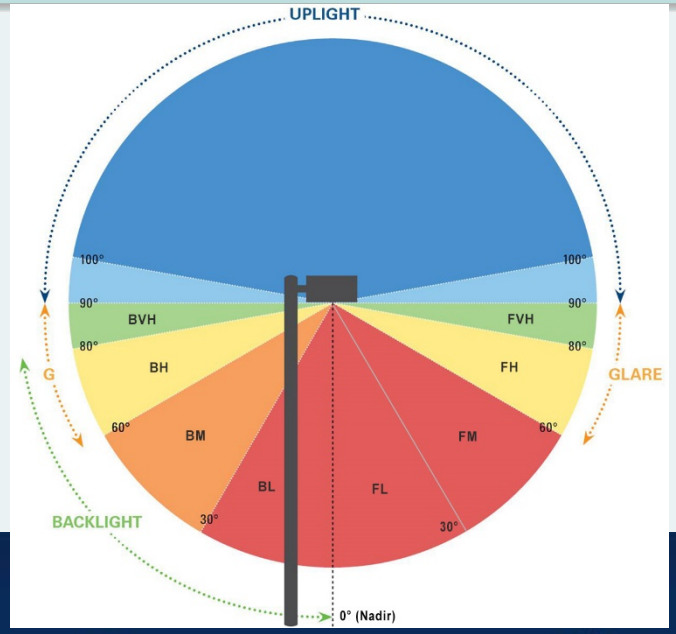
BUG Rating

Backlight, Uplight, Glare Rating (BUG)

- **Backlight:** light directed behind the fixture
  - Do you want to illuminate things behind the light? Your neighbors?
- **Uplight:** any light directed upward
  - We don't need to light the sky!
- **Glare:** amount of light emitted at high angles
  - Beyond 60 degrees, causes unnecessary glare



BUG Ratings + Lighting Zones

Lighting Zones are used to determine how much light is acceptable in each location.

BUG Ratings describe specific lighting conditions.

- Use the Lighting Zones to find proper lighting
- Then, review the fixture's BUG rating to ensure it is less than the maximum allowable backlight, up light, and glare for the Lighting Zone.

Promotes light fixtures with minimal negative effects on the environment, night sky, and human health.

https://www.ies.org/wp-content/uploads/2017/03/TM-15-11BUGRatingsAddendum.pdf

Maximum Allowable BUG Ratings

Defined by the Illuminating Engineering Society and the International Dark Sky Association's Model Lighting Ordinance (2011)

	Lighting Zone				
	LZ0	**LZ1**	**LZ2**	**LZ3**	**LZ4**
BACKLIGHT					
> 2 mounting heights from lighting boundary	B1	B3	B4	B5	B5
1 to 2 mounting heights from lighting boundary and properly oriented	B1	B2	B3	B4	B4
0.5 to 1 mounting height to lighting boundary and properly oriented	B0	B1	B2	B3	B3
< 0.5 mounting height to lighting boundary and properly oriented	B0	B0	B0	B1	B2
UPLIGHT					
Allowed uplight ratings	U0	U1	U2	U3	U4
GLARE					
Allowed uplight ratings	G0	G1	G2	G3	G4

- **LZ0:** No ambient lighting – Areas such as wilderness areas, parks and preserves, and undeveloped rural areas.
- **LZ1:** Low ambient lighting – Areas such as rural and low-density residential areas.
- **LZ2:** Moderate ambient lighting – Areas such as light commercial business districts and high density or mixed-use residential districts
- **LZ3:** Moderately high ambient lighting – Areas such as large cities' business districts
- **LZ4:** High ambient lighting – Special case areas such as high-intensity business or industrial zone districts.

Example

250W MH
22,000Lm

30W LED
3,000 Lm
(2015)
Mfg equivalent
to 100W MH

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250W MH
22,000Lm

30W LED
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Mfg equivalent
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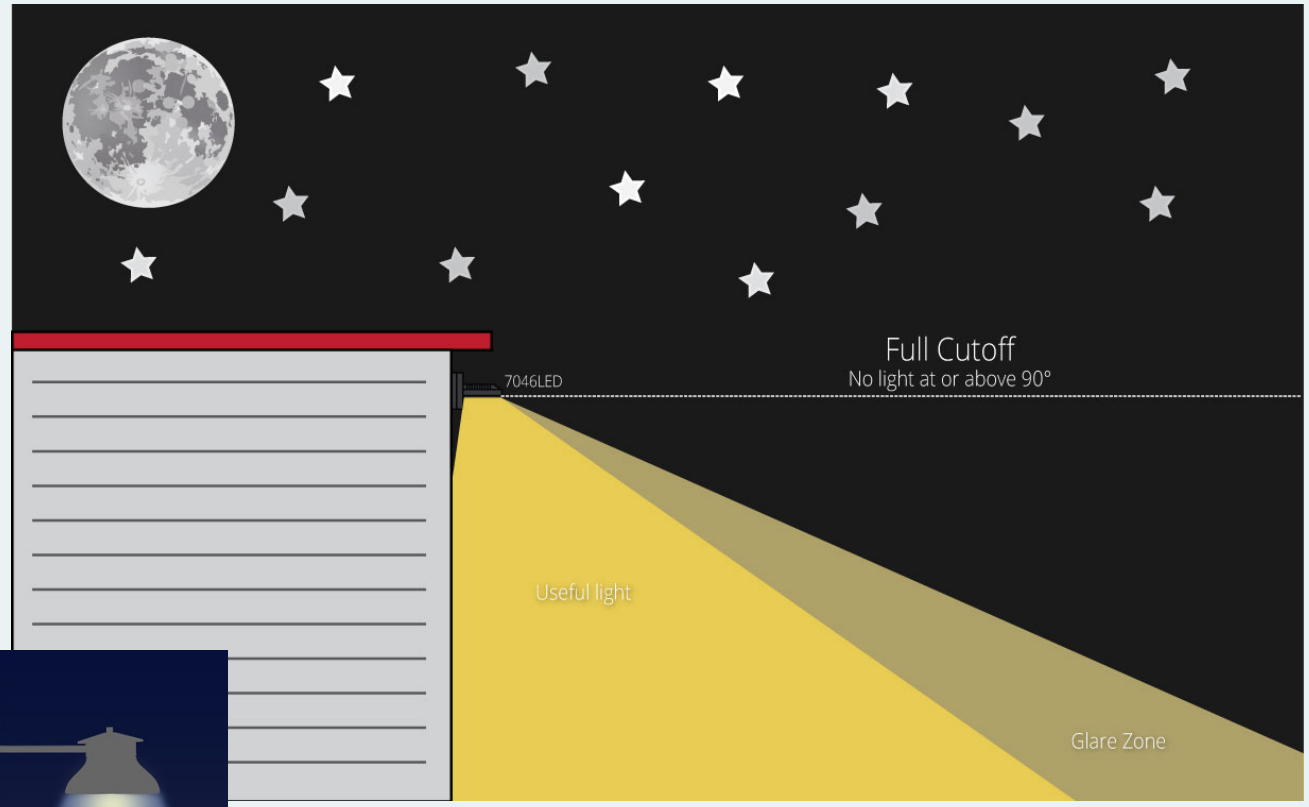
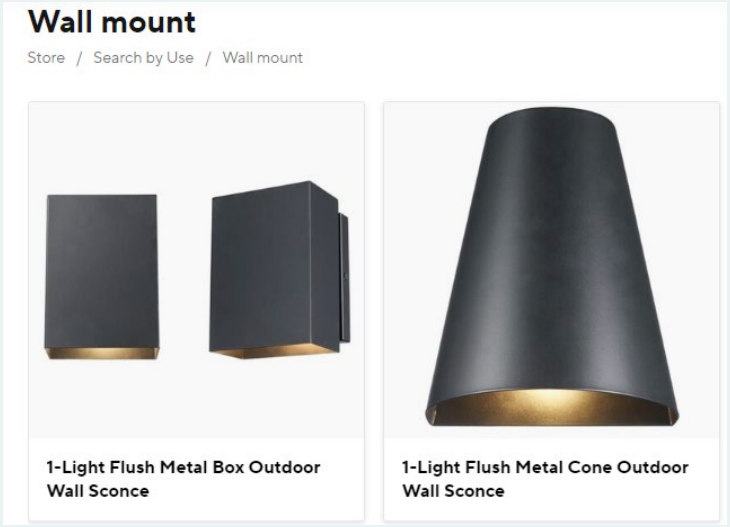
Fixture Attributes

Purchase outdoor fixtures that are “full cutoff”.

Full cutoff fixtures direct lighting downward and outward rather than upwards, towards the sky.

Direct light entirely to the ground.





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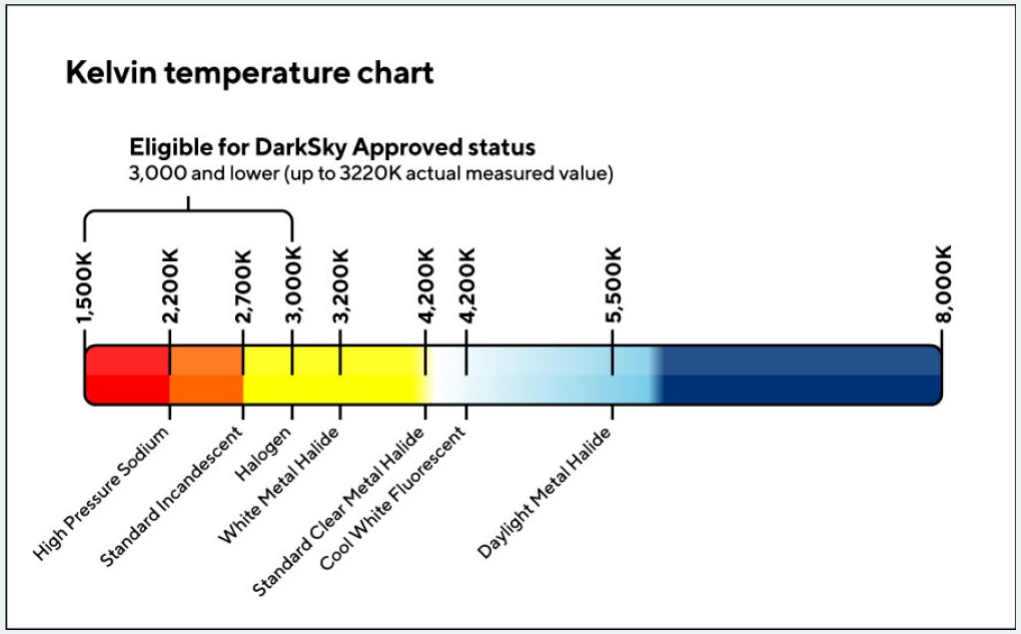
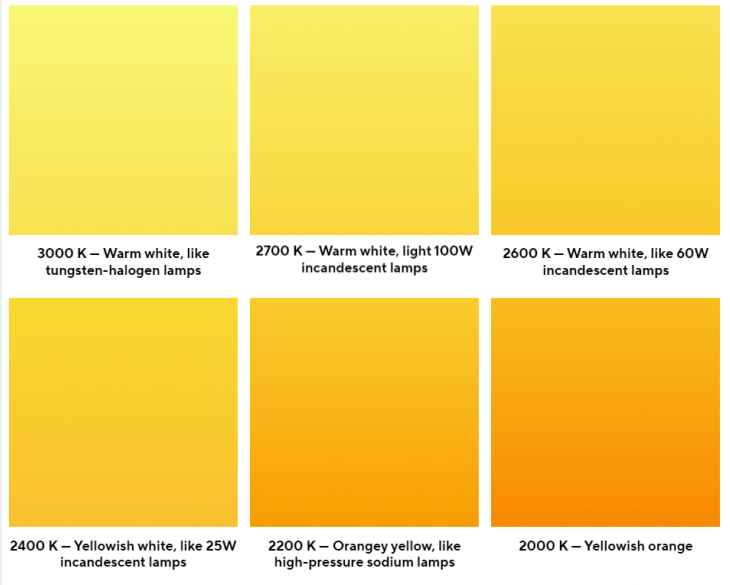
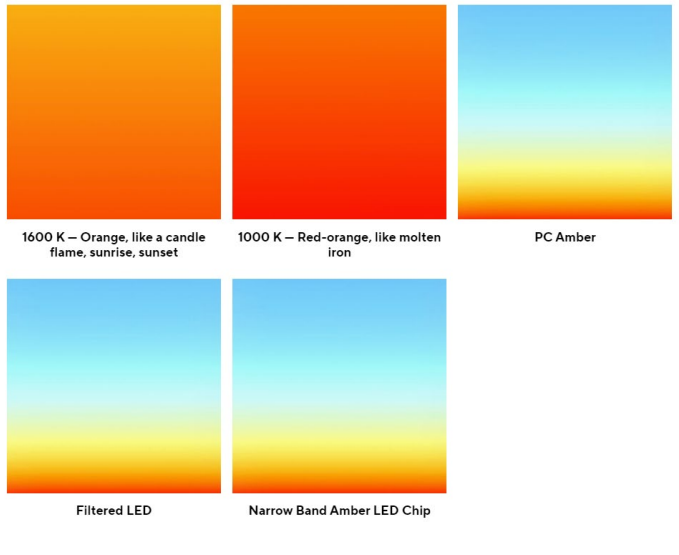
Color Temperature

Color temperature in kelvins (K) should be lower than 3,000k

- Warm white light





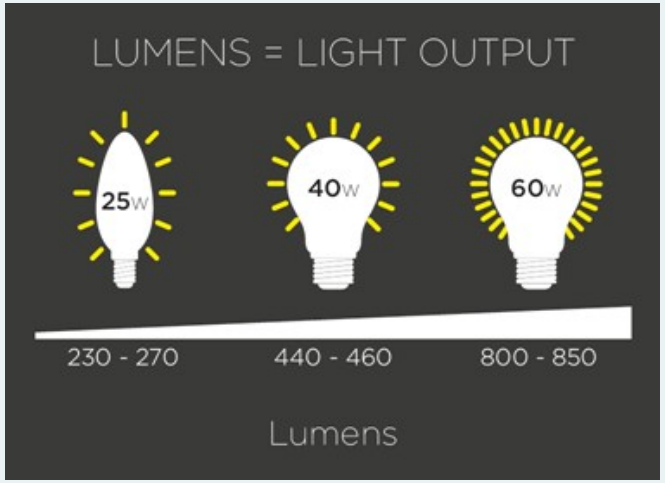


Lighting Intensity

Do not exceed 5 foot-candles (fc)

Over lighting = skyglow and glare diminishes our ability to see.

Less is more! Only light what is needed and how much is needed.



1 lumen across 1 sq ft = 1fc

A full moon is only 0.01 fc!

Controls

Place lighting on daylight sensors and timers to ensure lighting is on dusk to dawn, or for a certain number of hours needed.

Some lighting will already have photocells installed or can be added as an option.

Add occupant sensors to reduce operating hours further

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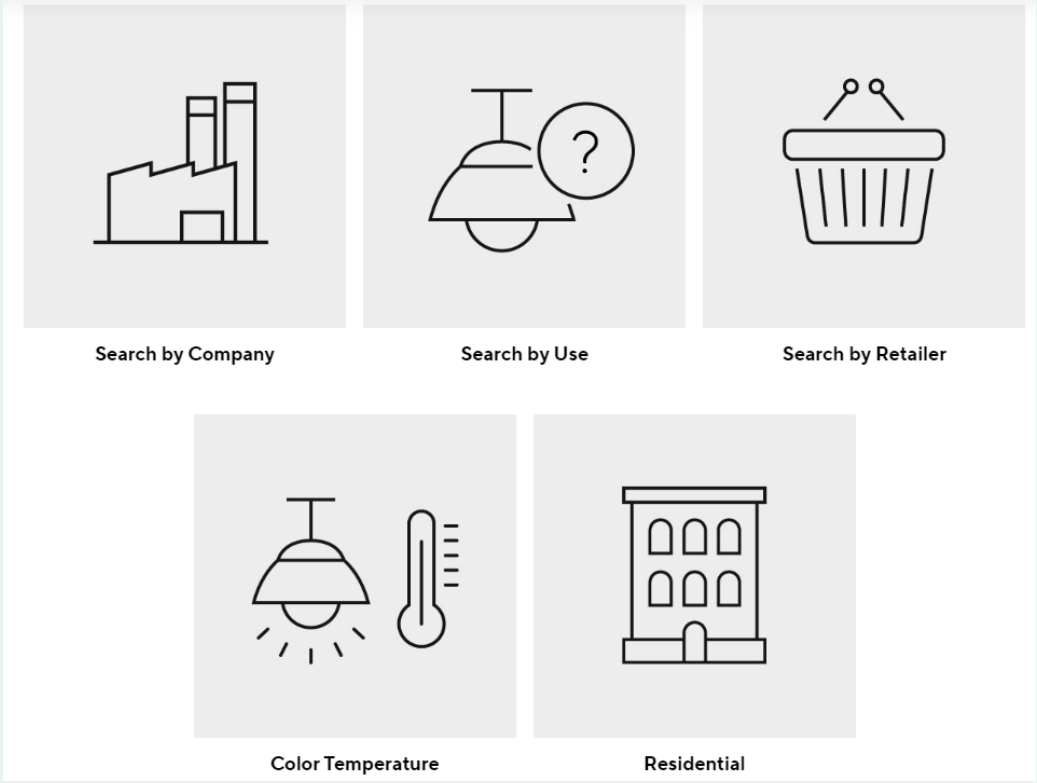
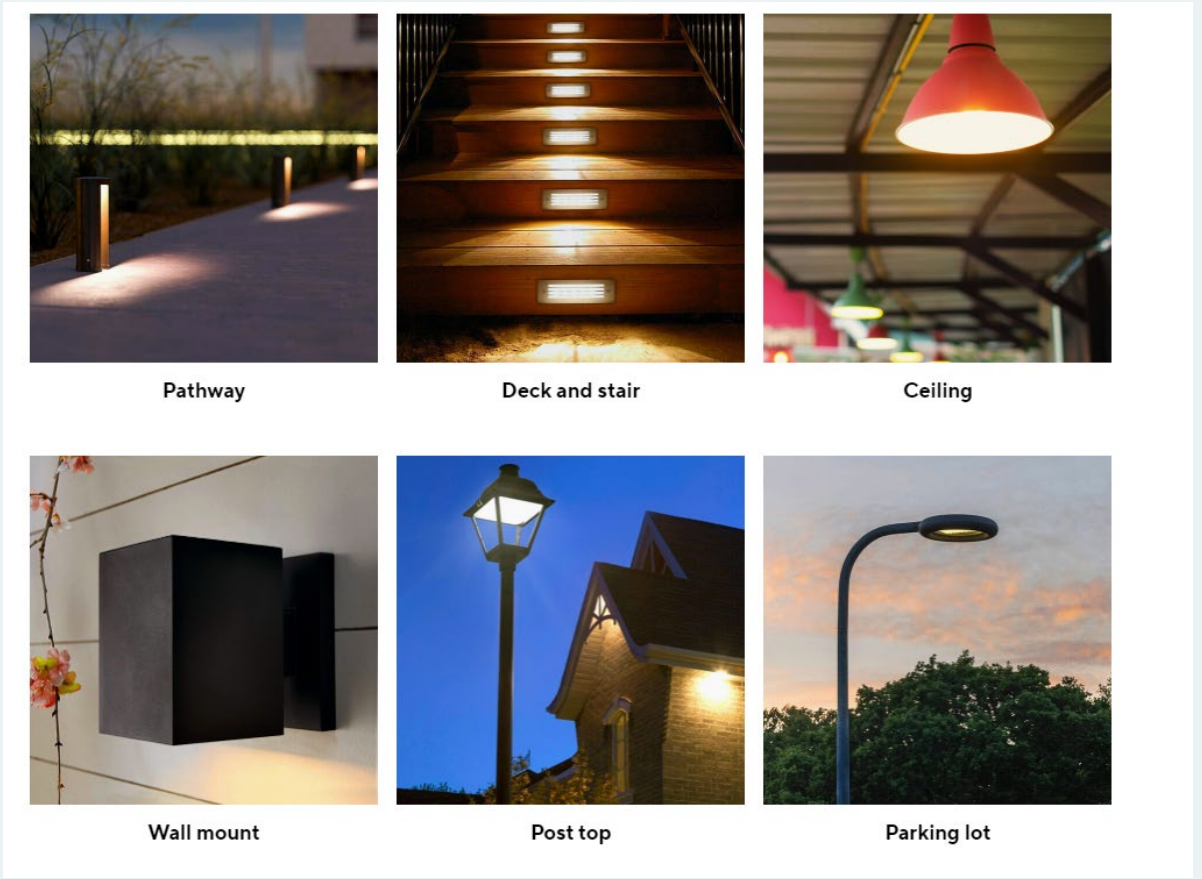
Resources

DarkSky.org has approved products!





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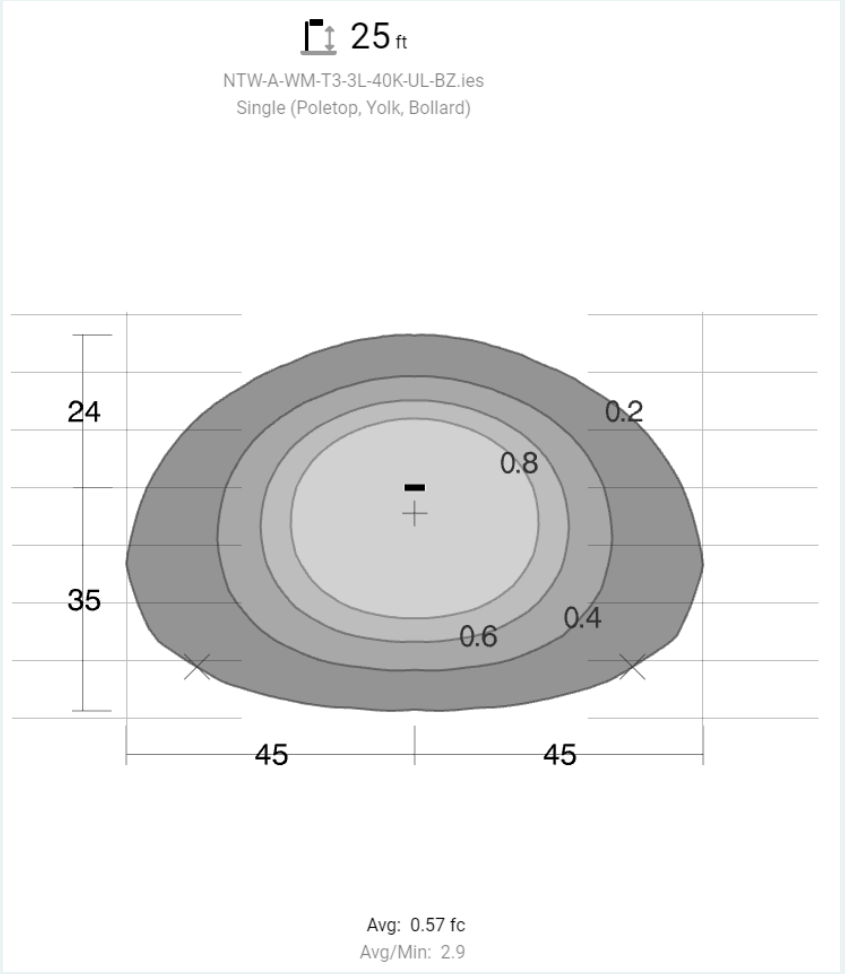
Resources

Lighting suppliers can do lighting layout



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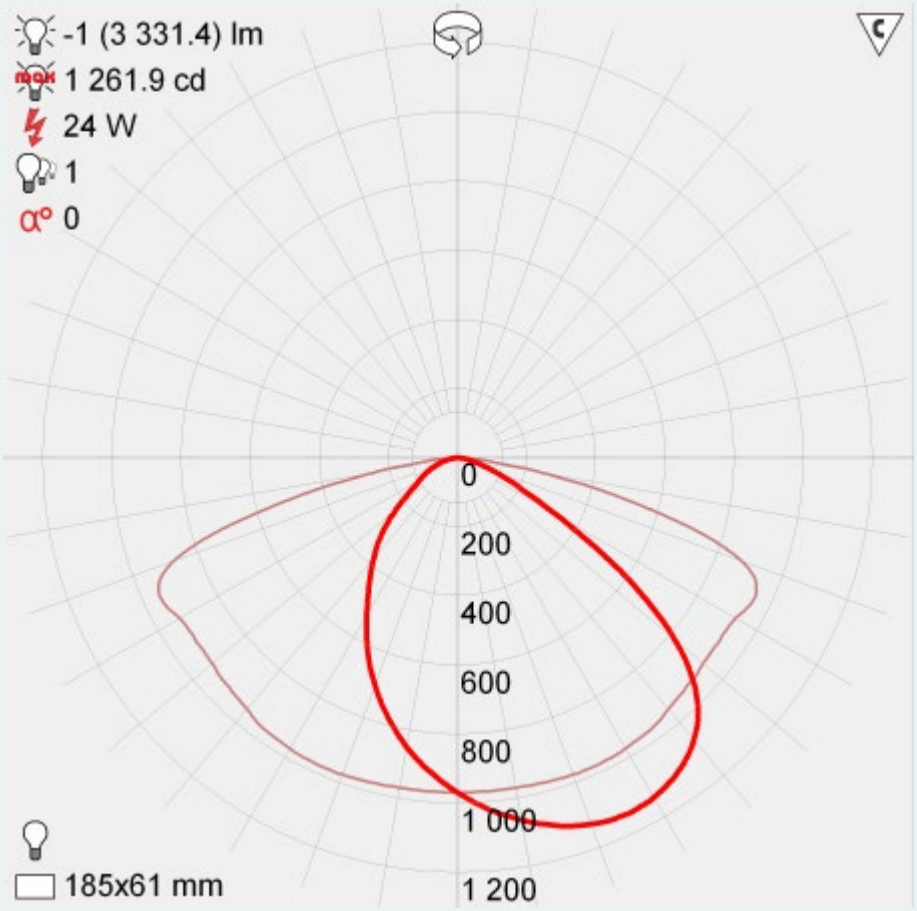
Resources

Fixture ies file can enable approximating BUG rating when not available



Useful/ Backlight

Glare

Uplight

Gamma(deg)	Fz(lm)
0- 10	92.17
10- 20	269.95
20- 30	426.98
30- 40	547.08
40- 50	614.28
50- 60	591.50
60- 70	485.80
70- 80	262.69
80- 90	40.46
90-100	0.00
100-110	0.00
110-120	0.00
120-130	0.00
130-140	0.00
140-150	0.00
150-160	0.00
160-170	0.00
170-180	0.00

LCS Table		
BUG Rating	**B1 - U0 - G1**	
Forward Light	Lumens	Lumens %
Low(0-30):	452.1	13.6%
Medium(30-60):	1,175.1	35.3%
High(60-80):	537.2	16.1%
Very High(80-90):	27.3	0.8%
Back Light		
Low(0-30):	337.0	10.1%
Medium(30-60):	577.9	17.3%
High(60-80):	211.5	6.3%
Very High(80-90):	13.1	0.4%
Uplight		
Low(90-100):	0.000	0%
High(100-180):	0.000	0%
Trapped Light:	0.000	0%

https://www.ies.org/wp-content/uploads/2017/03/TM-15-11BUGRatingsAddendum.pdf

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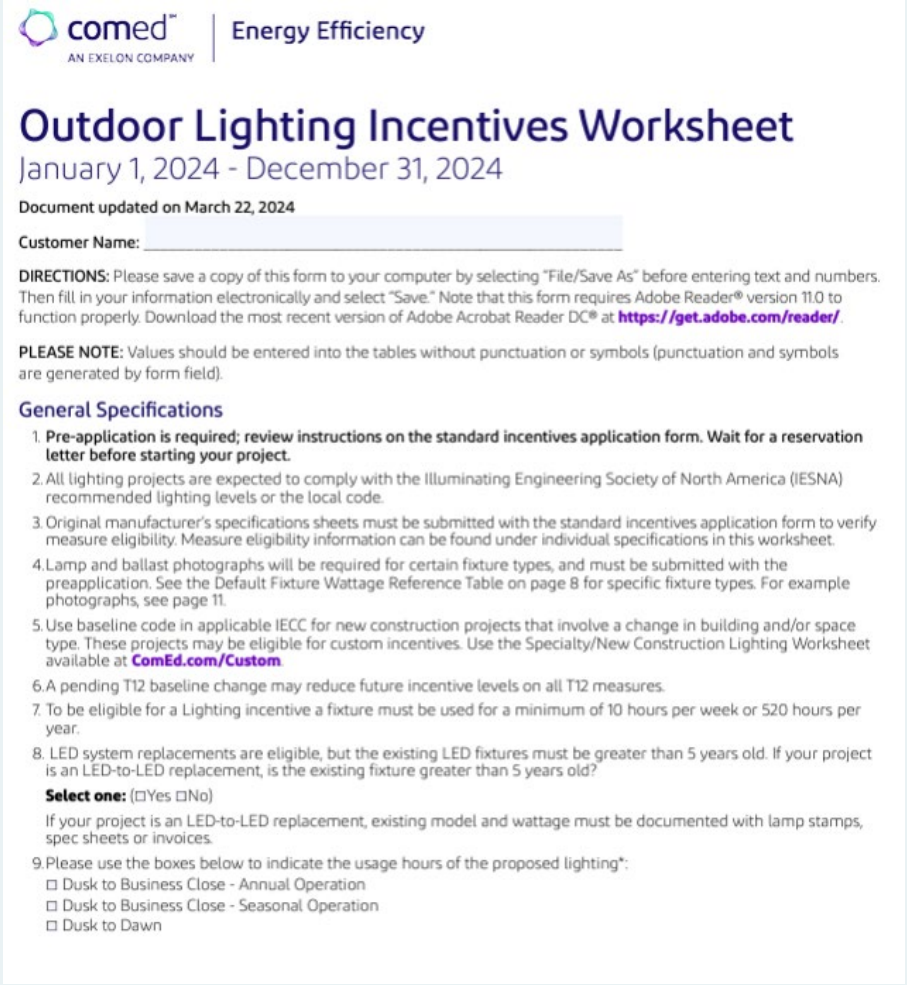
Funding Support

The ComEd Energy Efficiency Program incentives for efficient outdoor lighting + timers:

- Fixtures or bulbs: $0.75/watt reduced

- Photocells: $0.08/watt controlled
- Time clocks: $0.03/watt controlled
- Photocells w/ time clocks: $0.13/watt controlled
- Occupant sensors: $0.20/watt controlled

- Free assessments available!
    - Small businesses may be able to access greater incentives.
- May be able to get discounted bulbs or fixtures through the Instant Discount program



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Outdoor Lighting Incentives Worksheet

January 1, 2024 - December 31, 2024

Document updated on March 22, 2024

Customer Name: _____

DIRECTIONS: Please save a copy of this form to your computer by selecting "File/Save As" before entering text and numbers. Then fill in your information electronically and select "Save." Note that this form requires Adobe Reader® version 11.0 to function properly. Download the most recent version of Adobe Acrobat Reader DC® at **https://get.adobe.com/reader/**.

PLEASE NOTE: Values should be entered into the tables without punctuation or symbols (punctuation and symbols are generated by form field).

General Specifications

1. **Pre-application is required; review instructions on the standard incentives application form. Wait for a reservation letter before starting your project.**
2. All lighting projects are expected to comply with the Illuminating Engineering Society of North America (IESNA) recommended lighting levels or the local code.
3. Original manufacturer's specifications sheets must be submitted with the standard incentives application form to verify measure eligibility. Measure eligibility information can be found under individual specifications in this worksheet.
4. Lamp and ballast photographs will be required for certain fixture types, and must be submitted with the preapplication. See the Default Fixture Wattage Reference Table on page 8 for specific fixture types. For example photographs, see page 11.
5. Use baseline code in applicable IECC for new construction projects that involve a change in building and/or space type. These projects may be eligible for custom incentives. Use the Specialty/New Construction Lighting Worksheet available at **ComEd.com/Custom**.
6. A pending T12 baseline change may reduce future incentive levels on all T12 measures.
7. To be eligible for a Lighting incentive a fixture must be used for a minimum of 10 hours per week or 520 hours per year.
8. LED system replacements are eligible, but the existing LED fixtures must be greater than 5 years old. If your project is an LED-to-LED replacement, is the existing fixture greater than 5 years old?

   Select one: (☐Yes ☐No)

   If your project is an LED-to-LED replacement, existing model and wattage must be documented with lamp stamps, spec sheets or invoices.
9. Please use the boxes below to indicate the usage hours of the proposed lighting*:
   - ☐ Dusk to Business Close - Annual Operation
   - ☐ Dusk to Business Close - Seasonal Operation
   - ☐ Dusk to Dawn

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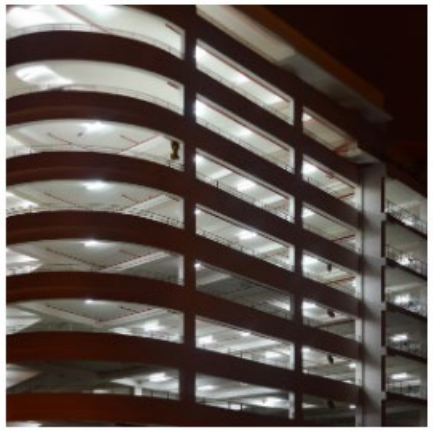
Funding Support - ComEd Examples

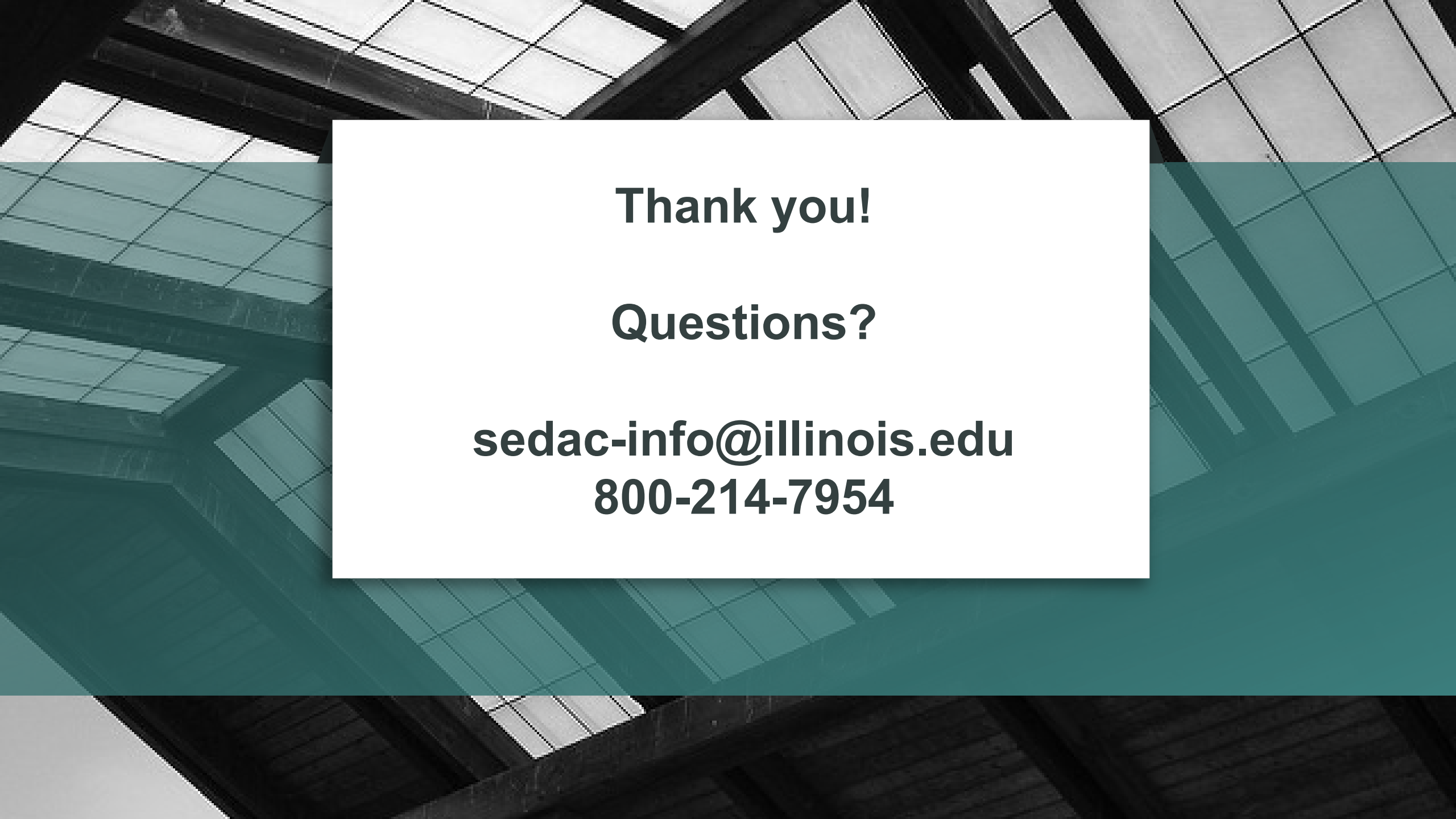
Office

Estimated Project Cost	$99,472
Incentive Received	$37,628
Estimated Annual Energy Savings	416,730 kWh
Estimated Annual Cost Savings	$37,339*
Estimated Payback After Incentives	1.7 years



Retail Store

Estimated Project Cost	$174,594
Incentive Received	$125,770
Estimated Annual Energy Savings	1,082,380 kWh
Estimated Annual Cost Savings	$96,981*
Estimated Payback After Incentives	0.5 years



Thank you!

Questions?

sedac-info@illinois.edu
800-214-7954