

Credit: Light pollution reduction

The light pollution reduction credit requires teams to demonstrate appropriate site lighting, given the lighting zone in which the project is located. To show that they are minimizing light pollution, teams need to demonstrate that both uplight (which is light directed into the sky) and light trespass (which is light spilling over the project's lighting boundary) do not exceed the maximum levels allowed for their lighting zone.

The goal of this credit is to increase night sky access, improve nighttime visibility, and reduce the consequences of development for wildlife and people. It may not be something you typically associate with a green building, but its affects are far reaching.

This credit can look a bit complicated at first glance – as the structure is a little different than the rest of the credits we've discussed for the Sustainable Sites category. When we break it down, we'll see that it seems this way because teams have the option to mix and match their methodologies. Fundamentally, teams have to do three things to meet the credit requirements: 1) meet uplight requirements, 2) meet light trespass requirements, and 3) meet internally illuminated exterior signage requirements. For these first two components – uplight and light trespass – teams have 2 options. Option 1 is the backlight-uplight-glare (or BUG) rating method and option 2 is the calculation method. As we said before, teams can mix and match, so you can use the BUG rating method for uplight and the calculation method for light trespass – or any combination of these methods that you see fit. So what might make this credit look more complex at first glance is actually an example of flexibility built into the rating system.

Much like the rest of the Sustainable Sites credits – this credit must be completed while there are still opportunities to change the lighting design. Yes, once again, the earlier this can be done, the more options that teams will have for compliance.

Depending on which option is selected, this credit will require a lighting designer or someone with specialized lighting knowledge. Teams pursuing Option 1 may be able to rely on manufacturer data rather than a specialist. Teams pursuing Option 2 will need a specialist to work with the rest of the team, particularly the civil engineer, landscape architect, electrical engineer, energy modeler, and architect, to ensure that the requirements are met.

To begin, the lighting designer or other professional prepares a schematic site lighting design. This is done by identifying the desired lighted areas on site and consulting the Illuminating Engineering Society Lighting Handbook recommendations. This information is used to establish target light levels and uniformities for the identified areas and identify any areas on site which may be problematic due to the light level needs of the area, location near a boundary, or other factors.

The next step is to identify the project's lighting zone. The reference guide will point you to the IES "Model Lighting Ordinance" User Guide for lighting zone descriptions and guidance. The entire project must be classified as one lighting zone. Since this classification will determine the specific requirements that the project must meet, teams have to provide justification for the lighting zone chosen for the project.

Once this has been done, the lighting boundary to the project must be established by creating a lighting boundary site plan or identifying this boundary on the existing site plan. This is another area where justification must be provided if the lighting boundary was modified from the requirements. Establishing the lighting boundary is one of the most important beginning steps, and will be highly dependent upon the specific context of the project. It is important to understand how the lighting boundary may differ from the property line and/or LEED project boundary, and the circumstances under which it can be modified. This information is listed in the rating system.

Next, a site lighting design is prepared. This is based on the lighting zone designation. As a part of this plan, a luminaire schedule for the project should be developed. Select luminaires that eliminate or minimize

uplight and light trespass off the site. The plan should include the designation of all exterior luminaires, and depict the LEED project boundary, the property line (if different from the LEED project boundary), the lighting boundary, any additional properties included in the lighting boundary (if applicable), and any relevant project site conditions. The total number of each luminaire type should be specified, along with the manufacturer, model number, lamp type, orientation and tilt angle (if applicable) as well as input wattage.

Teams pursuing the Calculation Method will perform calculations. Teams pursuing the BUG rating method, include the backlight rating, uplight rating, and glare rating of each unique luminaire in the orientation and tilt specified in the project design. If the chosen luminaire does not have a published BUG rating, it can be determined via software.

For the Calculation method, those include the total lumens per luminaire and lumens emitted above horizontal for each unique luminaire in the orientation and tilt specified in the project design as well as the performance for each angular position (or tilt) utilized, if there are multiple angular positions for a luminaire type. Finally, all auxiliary shielding must be specified. This is when a lighting expert will be most helpful because the calculation method requires software and specialized knowledge.

At this point, the plan is only showing a preliminary design; re-design efforts may need to occur once the rest of the steps are completed and the uplight and light trespass calculations are known, similar to how additional methods might have been added after the initial heat island reduction calculations were completed.

After this plan has been created, teams should determine which luminaires are exempt from the uplight and light trespass requirements and provide justification for the exemptions. Examples of such exempt lighting include emergency lighting, government mandated roadway lighting, theatrical lighting, or lighting of the national flag in certain lighting zones. If the only lighting required by the project is considered exempt, then the only thing the project must do is provide justification for the exemptions.

Going back to the non exempt lighting, project teams next need to figure out which method of compliance they are using for the uplight and the light trespass requirements. The initial luminaire selections will help determine which method is most appropriate. Namely, if the luminaires selected have BUG ratings available, then this option will likely be the easiest path. If the luminaires selected either don't comply with the BUG method or would be difficult to find, then teams can use the calculation method for documentation.

Once the methodology has been selected, teams must demonstrate compliance with the uplight requirement and the light trespass requirement through their chosen methodology. For the uplight requirements, compliance through the BUG rating method can be confirmed by checking Table 1 of the credit requirements for the maximum luminaire BUG uplight rating for the project's lighting zone. As you can see, this method, if feasible, is fairly straightforward to document. Alternately, project teams can use the calculation method to demonstrate compliance with the uplight requirements. This can be done by calculating the percentage of total lumens emitted above horizontal. The selected luminaires, cumulatively, must not exceed the maximum allowable uplight percentage as noted in Table 2 of the credit requirements. Again, these requirements are based on the project's lighting zone. For this credit, each individual luminaire does not need to meet the required percentages; only the composite total of uplight. The information needed for these calculations can either be found on manufacturer's data sheets or the IES files for each luminaire.

Teams using the calculation method may need to make adjustments to the preliminary lighting design if the project's lighting plan isn't meeting the uplight requirements. In these cases, complete the calculations again after adjusting designs to confirm compliance.

Next, the light trespass requirements must be assessed for credit compliance. Again, either method can be used to document this. If using Option 1, the BUG rating method, then table 3 of the credit requirements lists the luminaire BUG Rating for the project's lighting zone and the luminaire location and angular position. Mounting location, distance from the lighting boundary, and the light source should all be considered when selecting luminaires that meet the required ratings. Luminaires mounted at the highest height and located closest to the lighting boundary will constitute the worst case scenario and have the most difficulty complying.

Your lighting designer should be able to help identify tradeoffs when choosing luminaires. LEDs, for example, perform quite differently than traditional light sources. They are more directional and are brighter in some ways, which can produce more glare, but are also more controllable.

Teams opting to demonstrate compliance through the calculation method, should calculate the vertical illuminance at the lighting boundary in order to ensure that the illuminance does not exceed the maximum allowance as shown in Table 4 of the credit requirements. Teams must calculate the vertical illuminances on all vertical planes as they extend upward from the lighting boundary at grade level to a height that is at least 33 ft above the tallest luminaire on the project.

As with uplight, if the project isn't complying with the light trespass requirements through your chosen method, then adjustments to the design need to be made and the calculations redone.

Once teams have satisfied the requirements for both uplight and light trespass, there is one final requirement: the internally illuminated exterior signage. For this requirement, there aren't options for compliance methodologies. Select luminaires for any internally, illuminated exterior signage that do not exceed the luminance requirements for nighttime or daytime. While a lighting designer will be able to determine whether or not a sign complies, it's helpful for project team members to understand these requirements. This compliance may be shown by manufacturer data, taking measurements of the sign's maximum luminance, or by having the lighting consultant construct the sign in calculation software.

Now that we've walked through the various ways that teams can show compliance with these three fundamental requirements – uplight, light trespass, and exterior internally-illuminated signage, let's look at some overall strategies that will help teams be successful with this credit.

First, specify only the site lighting that is necessary. Minimize the overall number of exterior luminaires will help with credit compliance. When putting together your lighting design plan, make sure that you check the credit requirements. There are three separate qualities or ratings that need to be checked: backlight, uplight, and glare. Teams may need to switch out luminaires as different photometric plan scenarios are run. Sometimes, selecting luminaires can be more important than lighting design. This is something that lighting manufacturers may often help you with for free.

When considering that lighting design, make sure to locate luminaires appropriately within the project site. For example, luminaires mounted at the maximum height and located closest to the lighting boundary will have the most difficulty complying with light trespass requirements.

Let's look at a few more tips for this credit. We've mentioned this throughout, but involving a lighting designer is particularly helpful if using the calculation methodology. Their specialized knowledge will save you time when completing the complicated calculations required. A challenge to this credit can be getting the entire project team on one page, so it's important to have an expert who understands these concepts working with the team early on.

Make sure to carefully consider any exemptions that you justify – consult the rating system to make sure they are truly warranted. Similarly, make sure that the lighting zone that you choose is appropriate for your location. If you choose a lighting zone that is too high, your plan could be rejected in spite of the design. The zone needs to be appropriate for the project surroundings. And again, this is something that must happen prior to lighting design.

Campus projects in particular can have a hard time classifying the lighting zone and might have multiple types of boundaries. It can get confusing to navigate all three and to figure out which you are held to for which requirements, again this is a time when a lighting designer's expertise will save time and money.