

3M Window Film & LEED Sustainable Design

LEED, or Leadership in Energy and Environmental Design, is a third party building certification program output by the US Green Building Council (USGBC). The program is designed to transform the way buildings and communities are designed, built and operated, enabling an environmentally and socially responsible, healthy and prosperous environment that improves the quality of life.

With this goal in mind, LEED certifies projects, not products. The purpose of certifying projects instead of products is that it puts an emphasis on the building's end results instead of a prescriptive requirement. Although some of the credits have prescriptive requirements, the credits have all been written such that if the intent of the credit is achieved a project will receive points. Thus, the LEED handbook is written such that there is a credit title, intent of the credit, and then recommended, but not prescriptive, methods to obtain the credit. Below is a list of areas where 3M Window Films may apply to the intent of a credit, and the recommended documentation / method for applying for the credit. This does not in any way imply that window films will satisfy the requirement for the LEED credit, but the product will work toward the intent of the credit. Credits can only be given by the USGBC. These credits apply to LEED for New Construction and Major Renovations version 2.2.

SS credit 8 (1 pt) Light Pollution Reduction

Intent: Minimize light trespass from the building and site, reduce sky-glow to increase night sky access, improve nighttime visibility through glare reduction, and reduce development impact on nocturnal environments.

How 3M Window Films may apply to this credit

3M Window films can reduce the amount of light passing through a window from the interior to the exterior by up to 85% while minimizing the reflection from the interior lights, such that a pristine view out the windows is retained, even at night. This LEED credit is written in such a way that lighting is emphasized; however, reducing the amount of interior lighting that can escape through the window also satisfies the intent of the requirement. Specifically in major renovations, applying window film may reduce the amount of changes required for the building lighting scheme while still meeting this credit.

EA Credit 1 Optimize Energy Performance (Starting in 2009 at least 2 pts must be achieved in this section)

Intent: Achieve increasing levels of energy performance above the baseline in the prerequisite standard to reduce environmental and economic impacts associated with excessive energy use. There are 3 methods for satisfying this requirement. This credit is worth up to 10 pts (the most points of any LEED section).

Option 1 (1-10 pts) Whole Building Energy Simulation

The following table lists the amount of points for each percentage improvement over the base building. For existing buildings, the percentage improvement is based on the existing building. For new buildings, the percentage improvement is based on a base building built to the ASHRAE 90.1-2007 standard. Note: The percentage improvement listed below is based on cost

savings, not energy savings. This suggests that as utility prices/energy prices rise, saving the same amount of energy will result in greater improvement percentages. LEED utilizes this cost base method because they want to emphasize that saving energy is also a financial benefit.

New Buildings	Existing Buildings	Points
10.5%	3.5%	1
14.0%	7.0%	2
17.5%	10.5%	3
21.0%	14.0%	4
24.5%	17.5%	5
28.0%	21.0%	6
31.5%	24.5%	7
35.0%	28.0%	8
38.5%	31.5%	9
45.0%	35.0%	10

How 3M Window Films may apply to this credit

The whole building energy simulation referenced in this credit would require the use of an energy simulation program such as: eQuest, Energy Plus, or DOE-2. Demand Analyzer in itself does not take into account enough variables to determine credit for this section. In order to achieve credit whole window values for applying the window film should be given to the architect/energy simulation programmers to determine the effects of window films. In existing buildings there have been cases where simulations have shown greater than 8% energy improvement and often have paybacks in less than 5 years.

For new buildings very few single products on the market will give a significant enough improvement in energy savings to obtain credit by themselves. The savings will be dependent on multiple systems functioning together to provide the required savings. Window films are beneficial in achieving the required savings.

Option 2 (1-4 pts) Prescriptive Compliance Path ASHRAE Advanced Energy Design Guide for Small Office Buildings 2004

(To use this method the building must be an office type building with less than 20,000 square feet floor area.)

The following table lists the prescriptive glazing requirements per climate zone. (For all climate zone information go to the USGBC or NFRC website). The design guide focuses on more than glazings; however, window films will aide in the glazing section. All values in the table below are whole window values, be sure to utilize the correct values for determining compliance.

Climate Zone	SHGC	U value
1	0.35	0.56
2	0.31	0.45
3	0.31	0.45
4	0.46	0.42
5	0.46	0.42
6	0.46	0.42
7	NA	0.33
8	NA	0.33

How 3M Window Films may apply to this credit

Obtain the whole window values from 3M for different glazing types. These values will determine compliance with the Advanced Energy Design Guide.

Option 3 (2-5 pts) Prescriptive Compliance Path Advanced Buildings Core Performance

(To use this method the building must have less than 100,000 square feet floor area and must fully comply with both sections 1 and 2. Additional points are achieved for utilizing steps in section 3.)

The following table lists the prescriptive glazing requirements per climate zone. (For all climate zone information go to the USGBC or NFRC website). The design guide focuses on more than glazings; however, window films will aide in the glazing section. All values in the table below are whole window values, be sure to utilize the correct values for determining compliance.

Climate Zone	1	2	3	4 (Dry / Marine)	4 (Humid)	5 (Dry)	6 (Dry)	6 (Humid)	7	8
Other Frame U	0.57	0.57	0.4	0.35	0.4	0.35	0.35	0.35	0.35	0.35

Products	SGHC	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	Any	Any
Metal Frame	U	0.57	0.57	0.5	0.35	0.42	0.45	0.42	0.45	0.35	0.35
	SGHC PF<0.25	0.24	0.24	0.2	0.24	0.24	0.3	0.3	0.3	0.49	0.49
	SGHC 0.25<PF<0.5	0.32	0.32	0.3	0.32	0.32	0.39	0.39	0.39	0.49	0.49
	SGHC PF>0.5	0.39	0.39	0.3	0.39	0.39	0.39	0.39	0.39	0.49	0.49
All Products	VLT/SHGC	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5

MR Credit 1.1-1.2 (1-2 pts) Retain 75%-95% (based on surface area) of Existing walls, Floors and Roof

Intent: Extend the life cycle of existing building stock, conserve resources, retain cultural resources, reduce waste and reduce environmental impacts of new buildings as they relate to materials manufacturing and transport.

How 3M Window Films may apply to this credit

This credit specifically states that glazings are to be removed from the calculations and disposed of. The reasoning behind this may be due to the fact that a glazing is the most energy inefficient part of the building envelope, and significant advancements have been made in lowering the solar heat gain coefficient and the U values of windows. However, the intent of the credit states specifically that the purpose of the credit is to conserve resources, building stock, and reduce waste and environmental impacts. In warmer climates reducing the solar heat gain coefficient has a much greater net effect on saving energy than reducing the U value, and 3M Window Films have been specifically designed to retrofit existing windows such that, existing windows can be upgraded to have similar solar heat gain performance as new windows.

Applying 3M Window Films to the windows not only diverts large quantities of windows from the waste/recycling stream, but also reduces the environmental costs of shipping both the waste windows as well as the new windows to the construction site. A standard 72" box of window film covers 600 square feet of windows, while weighing less than 20 lbs and taking up only 6"x6"x72" of cargo space, which is both less space and less weight than sending a standard single 12 square foot window.

Reusing windows may allow a builder to dispose of other sections of the building envelope and still obtain credit for this section, and since this credit specifically states that windows need not be retained, by utilizing film it may also be possible to obtain an Innovation in Design Credit.

MR Credit 5.1 and 5.2 Extracted, Processed, & Manufactured Regionally

Intent: Increase demand for building materials and products that are extracted and manufactured within the region, thereby supporting the use of indigenous resources and reducing the environmental impacts resulting from transportation.

How 3M Window Films may apply to this credit

3M Window films are sold globally, and manufactured in a few select locations. However, one of the intents of this credit is to reduce the environmental impacts resulting from transportation. 3M Safety and Security Films pass the ANSI Z97 Human Impact Safety (and like standards), as well as the small missile impact test. The films and attachments have GSA ratings, aide in windstorm protection, and also in smash and grab crime. Another method to gain this type of performance may be to use laminated glass. A $\frac{1}{8}$ " thick piece of glass has a typical density of .0226 lbm/in² (1.589 g/cm²). For a standard 43" by 68" piece of glass this relates to 66 lbm (29.9 kg). A piece of 4 mil window film weighs approximately 20 g/ft². For a standard 43" x 68" piece of glass this would be .895 lbm. Utilizing film instead of a second pane of glass (such as a laminated unit) has reduced the weight of a standard size window (43"x 68") by 65 lbs. This has the potential to save thousands of pounds in shipping weight, as well as significant reduction in materials use in construction.

EQ Credit 7.1 (1 pt) Thermal Comfort

Intent: Provide a comfortable thermal environment that supports the productivity and well being of building occupants

How 3M Window Films may apply to this credit

This credit states that a building must be designed in accordance to ASHRAE 55-2004. ASHRAE 55-2004 does not define how to design a building or system, but rather the acceptable environmental conditions under which a person is comfortable. There are many variables that determine occupant comfort, but 3M Window Films will apply in the area of thermal comfort. According to ASHRAE 55-2004 the optimal temperature for thermal comfort lies within the range of 67°F-83°F, depending on the air speed and the humidity ratio. 3M Window Films have shown in numerous case studies that they will reduce the temperature of an area in direct sunlight, and also aide in balancing the temperature of a building. Often early in the morning east facing tenants will complain of heat and glare, while facing tenants have their heat and lights on. By minimizing the amount of solar gain through the windows 3M Window Films can aide in meeting the thermal comfort credit.

EQ Credit 7.2 Thermal Comfort Verification

Intent: Provide for the assessment of building thermal comfort over time

How 3M Window Films may apply to this credit

This credit states that a building owner must conduct a thermal comfort survey of the building occupants within 18 months of occupancy. Upon completion of the survey 80% of the building occupants must be satisfied with the thermal comfort of the building. If 80% of the building occupants are not satisfied with the building environment a corrective action plan must be put into place. Windows are a large contributor to thermal discomfort, and adding 3M Window Film is an inexpensive alternative to having to change out windows that are not as effective at controlling transmitted solar energy as is needed.

EQ Credit 8.1-8.2 (1-2 pts) Daylight 75-95% of spaces

Intent: Proved for the building occupants a connection between indoor spaces and the outdoors through the introduction of daylight and views into the regularly occupied areas of the building. There are 3 methods for satisfying this requirement. NOTE: It states directly in the LEED Handbook that the most common reason for failure of this credit is due to lack of glare reduction. 3M Window Films are capable of tuning the visible light transmission of each application appropriately.

Option 1 - Calculation

Achieve a minimum glazing factor of 2% in a minimum of 75% of all regularly occupied areas.

Glazing Factor=Window Area/Floor Area*Geometry Factor* Tvis(actual)/Tvis(min) * Height Factor

Window Type	Geometry Factor	Minimum Tvis	Height Factor
Sidelighting daylight glazing (7'6" and higher above the floor)	0.1	0.7	1.4
Sidelighting vision glazing (2'6"-7'6" above the floor)	0.1	0.4	0.8
Toplighting vertical monitor	0.2	0.4	1
Toplighting sawtooth monitor	0.33	0.4	1
Toplighting horizontal skylights	0.5	0.4	1

Option 2 - Computer Simulation

Demonstrate through computer simulation that a minimum daylight illumination of 25 ftcandles has been achieved in 75% of all regularly occupied areas. Demonstration should be in clear sky conditions, at noon, on the equinox, 30' above the floor.

Option 3 - Daylight Measurement

Demonstrate through indoor light measurements that a minimum daylight illumination of 25 ft. candles has been achieved in 75% of all regularly occupied areas. Measurements to be

taken on a 10ft grid. Demonstration should be in clear sky conditions, at noon, on the equinox, 30' above the floor.

How 3M Window Films may apply to this credit

3M Window Films may apply to this credit in a variety of manners. 3M Window Films can reduce both the SHGC and the U value of a window, which would allow larger glazings without affecting energy costs for the building. Also, 3M Window Films allow a customization of visible transmittance. According to the LEED handbook, the number one reason this credit is denied is due to inadequate glare control. 3M Window Films can be used to customize the amount of light transmitted into different areas of the building, providing the most efficient and effective usage of daylighting. The 3M light diffusing Fasara films can also be an effective way to reduce glare, but retain daylight.

ID Credit (1 pt) Fade Reduction

Innovation Design Credit Intent: Provide design teams and projects the opportunity to be awarded points for exceptional performance above the requirements set by the LEED Green Building Rating System and/or innovative performance in green building categories not specifically addressed by LEED.

How 3M Window Films may apply to this credit

According to a study done by Lawrence Berkeley National Laboratories the causes of fading are 40% UV, 25% heat, 25% visible light, and 10% miscellaneous. 3M Window Films reject 99% of the UV from the sun, can reduce the visible light transmitted depending on the selected film, and also reduce the heat of the building by reducing the SHGC for the window. 3M Window Films will not stop fading but will significantly slow fading from occurring. All 3M Window Films reject at least 40% of the cause of fading (UV), and depending on film choice will effect the heat and visible light effects which is another 50% of the cause of fading. By reducing fading, 3M Window Films can extend the life of furniture and building interiors. By extending the life of products 3M Window Films has reduced the amount of furnishings that may have been diverted to the waste stream, the shipping costs of new and disposed furnishings, and/or the amount of materials required to refurbish the furnishings and building interior. 3M Window Films can extend the timeframe needed to repaint/refinish building interiors/furnishings, thereby reducing occupancy interruptions and increase indoor air quality by minimizing the amount of odor typical refinishing materials may release.

ID Credit (1pt) Environmental quality UV rejection

Innovation Design Credit Intent: Provide design teams and projects the opportunity to be awarded points for exceptional performance above the requirements set by the LEED Green Building Rating System and/or innovative performance in green building categories not specifically addressed by LEED.

How 3M Window Films may apply to this credit

Harmful UV rays are a known contributor to skin cancer. It is well known that sunscreen should be applied when going outside. What is not well known is that a clear single pane window only has an SPF factor of 12, and a clear double pane window an SPF factor of 18. Thus, the window itself is not protecting an individual from harmful UV rays. 3M Window Films are recommended by the Skin Cancer Foundation¹. Applying 3M Window Films to a window increases the SPF factor of a window to greater than 1,000. Applying the 3M Window Film significantly decreases the potential harmful effects of UV rays.

ID Credit (1pt) Materials Reuse

Innovation Design Credit Intent: Provide design teams and projects the opportunity to be awarded points for exceptional performance above the requirements set by the LEED Green Building Rating System and/or innovative performance in green building categories not specifically addressed by LEED.

How 3M Window Films may apply to this credit

In the event that credit will not be granted for reusing the glazings for credits MR 1.1 & 1.2, it may be possible to apply reusing the glazings with film added to an innovative design credit. All comments from credit MR 1.1&1.2 above would apply.

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