

# REFLECTIVE ROOF COATINGS AND LEED V4



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## ABSTRACT

This paper, published by the Roof Coatings Manufacturers Association (RCMA), is an update to *Reflective Roof Coatings and LEED*, issued by the Reflective Roof Coatings Institute (RRCI) in 2012. The purpose of this paper is to discuss the role of reflective roof coatings in the US Green Building Council's Leadership in Energy and Environmental Design™ (LEED®) Version 4 (v4) green building program. Emphasis is on the structure of LEED v4 for New Construction and LEED v4 for Existing Buildings Operation and Maintenance, and how reflective roof coatings can fulfill LEED v4 *Prerequisites* and *Credit* requirements. The intent is to provide stakeholders with an understanding of how reflective roof coatings contribute to cost effective, environmentally sound new building and renovation projects that use LEED v4. These findings apply to any reflective roof coatings that are LEED compliant. In addition, the document can be viewed as a resource as to the benefits reflective roof coatings provide to buildings, businesses, and the environment at large. USGBC and LEED's acceptance of these products indicates the important role reflective roof coatings play in the green building industry.

## PURPOSE

The purpose of this paper is to:

- Raise awareness of the qualities and attributes of reflective roof coatings in the green building industry and the LEED v4 rating systems;
- Encourage stakeholders to value reflective roof coatings in the integrative design process when resolving price / cost / value design and construction budget issues; and
- Enable LEED project teams to evaluate reflective roof coatings when compiling LEED v4 *Credit* requirements.

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## INTRODUCTION

The emergence of the high performance green building movement and its impact on how buildings are designed, constructed, operated, and maintained has prompted industry-wide discussions of how stakeholders can best achieve their goals in a cost-effective and timely manner. These include energy, material, and resource efficiency, as well as reduced operation and maintenance, the adaptive reuse of existing buildings, and optimizing facilities for the health and productivity of the occupants, among other considerations.

The evolution of various building rating systems developed to optimize building performance and provide superior indoor environmental quality has contributed to a move away from the traditional linear approach to project development and ownership toward a more integrative process. Chief among these is the US Green Building Council's Leadership in Energy and Environmental Design™ (LEED®) Version 4 (v4) green building program, wherein integrative design is a *Prerequisite* for healthcare facilities, and an optional *Credit* opportunity in most other LEED v4 building rating systems. Given reflective roof coatings' impact on improving building energy performance, occupant comfort, and achieving cost effective, reliable maintenance regimes, the use of these products plays an important role in achieving LEED certified buildings.

## OVERVIEW OF LEED RATING SYSTEMS AS THEY PERTAIN TO APPLYING REFLECTIVE ROOF COATINGS

The USGBC is a private 501(c) (3) membership based, non-profit organization headquartered in Washington, DC. It was founded in 1993 as a trade organization to promote sustainability in how buildings are designed, constructed, and operated. To achieve this, it has developed a variety of programs and services, and works closely with key industry and research organizations and federal, state, and local government agencies. The USGBC is perhaps best known for the development of the LEED green building rating systems.

In September 2011, the USGBC began organizing the *LEED* rating systems around the current *LEED Rating System*

**Project:** South Carolina 225,000 sq. ft., 227 ft. high steel framed building with multiple leaks and gutter failures due to high heat, humidity, thermal shock, and UV degradation



**Challenges:** Difficult, time-consuming access to the roof, and prohibitive costs associated with replacing substrates to accept another bitumen based roof membrane replacement. A more cost effective replacement was needed to eliminate work stoppages and lost production.

**Solution:** Metal fluid applied reflective roof coating pumped to the roof outside the building. Some benefits of the project:

- Avoided tear off, disposal, and substrate replacement costs, significantly reducing project time and costs.
- No business interruptions, and a cooler, dryer work environment.
- Seamless, wind and weather resistant monolithic roof system including improved seams, penetrations, and gutters.
- Success led to increased scope of one to six roofs, more savings, and greater reliability.

**LEED v4:** This project would contribute to meeting all roofing related *Prerequisites*, and would qualify for all applicable LEED v4 *Credits*.

*Guidance Version 4 (LEED v4)*, and launched LEED v4 in November 2013 as a more rigorous green building rating system, to include new concepts such as product transparency, whole building life-cycle analysis, and newer energy standards.<sup>1</sup> It was determined that LEED 2009 or LEED v4 could be used until October 31, 2016, after which

<sup>1</sup> For further details on LEED v4, visit the LEED website: <http://www.leeduser.com/leedv4> or <http://www.leeduser.com/blogs/leed-2009-registration-extended-october-2016>

projects can only *register* for LEED certification using LEED v4. The last date a project can submit for LEED 2009 certification is June 30, 2021.

Today, LEED v4 is comprised of a suite of rating systems for the design, construction, and operation of buildings, homes, and neighborhoods, and reflective roof coatings are in play in any project that uses them. The five overarching categories correspond to the specialties available under the LEED Accredited Professional program. They are:

- New Building Design + Construction
- Interior Design Construction
- Existing Building Operation and Maintenance
- LEED for Homes; and
- LEED for Neighborhood Development.

As in previous LEED rating systems, LEED v4 is comprised of *Credit Categories* that include *Prerequisites*, *Credits*, and *Bonus Credits*. In each rating system, *Prerequisites* must be met in order for the project to be eligible for LEED Certification. *Prerequisites* include compliance with environmental laws and regulations, occupancy codes, building permanence, and pre-rating completion, site boundaries and area-to-site ratios, and obligatory five-year sharing of whole building energy and water use data. Reflective roof coatings contribute directly to the *Energy and Atmosphere Prerequisite: Minimum Energy Performance*, and have an important role to play in several *Credits*. A complete list of changes to LEED v4 *Prerequisites* and *Credits* is available at [www.usgbc.org](http://www.usgbc.org).

## THE ROLE OF REFLECTIVE ROOF COATINGS IN THE LEED CERTIFICATION PROCESS

Reflective roof coatings have a direct and indirect role to play in the LEED certification process. There are two basic types of reflective roof coatings: reflective elastomeric coatings and aluminum coatings. The selection of one of these two types of coatings is typically based on a myriad of project goals including microclimate, existing roof conditions, the material to be coated and the condition it is in, desired energy savings, code requirements, budget, and special conditions. These materials are recognized in LEED rating systems for several reasons. Chief among these is their ability to

reduce the urban heat island effect, their contribution to energy conservation with the attendant benefit of carbon emission reduction, and the ability to extend the life of roofing systems specifically, and existing buildings generally.

To understand the role of reflective roof coatings in LEED, project teams must first address the building type and LEED rating system being used. Further, it must be determined whether the project classifies as new or existing construction, or a mixture of the two. LEED uses a “40/60 rule” to select the proper rating system when more than one appears to be appropriate for a project. The project is subject to all *Prerequisites* and attempted *Credits* in that rating system, regardless of a mixed construction or space usage type. The entire gross floor area of a LEED project must be certified under a single rating system. Generally, the 40/60 Rule is applied as follows:

- a. If a rating system is appropriate for less than 40% of the gross floor area of a LEED project building or space, then that rating system should not be used.
- b. If a rating system is appropriate for more than 60% of the gross floor area of a LEED project building or space, then that rating system should be used.
- c. Project teams with buildings and spaces that do not fall into the scenarios described in a) and b) must independently assess their situation and decide which rating system is most applicable.

Once the proper LEED rating system has been identified, the LEED team can proceed with evaluating the contribution of reflective roof coatings to achieving as many LEED *Prerequisites*, *Credits* and associated *Credit* points as possible. The following overview highlights the *Credits* that directly or indirectly involve reflective roof coatings. The reader is encouraged to reference the complete LEED v4 guidelines as published by the USGBC, which are available online at [www.usgbc.org](http://www.usgbc.org).

## DOCUMENTING THE USE OF REFLECTIVE ROOF COATINGS IN LEED PROJECTS

LEED documentation consists of recognizing the design and construction intent, acknowledging what is actually constructed, and verifying all aspects of the project using LEED Online, an interactive, web based electronic format

that facilitates the LEED team's collaboration. LEED Online also enables the requisite third party review by the Green Building Certification Institute (GBCI).

A LEED project typically starts with a goal setting session to verify all *Prerequisites* can be met, and to decide which optional *Credits* will be pursued. Beyond the required *Prerequisites*, *Credits* are usually pursued based on project context or location, choices that contribute to the physicality of the architecture including materials and resources, and related building processes, such as computer modeling and commissioning. Generally, building products are included in LEED projects based on their ability to provide cost effective utility while minimizing environmental impact. Reflective roofs provide well-documented and reliable responses to energy conservation goals. Once the decision to use reflective roof coatings in a LEED project is made, information pertaining to the chemistry, behavioral characteristics, and physical parameters of the products are entered into the appropriate LEED Online templates. LEED templates enable LEED teams to share information, and serve as a convenient way to store supplemental data, specifications, and other technical information that support the inclusion of a specific reflective roof coating.

Reflective roof coating technical representatives must contribute information to the LEED project administrator that accurately represents the products to be used. The contractor also participates by providing proof of purchase and field application information as required. LEED is an honor system that assumes the product information entered into templates represents that which is actually used. LEED teams are not limited to submitting a material in only one *Credit* opportunity. The integrative design process encourages LEED teams to take advantage of the relationships and synergies between products and processes to insure the investment made reaps the maximum return of LEED points earned.



**Project:** Texas Plastics Manufacturer

**Challenges:** The buildings in this one million sq.ft. manufacturing facility located in coastal Texas were structurally sound, but plagued with numerous, persistent leaks that were difficult to access and repair. The leaks resulted from the typical UV degradation and thermal shock, but were aggravated by prevailing winds across the Texas flatlands, tropical storms, and salt air. Leaking was often sufficient to cause work interruptions and the complete shut down of some work areas.

**Solution:** A reflective roof coating was applied to the buildings as the client's budget allowed. Project expenses were minimized by eliminating roofing tear off and disposal costs. With each application, the corporation reported no further leaks, increased comfort and energy savings. The roof temperatures dropped 30 to 35°F, resulting in increased productivity and decreased maintenance.

**LEED v4:** This project would contribute to meeting all roofing related *Prerequisites*, and would qualify for all applicable LEED v4 *Credits*, including *Integrative Design, Sustainable Sites, Energy and Atmosphere, Materials and Resources, Innovation and Regional Priority*.

## LEED v4 CREDIT CATEGORIES

This paper examines seven LEED *Credit Categories* wherein reflective roof coatings are relevant, weighted to how directly reflective roof coatings apply.<sup>2</sup> Once all *Prerequisites* are met, LEED project teams can select any *Credits* that are applicable in any *Credit Category*, preferably by using an integrative design approach. Points are earned by successfully accomplishing all of the *Credit* requirements associated with an individual *Credit*. A LEED v4 Score Sheet showing the points associated with each *Credit* is included in the Appendix. The LEED v4 *Credit Categories* covered in this paper are:

- Innovation
- Integrative Process
- Sustainable Sites
- Energy and Atmosphere
- Materials and Resources
- Indoor Environmental Quality
- Regional Priority

### ***LEED v4 Credit Categories: Innovation***

Generally, project teams can earn Innovation Points by using any combination of innovation, pilot *Credits*, and exemplary performance strategies. Up to five points may be earned in the *Innovation Category*, wherein LEED project teams are invited to present how reflective roof coatings can be used in innovative ways or creative building solutions. All *Innovation in Design Credit* approaches or strategies must be quantifiable, exhibited as part of the finished project, and documented in LEED Online format with all other LEED project submission information. The role of reflective roof coatings in these scenarios is valid with respect to educating all stakeholders to their value in energy conservation, urban heat island reduction, and architecture. *Innovation Points* are gained by exceeding the base requirements for eligible *Credits*, or by developing a quantifiable design or construction idea that gets included in the project. Reflective roof coating stakeholders can contribute expertise, insight, or suggestions that to help the LEED Team meet the *Innovation Credit* criteria.

### ***LEED v4 Credit Categories: Integrative Process***

One of the most significant developments in LEED v4 is the introduction of integrative design as a *Prerequisite* in LEED v4 for Healthcare, and a *Credit* opportunity LEED v4 for Building Design and Construction. Integrative design is the process by which a number of project conditions and variables are investigated and evaluated comprehensively to determine the most cost effective and environmentally benign project possible. The integrative design process begins in the earliest stages of the project. It encourages team members to base design and construction decisions on the multiple returns and benefits possible when the synergies and relationships of various project factors are well understood. Integrative design invites out-of-the-box thinking, and creative, constructive input by all members of the design and construction community associated with the project. Reflective roof coating stakeholders benefit from being familiar with the concept of integrative design and being willing to participate in the collaborative design development process.

#### ❖ **Integrative Process – (1) point<sup>3</sup>**

- *Intent*: To support high-performance, cost-effective project outcomes through an early analysis of the interrelationships among systems.
- *Requirements*: Beginning in pre-design and continuing throughout the design phases, the LEED team must identify and use opportunities to achieve synergies across disciplines and building systems. Computer analyses, site observations, microclimate data, hydrology, geology, community connections, and any other quantifiable methodology can be used to inform the owner's project requirements, basis of design, design documents, and construction documents. *Innovation Points* for Integrative Process are not available through *Exemplary Credit* or as a *Regional Priority*.

<sup>2</sup> The paper does not go into detail about the Location and Transportation or Water Efficiency categories, as reflective roof coatings do not directly qualify.

<sup>3</sup> <http://www.usgbc.org/credits/new-construction-core-and-shell-schools-new-construction-retail-new-construction-healthca-21>

## LEED v4 Credit Categories: Sustainable Sites

According to a study of the metropolitan areas of Baton Rouge, Chicago, Houston, Sacramento, and Salt Lake City by the Department of Energy's Lawrence Berkeley National Laboratory (LBNL), the energy savings potential of heat island reduction measures ranges from \$4 million to \$15 million per year.<sup>4</sup> This estimated energy savings range refers to metropolitan-wide annual energy savings as measured in this LBNL multi-city study, which took into account factors such as annual electricity savings, annual natural gas deficit, and peak power avoided. Efforts to reduce heat islands can have a reasonable payback period when included as part of an integrated systems approach to improving building performance, such as installing solar panels or shading devices, or using a vegetated roof to extend the life of the roof.

The most effective measure of a roofing material's ability to reject solar heat is the solar reflectance index (SRI). In addition to a product's initial SRI or SR value, this *Credit* considers a product's three-year aged SRI or SR values, which measure material performance over time. The *Credit* encourages project teams to adopt a variety of strategies, including reducing hardscape and incorporating high-SRI or high-SR materials, which minimize a project's overall contribution to heat island effects.

### ❖ Heat Island Reduction (2 points except Healthcare, 1 point Healthcare) (Formally Sustainable Sites Credit 7.2: Urban Heat Island Reduction – Roof)

- *Intent:* To minimize effects on microclimates and human and wildlife habitats by reducing heat islands.
- *Requirements:* Use one of the following options:  
(Option 1) Non-roof and roof  
Meet the following criterion for Area of Non-Roof or Roof Measures:

TABLE ONE

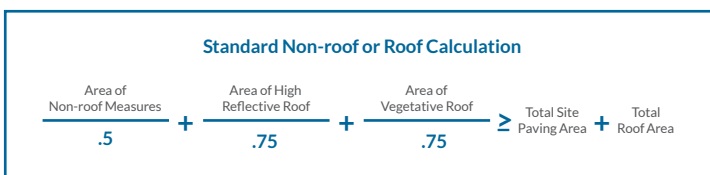
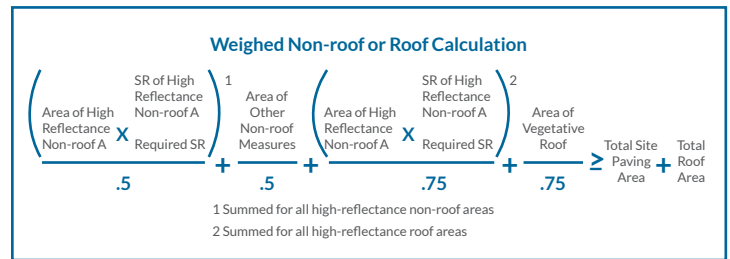


TABLE TWO



To meet the criteria in Table Three, reflective roofing materials that have an aged SRI equal to or greater than the values in the table below to meet the three-year aged SRI value must be used. If three-year aged value information is not available, materials that meet the initial SRI value can be submitted for review.

TABLE THREE

Minimum Solar Reflectance Index Value, by Roof Slope				
Slope		Initial SRI	OR	3-Year Aged SRI
Low Sloped Roof	</=2:12	82		OR
Steep Sloped Roof	< 2:12	39	32	

The ratings must apply to a minimum of 75% of the roof surface. Other noncompliant materials may be used for the remaining 25%. Achieving this *Credit* is largely a matter of documenting the physical area of the roof and the characteristics of the reflective roof coating surface material. There are no additional energy related calculation requirements for this *Credit*.

## LEED v4 Credit Categories: Energy and Atmosphere

Fundamental commissioning of building systems and verification of building performance are now major components in high performance building design and operation strategies. *Fundamental Commissioning*<sup>5</sup> and *Verification is a Prerequisite*. Meeting the requirements for the Fundamental Commissioning Prerequisite does not include roof constructions unless they are part of the Owner's Program Requirements.

<sup>4</sup>Energy Savings of Heat-Island Reduction Strategies in Chicago and Houston (Including Updates for BatonRouge, Sacramento, and Salt Lake City) S. Konopacki and H. Akbari, Heat Island Group Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory, University of California Berkeley, CA 94720, February 2002 <http://www.osti.gov/scitech/servlets/purl/795970/>

<sup>5</sup> Commissioning (Cx) is the art and science of applying the existing body of literature and experience by trained experts using the appropriate tools and technology to determine, to the extent possible, that the building has been designed, constructed and will operate as intended.

## ❖ **Fundamental Commissioning and Verification (Prerequisite)**

- *Intent:* To support the design, construction, and eventual operation of a project that meets the owner's project requirements for energy, water, indoor environmental quality, and durability.

Once the *Fundamental Commissioning Prerequisite* has been met, LEED v4 affords project teams the opportunity to earn a point for successfully completing the *Enhanced Commissioning Credit*. This includes commissioning the roof as part of the building envelope. Reflective roof coating stakeholders should be aware of what is required to meet LEED v4 commissioning expectations. The integrative design approach often uses intensive preliminary meetings and strategy sessions to comprehensively establish the scope and approach to the project. The role of commissioning is often included in these sessions, and reflective roof coating stakeholders should be represented in these very important discussions.

## ❖ **Enhanced Commissioning (Credit)**

- *Intent:* To further support the design, construction, and eventual operation of a project that meets the owner's project requirements for energy, water, indoor environmental quality, and durability.
- *Requirements:* Implement, or have in place a contract to implement, the required commissioning process activities in addition to those required under *Energy and Atmosphere Fundamental Commissioning and Verification*.
- *Prerequisite:* The Commissioning Authority (CxA) must have documented commissioning process experience on at least two building projects with a similar scope of work. The experience must extend from early design phase through at least 10 months of occupancy. The CxA may be a qualified employee of the owner, an independent consultant, or a disinterested subcontractor of the design team.

There is a trend in whole building commissioning to take a very comprehensive approach to building envelope performance. The intent of *Enhanced Commissioning Credit* is to begin the commissioning process early in the design process and execute additional activities after systems performance verification is completed. Reflective roof coating technical representatives, suppliers, and contractors

all have a role in completing commissioning requirements. What constitutes comprehensive commissioning should be discussed in the integrative design process to insure the scope and chronology will be sufficient and well-coordinated. This often includes the use of thermal imaging and testing for moisture migration and infiltration through the roof composite. Those responsible for the design, specification, installation, and testing of roof assemblies must coordinate with the LEED project administrator to insure the proper LEED documentation. Reflective roof coatings materials, construction techniques and sequences, testing procedures, and anticipated performance metrics and results are included in the commissioning documents and field work. In order to claim the *Enhanced Commissioning Credit*, their participation is best documented beginning in schematic design, but no later than the completion of the design development phase.

## ❖ **Minimum Energy Performance (Prerequisite)**

- *Intent:* To reduce the environmental and economic harms of excessive energy use by achieving a minimum level of energy efficiency for the building and its systems.
- *Requirements:*
  - (*Option 1*) Whole-building energy simulation: Demonstrate an improvement of 5% for new construction, 3% for major renovations, or 2% for core and shell projects in the proposed building performance rating compared with the baseline building performance rating. Calculate the baseline building performance according to ANSI/ASHRAE/IESNA Standard 90.1-2010, Appendix G, with errata (or a USGBC-approved equivalent standard for projects outside the U.S.), using a simulation model.
  - (*Option 2*) Prescriptive compliance: ASHRAE 50% Advanced Energy Design Guide Comply with the mandatory and prescriptive provisions of ANSI/ASHRAE/IESNA Standard 90.1-2010, with errata (or a USGBC-approved equivalent standard for projects outside the U.S.).
  - (*Option 3*)<sup>6</sup> Prescriptive compliance: Advanced Buildings™ Core Performance™ Guide: Comply with the mandatory and prescriptive provisions of ANSI/ASHRAE/IESNA Standard 90.1-2010, with errata (or USGBC approved equivalent standard for projects outside the U.S.).

<sup>6</sup>Note: Healthcare, Warehouse or Laboratory projects are ineligible for Option 3.



The role of reflective roof coatings in energy conscious architecture is well documented and contributes directly to achieving LEED v4 *Minimum Energy Performance Prerequisite* and *Optimum Energy Performance Credit*. The *Minimum Energy Performance Prerequisite* is to establish the minimum level of energy efficiency for the proposed building and systems to reduce environmental and economic impacts associated with excessive energy use. LEED v4 is based on ANSI/ASHRAE/IESNA Standard 90.1-2010, Appendix G, with errata (or a USGBC-approved equivalent standard for projects outside the U.S.), using a simulation model. While there are a number of options that allow for the use of prescriptive approaches, depending on the size and building type, *Option 1 - Whole Building Energy Simulation*, is most common for commercial construction. Again, in LEED, *Prerequisites* are mandatory and are not rewarded with points that contribute to the overall LEED score. The *Minimum Energy Performance Prerequisite* requires LEED project teams to demonstrate an improvement of 5% for new construction, 3% for major renovations, or 2% for core and shell projects in the proposed building performance rating compared with a baseline building performance using the ANSI/ASHRAE/IESNA Standard 90.1-2010, Appendix G, with errata (or a USGBC-approved equivalent standard for projects outside the U.S.). This is typically done using a computer simulation model. Reflective roof coatings are involved directly in this exercise and contribute to reducing the calculated (modeled) baseline energy performance required in each building type. Reflective roof coating representatives must supply the reflective roof coating technical information needed to participate based on which requirement compliance option is chosen.

Once the *Minimum Energy Performance Prerequisite* is met, the LEED team can pursue the points associated with the *Optimize Energy Performance Credit*. Points are rewarded in response to how far beyond the minimum *Prerequisite* energy reduction requirements the team goes in achieving an energy efficient project. Up to 18 points can be earned, making this *Credit* this most lucrative point scoring opportunity.

#### ❖ Optimize Energy Performance (Credit)

- *Intent*: To achieve increasing levels of energy performance beyond the prerequisite standard to

reduce environmental and economic harms associated with excessive energy use.

- *Requirements*: Establish an energy performance target no later than the schematic design phase. The target must be established as kBtu per square foot-year (kW per square meter-year) of source energy use. Choose one of the following options:
  - (*Option 1*) Whole-building energy simulation (1-18 points except Schools and Healthcare, 1-16 points Schools, 1-20 points Healthcare)
  - (*Option 2*) which takes a prescriptive approach to LEED compliance using the ASHRAE Advanced Energy Design Guide (1-6 points) for the LEED building type seeking certification.

### **LEED v4 Credit Categories: Materials and Resources**

The *Materials and Resources Category* of LEED v4 has been substantially revised from LEED 2009. Changes include the addition of the *Construction and Demolition Waste Management Planning Prerequisite*, and a completely new approach to product sourcing and formulations declarations and disclosures. These are manifest in six new or revised *Credit* constructs, all of which have implications for reflective roof coatings:

- Construction and demolition waste management planning
- Building life-cycle impact reduction
- Building product disclosure and optimization - environmental product declarations
- Building product disclosure and optimization - sourcing of raw materials
- Building product disclosure and optimization - material ingredients
- Construction and demolition waste management

Like in previous versions, LEED v4 rewards efforts to reuse existing buildings, in whole or in part, as well as any effort that diverts material from landfills. The intent is to extend the life cycle of existing building stock, conserve material resources, retain cultural resources, reduce waste, and reduce environmental impacts of new buildings as they relate to materials manufacturing and transport.

The *Materials and Resources Category* has a *Prerequisite* and *Credit* opportunity related to waste management. Reflective roof coatings have a role to play in both. Renovating or upgrading roofs can sometimes be accomplished using new reflective roof coatings applied over existing substrates. The LEED team must be able to assess the benefits that come from using reflective roof coatings in this manner and provide the information necessary for *Prerequisite* and *Credit* construction waste documentation. Like others, this effort should be discussed early in the integrative design process to be sure the work is completed in a way that anticipates the effort and captures the required documentation information. LEED v4 does not penalize the LEED team for removing non-structural elements of an existing roof when calculating the percentage of the building that remains in play. Therefore, any roof repair or preparation that involves removing damaged or otherwise unsuitable roofing material prior to applying new reflective roof coating does not jeopardize the ability to score LEED points.

❖ **Construction and Demolition Waste Management Planning (Prerequisite)**

- *Intent:* To reduce construction and demolition waste disposed of in landfills and incineration facilities by recovering, reusing, and recycling materials.
- The waste associated with fluid applied reflective roof coating membranes should be minimal, but the calculations must include proper disposal of packaging and containers. This also applies to the *Credit*.

❖ **Construction and Demolition Waste Management (Credit) 1 to 2 points**

- *Intent:* To reduce construction and demolition waste disposed of in landfills and incineration facilities by recovering, reusing, and recycling materials.

Reflective roof coatings can contribute to recycling and /or salvaging nonhazardous construction and demolition materials. Calculations are based on diverting excess or material from landfills or by limiting the construction waste generated to less than 2.5 pounds of construction waste per square foot of construction. Careful scope and material needs assessment can limit the amount of reflective roof coating material that is brought to a job site. Material purchase return policy or the contractor’s ability to warehouse extra material until needed can also contribute

to minimizing waste. Reflective roof coating suppliers should assist in taking back containers, or helping to find reuse or redistribution opportunities for all packaging.

❖ **Building Life Cycle Impact Reduction (Credit) 2 to 5 points**

- *Intent:* To encourage adaptive reuse and optimize the environmental performance of products and materials.

Any use of reflective roof coatings that contributes to saving or renovating existing historic, abandoned, or blighted buildings contributes to achieving this *Credit*. Team members must demonstrate reduced environmental effects during initial project decision-making by reusing existing building resources or demonstrating a reduction in materials use through life-cycle assessment. The application of reflective roof coatings to any building type that enables the team to maintain existing roof profiles, eliminate the need for new roof structure, or contribute to the cost effective reuse of a building has merit. Generally, the team must achieve one of the following options:

*(Option 1) Historic building reuse (5 points)*

*(Option 2) Renovation of abandoned or blighted building (5 points)*

Maintain at least 50%, by surface area, of the existing building structure, enclosure, and interior structural elements for buildings that meet local criteria of abandoned or are considered blight. The building must be renovated to a state of productive occupancy. Up to 25% of the building surface area may be excluded from *Credit* calculation because of deterioration or damage.

*(Option 3) Building and material reuse (2-4 points)*

Reuse or salvage building materials from off site or on site as a percentage of the surface area, as listed in Table 1. Include structural elements (e.g., floors, roof decking), enclosure materials (e.g., skin, framing), and permanently installed interior elements (e.g., walls, doors, floor coverings, ceiling systems). Exclude from the calculation window assemblies and any hazardous materials that are remediated as a part of the project. Materials contributing toward this *Credit* may not contribute toward *Materials and Resources Credit Building Product Disclosure and Optimization - Sourcing of Raw Materials*.

*(Option 4) Whole-building life-cycle assessment (3 points)*  
LEED v4 introduced a systematic evaluation of a building material's formulations and sourcing. The intent is to insure a close examination of the environmental impact of manufacturing, as well as increased scrutiny of a material on health and well-being. The material assessments are based on standards referenced in each *Credit*. It is up to the manufacturer to provide the information required for documentation. Many materials have yet to be third party evaluated for compliance with the requirements in the following *Credits*, but the number of LEED compliant products is expected to grow as the industry responds to the growing need for material accountability. The following *Credits* illustrate LEED v4's emphasis on environmentally and ecologically responsible materials.

❖ **Building Product Disclosure and Optimization**  
– **Environmental Product Disclosures (Credit)**

- *Intent:* To encourage the use of products and materials for which life cycle information is available and that have environmentally, economically, and socially preferable life cycle impacts. To reward project teams for selecting products from manufacturers who have verified improved environmental life-cycle impacts.
- *Requirements:* Achieve one or more of the options below, for a maximum of 2 points.

*(Option 1) Environmental product declaration (1 point)*  
Use at least 20 different permanently installed products sourced from at least five different manufacturers that meet one of the disclosure criteria listed by the USGBC. These are generally industry standards for environmental impact, toxicity, etc. In some cases, the USGBC uses its own criteria for evaluating products.

*(Option 2) Multi-attribute optimization (1 point)*  
Use third party certified products that comply with one of the criteria below for 50%, by cost, of the total value of permanently installed products in the project. Products must demonstrate impact reduction below industry average in at least three environmental stewardship categories. For *Credit* achievement calculation, products sourced (extracted, manufactured, or purchased) within 100

miles (160 km) of the project site are valued at 200% of their base contributing cost. Structure and enclosure materials may not constitute more than 30% of the value of compliant building products.

❖ **Building Product Disclosure (Credit)**

- *Intent:* To encourage the use of products and materials for which life cycle information is available and that have environmentally, economically, and socially preferable life cycle impacts. To reward project teams for selecting products verified to have been extracted or sourced in a responsible manner.
- *Requirements:*

*(Option 1) Raw Material Source and Extraction Reporting (1 point)*

Use at least 20 different permanently installed products from at least five different manufacturers that have publicly released a report from their raw material suppliers (which includes raw material supplier extraction locations, a commitment to long-term ecologically responsible land use, a commitment to reducing environmental harms from extraction and/or manufacturing processes, and a commitment to meeting applicable standards or programs that address responsible sourcing criteria).

❖ **Building Product Disclosure and Optimization**  
– **Material Ingredients (Credit)**

- *Intent:* To encourage the use of products and materials for which life cycle information is available and that have environmentally, economically, and socially preferable life cycle impacts. To reward project teams for selecting products for which the chemical ingredients in the product are inventoried using an accepted methodology and for selecting products verified to minimize the use and generation of harmful substances. To reward raw material manufacturers who produce products verified to have improved life cycle impacts.

To achieve this *Credit*, suppliers must have the material ingredients evaluated by name, listed by name and have a Chemical Abstract Service Registration Number, a Health Product Declaration open standard, a Cradle-to-Cradle assessment or another USGBC approved evaluation methodology.

- ❖ **Product Manufacturer Supply Chain Optimization (1 point)** allows for *Credit* attainment if at least 25% (by cost) of the total value of permanently installed products in the project are sourced from product manufacturers that engage in validated and robust safety, health, hazard, and risk programs. These must, at a minimum, document at least 99% (by weight) of the ingredients used to make the building product or building material. Products must be sourced from manufacturers with independent third party verification of their supply chain. Structure and enclosure materials may not constitute more than 30% of the value by cost of compliant building products.

### **LEED v4 Credit Categories: Indoor Environmental Quality**

The emphasis on integrative design in LEED v4 encourages LEED teams to thoroughly evaluate and quantify the contributions of a material both directly and indirectly. A good example of this in the case of reflective roof coatings is the possible contribution the material can make to daylighting a building. In projects where roof monitors or other overhead lighting structures with vertical or near vertical glazing are included to enhance daylighting, a reflective roof coating can add significantly to the amount of light that is bounced from adjacent roof surfaces into the aperture of the daylighting structure. In this way, reflective roof coatings contribute directly to achieving the *Indoor Environmental Quality Category Daylight Credit*, and is therefore an important part of the overall integrative design approach.

The use of reflective roof coatings in daylighting can also contribute directly to *Energy and Atmosphere Optimize Energy Performance Credit* as daylighting devoid of direct gain into a space can be as much as 75% cooler than fluorescent lighting. LEED points for the Optimize Energy Performance *Credit* are based in part on the capacity of the space conditioning systems installed. Building systems computer modeling can quantify this relationship and assist the project team in downsizing or “right sizing” the space conditioning systems. Reflective roof coatings can contribute to an energy efficient building envelope as well as an effective daylighting scheme. The LEED project team is charged with capitalizing on these kinds of synergies in both new construction and building retrofits.

**Project:** This project is a successful application of a 100% silicone RRC product to an existing structure.

**Challenges:** The Clarksville, Indiana company experienced roof leakage shortly after purchasing the building and needed a quick, effective solution to protect the inventory and keep the business running.

**Solution:** It was determined that no substrate repairs were needed, the material could be applied directly to the roof, and only one coat would be required.



**LEED v4:** This project is representative of how reflective roof coating products can contribute to achieving LEED v4 certification. Application directly to the existing roof eliminated existing roof materials from the construction waste stream. The project became more comfortable and energy efficient, and the owner was able to remain in service. The warranties and application service life will contribute to simplifying future LEED v4 for Existing Buildings Operation and Maintenance applications.



Reflective roof coatings contribute directly to a number of *Prerequisites* and *Credits*, most significantly in the *Energy and Atmosphere* and *Materials and Resources* categories in both *LEED v4 for New Construction*, and *LEED for Existing Buildings Operation and Maintenance*, but they are valuable in any green building project.

## **LEED v4 Credit Categories: Regional Priority**

*Regional Priority Credits* are LEED v4 *Credits* that have been identified by USGBC chapters as particularly important in a given location, as identified by ZIP code. The intent is to provide an incentive for the achievement of *Credits* that address geographically specific environmental, social equity, and public health challenges and priorities. *Regional Priority Credits* are not separate or different. They are simply any *Credit* that has been selected by local USGBC chapters as particularly important in a given locale. If a *Credit* is achieved that has been designated as a *Regional Priority Credit*, the LEED team is awarded the point associated with the *Credit* as well as an additional point for it being a *Regional Priority Credit*. For instance, reflective roof coatings are commonly used to achieve the LEED v4 *Sustainable Sites (SS) Credit: Heat Island Reduction*. If the project location lists *SS: Heat Island Reduction* as a *Regional Priority Credit*, and the *Credit* is achieved, the project team can earn an additional *Regional Priority* point. A database of *Regional Priority Credits* and their geographic applicability is available on the USGBC website, [www.usgbc.org/rpc](http://www.usgbc.org/rpc). One point is awarded for each *Regional Priority Credit* achieved, with a maximum of four.

## **CONCLUSIONS AND RECOMMENDATIONS**

Reflective roof coatings have a valuable role in the high performance green building movement generally, and the LEED building rating process specifically. Their reputation for reducing energy consumption, improving building occupant comfort, and extending the life of existing roofing systems and buildings is widely recognized. Reflective roof coatings are central to a number of LEED *Prerequisites* and *Credits*. Indications are reflective roof coatings will continue to be included in future LEED rating systems as the utility and benefits they provide will become even more important over time. Advancements in building energy systems modeling, building forensics, commissioning, and ongoing measurement and verification of building performance will only reinforce the desirability of reflective roof coatings in high performance buildings, LEED v4, and other rating system projects in the future. Therefore, it benefits all stakeholders involved with the manufacturing, specification, and installation of reflective roof coatings to be knowledgeable of this material's role in the LEED submission process.

## SOURCES AND CITATIONS

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- Lawrence Berkeley Laboratory Cool Roofs Program  
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- RCMA Reflective Roof Coatings Institute  
<http://www.roofcoatings.org/reflective-roof-coatings-institute/solar-reflective-coatings-faqs/>
- Clean Energy – Environmental Technical Forum  
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- Reflective Roof Coatings Have a Bright Future  
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- Being in the Know About Solar Reflective Roof Coatings  
<http://www.rci-online.org/interface/2009-12-heinje-meyer.pdf>

# APPENDIX



## LEED v4 for BD+C: New Construction and Major Renovation Project Checklist

Project Name:  
Date:

Y	?	N			
Green	Yellow	Red	Credit	Integrative Process	1

0	0	0	Location and Transportation		16
Green	Yellow	Red	Credit	LEED for Neighborhood Development Location	16
Green	Yellow	Red	Credit	Sensitive Land Protection	1
Green	Yellow	Red	Credit	High Priority Site	2
Green	Yellow	Red	Credit	Surrounding Density and Diverse Uses	5
Green	Yellow	Red	Credit	Access to Quality Transit	5
Green	Yellow	Red	Credit	Bicycle Facilities	1
Green	Yellow	Red	Credit	Reduced Parking Footprint	1
Green	Yellow	Red	Credit	Green Vehicles	1

0	0	0	Sustainable Sites		10
Yellow	Green	Red	Prereq	Construction Activity Pollution Prevention	Required
Green	Yellow	Red	Credit	Site Assessment	1
Green	Yellow	Red	Credit	Site Development - Protect or Restore Habitat	2
Green	Yellow	Red	Credit	Open Space	1
Green	Yellow	Red	Credit	Rainwater Management	3
Green	Yellow	Red	Credit	Heat Island Reduction	2
Green	Yellow	Red	Credit	Light Pollution Reduction	1

0	0	0	Water Efficiency		11
Yellow	Green	Red	Prereq	Outdoor Water Use Reduction	Required
Yellow	Green	Red	Prereq	Indoor Water Use Reduction	Required
Yellow	Green	Red	Prereq	Building-Level Water Metering	Required
Green	Yellow	Red	Credit	Outdoor Water Use Reduction	2
Green	Yellow	Red	Credit	Indoor Water Use Reduction	6
Green	Yellow	Red	Credit	Cooling Tower Water Use	2
Green	Yellow	Red	Credit	Water Metering	1

0	0	0	Energy and Atmosphere		33
Yellow	Green	Red	Prereq	Fundamental Commissioning and Verification	Required
Yellow	Green	Red	Prereq	Minimum Energy Performance	Required
Yellow	Green	Red	Prereq	Building-Level Energy Metering	Required
Yellow	Green	Red	Prereq	Fundamental Refrigerant Management	Required
Green	Yellow	Red	Credit	Enhanced Commissioning	6
Green	Yellow	Red	Credit	Optimize Energy Performance	18
Green	Yellow	Red	Credit	Advanced Energy Metering	1
Green	Yellow	Red	Credit	Demand Response	2
Green	Yellow	Red	Credit	Renewable Energy Production	3
Green	Yellow	Red	Credit	Enhanced Refrigerant Management	1
Green	Yellow	Red	Credit	Green Power and Carbon Offsets	2

0	0	0	Materials and Resources		13
Yellow	Green	Red	Prereq	Storage and Collection of Recyclables	Required
Yellow	Green	Red	Prereq	Construction and Demolition Waste Management Planning	Required
Green	Yellow	Red	Credit	Building Life-Cycle Impact Reduction	5
Green	Yellow	Red	Credit	Building Product Disclosure and Optimization - Environmental Product Declarations	2
Green	Yellow	Red	Credit	Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
Green	Yellow	Red	Credit	Building Product Disclosure and Optimization - Material Ingredients	2
Green	Yellow	Red	Credit	Construction and Demolition Waste Management	2

0	0	0	Indoor Environmental Quality		16
Yellow	Green	Red	Prereq	Minimum Indoor Air Quality Performance	Required
Yellow	Green	Red	Prereq	Environmental Tobacco Smoke Control	Required
Green	Yellow	Red	Credit	Enhanced Indoor Air Quality Strategies	2
Green	Yellow	Red	Credit	Low-Emitting Materials	3
Green	Yellow	Red	Credit	Construction Indoor Air Quality Management Plan	1
Green	Yellow	Red	Credit	Indoor Air Quality Assessment	2
Green	Yellow	Red	Credit	Thermal Comfort	1
Green	Yellow	Red	Credit	Interior Lighting	2
Green	Yellow	Red	Credit	Daylight	3
Green	Yellow	Red	Credit	Quality Views	1
Green	Yellow	Red	Credit	Acoustic Performance	1

0	0	0	Innovation		6
Green	Yellow	Red	Credit	Innovation	5
Green	Yellow	Red	Credit	LEED Accredited Professional	1

0	0	0	Regional Priority		4
Green	Yellow	Red	Credit	Regional Priority: Specific Credit	1
Green	Yellow	Red	Credit	Regional Priority: Specific Credit	1
Green	Yellow	Red	Credit	Regional Priority: Specific Credit	1
Green	Yellow	Red	Credit	Regional Priority: Specific Credit	1

0	0	0	TOTALS		Possible Points: 110
Certified: 40 to 49 points, Silver: 50 to 59 points, Gold: 60 to 79 points, Platinum: 80 to 110					



**Roof Coatings Manufacturers Association**

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*The Reflective Roof Coatings Institute is RCMA's standing committee focused on advancement of reflective roof coatings through development of research, marketing, technical information, and educational resources*