A New Environmental Assessment Tool for Roof Systems

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Abstract

Few elements of modern construction have as great an effect on long-term sustainability as the roofs over our heads. In addition to shielding building occupants from the elements, roofs provide a wide variety of functions critical to the long-term sustainability of the built environment. In an effort to support the sustainable design and management of the billions of square feet of new roofing assets installed each year in North America, the Center for Environmental Innovation in Roofing (CEIR) has developed RoofPoint.™ Organized around five primary categories of energy, materials, water, life cycle and innovation, RoofPoint provides a comprehensive roadmap for the design, installation and operation of environmentally optimal roof systems. Starting with a brief overview of the history and mission of RoofPoint, this paper discusses how RoofPoint may serve as an ongoing decision model, asset management tool, educational framework and research agenda for the roofing industry. In addition, this paper discusses critical issues going forward as development of the RoofPoint program continues.

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Introducing RoofPoint™

Developed by the Center for Environmental Innovation in Roofing (CEIR), RoofPoint is a roofing-specific version of green building rating systems that have emerged to promote an environmentally responsible built environment. Similar to its whole-building counterparts, RoofPoint embraces a mission to elevate the professional practice**s** of everyone involved in the roofing process to a higher level of accomplishment and recognition. To accomplish this mission, RoofPoint embraces several important functions. First, RoofPoint is a *guideline* for the selection of environmentally innovative roof systems—roof systems that maximize energy efficiency and longevity while minimizing environmental impact. In addition, RoofPoint may be viewed as a *checklist* to

identify the many ways roof systems provide economic and environmental benefit**s**. RoofPoint also serves as an *assessment system* to compare different roofing alternatives for a particular environmental application. Finally, RoofPoint provides a platform for a comprehensive *certification program* to recognize and reward environmentally responsible roofing practices.

Why RoofPoint is Needed

Overlooked Strategic Resource: RoofPoint helps to showcase the roofing industry's strategic role in supporting energy and environmental security. Nonresidential rooftops cover more than 50 billion square feet of developed space in North America, and if effectively used, this vast roof surface area could deliver enormous benefits through energy efficiency and clean energy production. A 2010 recent study prepared for CEIR estimates this total energy potential to exceed the combined output of 25 Grand Coulee Dams[1].

Because of this untapped energy and environmental potential, roof systems are gaining expanded public interest. Increasingly, the rooftops of buildings are becoming a focal point for the benefits of green construction, bringing opportunities for enhanced occupant satisfaction, increased rents and stable property values. By directly targeting this new public awareness, RoofPoint further enlarges the visibility of roofing while helping building designers and owners put this growing interest into daily practice.

Lack of Effective Tools: Although the energy and environmental potential of roofing is significant, many green building rating systems fail to capture this potential. Rating

systems for new buildings fail to address reroofing activity, which accounts for more than two-thirds of the total roofing market and billions of square feet of annual opportunity. At the same time, rating systems for existing buildings tend to only address roofing when it is part of large renovation projects. As a result, few standardized tools are available to building owners and designers to evaluate the environmental performance of roofing assets alone.

Many building and roofing professionals also recognize potential conflicts between the environmental ideals of green building rating systems and practical realities of building construction and maintenance[2]. The application of new technologies and use of new materials only can be productive if these technologies and materials do not adversely affect the longevity and serviceability of roof systems. Aging roof systems leaking beneath new rooftop solar arrays, unanticipated moisture movement in new and retrofit roof designs and the serviceability of new, untested roofing products are just a few examples of concerns raised within the roofing industry. And as these concerns are raised, many roofing professionals agree that comprehensive guidelines are needed to address them.

Increased Industry Value: With RoofPoint, the roofing industry will be recognized and rewarded for adding value to the environment and society. Using the guidelines established by RoofPoint, roofing becomes a *value-added product* as building owners trade up to more efficient and longer-lasting roof systems. And in the process, roofing becomes a *value-added profession* with enhanced public image, expanded career opportunities and higher-paying job skills. Finally, the principles embodied in RoofPoint

help increase the industry's role as a *value-added influence* on public policy, as well as individual design and purchase decisions. In a nutshell, RoofPoint allows building owners and designers to make better decisions, and our industry benefits by transforming these decisions into as-built realities.

RoofPoint Mission and Goals

As identified by the CEIR Research Committee, RoofPoint's mission is to provide a means of roof system selection across membrane types and system designs so the roofing industry as a whole is recognized for the variety of environmentally responsive options it offers to meet the needs of concerned building owners. As a starting point in fulfilling this mission, RoofPoint is designed to achieve the following goals:

- It must be easy to understand and use so it can gain rapid public visibility and recognition.
- It must reflect current green building thinking by incorporating established criteria and measurements from existing green building standards.
- It must be designed for tangible value: a reliable guide to help building owners make effective decisions; useful template for designing education and certification programs; and valuable tool for design and construction professionals.
- It must be designed to evolve into a recognized consensus standard so it may be formally integrated into public construction specifications and requirements.

Overall, the mission of RoofPoint is similar to the original mission established in 1998 by the U.S. Green Building Council for its LEED® Green Building System. As shown in Table 1, RoofPoint seeks to advance the same primary goals as LEED:

LEED Goal[3]	RoofPoint Goal
Define "green building" by establishing a common standard of measurement	Define "environmentally innovative roofing" by establishing a common method of evaluation
Promote integrated, whole-building design practices	Promote integrated, total roof system design, installation and management practices
Recognize environmental leadership in the building industry	Recognize environmental leadership in the roofing industry and among roofing professionals
Stimulate green competition	Stimulate innovation in roofing
Raise consumer awareness of green building benefits	Raise public awareness of roofing's role in energy and the environment
Transform the building market	Transform the roofing industry and roofing market

Table 1: LEED and RoofPoint goal comparison

RoofPoint Structure

The structure of RoofPoint also is similar to the organization of many green building rating systems. Organized around five primary functional areas of environmental contribution, RoofPoint provides the end-user with a comprehensive inventory of detailed environmental goals, specific strategies to address these goals and the appropriate criteria to implement these strategies. In addition, RoofPoint incorporates an assessment system to support a formal recognition program for roof systems that meet or exceed a minimum established assessment score. Figure 1 illustrates the basic structure of RoofPoint.

Figure 1: RoofPoint structure

RoofPoint Pilot Draft

The *RoofPoint Guideline for Environmentally Innovative Non-Residential Roofing (Pilot Draft)* was released late in 2010[4] and provides a comprehensive roadmap for the achievement of environmentally innovative nonresidential roof systems. In addition to addressing all key stages of roof system development from design and selection through installation and long-term maintenance, the pilot draft also encompasses a wide variety of roofing applications, including new construction and reroofing, as well as low-slope and steep-slope installations. In addition, the pilot draft has been designed to accommodate applications involving above-deck insulations, attic spaces, structural metal roof systems and combinations of these applications. Table 2 provides a

summary of the specific credits included in the pilot draft along with a brief description of the intents and strategies for each credit.

CREDIT	TITLE	INTENT	STRATEGY
SECTION 1: ENERGY MANAGEMENT			
E1	HIGH R ROOF SYSTEMS(You can make an argument that "High R-Value" is more precise; however, we already have published it as "High R")	REDUCE ENERGY USE	INCREASE ROOF SYSTEM R-VALUE
E2	BEST THERMAL PRACTICES	REDUCE ENERGY USE	REDUCE THERMAL DISCONTINUITIES
E3	ROOF SURFACE THERMAL CONTRIBUTION	REDUCE ENERGY USE/HEAT ISLAND EFFECTS	INSTALL CLIMATE-APPROPRIATE ROOF SURFACE
E4	ROOF AIR BARRIER	REDUCE ENERGY USE	INSTALL AIR BARRIER
E5	ROOFTOP ENERGY SYSTEMS	PRODUCE CLEAN ENERGY	INSTALL SOLAR/WIND ENERGY
E6	ROOF DAYLIGHTING	PRODUCE CLEAN ENERGY	INSTALL DAYLIGHTING
SECTION 2: MATERIALS MANAGEMENT			
M1	RECYCLED CONTENT	REDUCE SOLID WASTE	INCREASE RECYCLED PRODUCT CONTENT
M2	MATERIAL REUSE	REDUCE SOLID	INCREASE MATERIAL REUSE

		WASTE	
M3	WASTE MANAGEMENT	REDUCE SOLID WASTE	REDUCE ROOFING WASTE AND SCRAP
M4	LOW-VOC MATERIALS	REDUCE OZONE	REDUCE VOC CONTENT
SECTION 3: WATER MANAGEMENT			
W1	ROOF STORM WATER RETENTION	REDUCE STORM WATER RUNOFF/WATER POLLUTION	INSTALL VEGETATIVE OR WATER-RETAINING ROOF SYSTEM
W2	ROOF-RELATED WATER USE REDUCTION	REDUCE WATER USE	CAPTURE ROOF WATER FOR LANDSCAPING
SECTION 4: DURABILITY/LIFE-CYCLE MANAGEMENT			
D1	DURABLE ROOF INSULATION	REDUCE INSULATION DAMAGE	INSTALL DURABLE INSULATION SYSTEM
D2	ROOF DRAINAGE DESIGN	REDUCE WATER ENTRY	ASSURE POSITIVE ROOF DRAINAGE
D3	ROOF TRAFFIC PROTECTION	REDUCE SURFACE DAMAGE	PROVIDE TRAFFIC PROTECTION
D4	INCREASED WIND RESISTANCE	REDUCE STORM DAMAGE	INCREASE WIND-UPLIFT RATING
D5	HYGROTHERMAL ANALYSIS	REDUCE MOISTURE DAMAGE	PROJECT MOISTURE ANALYSIS
D5	CONSTRUCTION MOISTURE MANAGEMENT	REDUCE MOISTURE DAMAGE	PROJECT MOISTURE MANAGEMENT

D6	DURABILITY ENHANCEMENTS	INCREASE SYSTEM DURABILITY	INSTALL SYSTEM UPGRADES
L1	ROOF MAINTENANCE PROGRAM	INCREASE SERVICE LIFE	ONGOING MAINTENANCE PROGRAM
L2	PROJECT INSTALLATION QUALITY	INCREASE SERVICE LIFE	CONTRACTOR QA [QUALITY ASSURANCE] PROGRAM
SECTION 5: INNOVATION IN ROOFING			
IR1	INNOVATION IN DESIGN	RECOGNIZE DESIGN AND PRODUCT INNOVATION	EXTRA CREDIT FOR FIRST-TIME INNOVATION
IR2	EXEMPLARY PERFORMANCE	RAISE INDUSTRY STANDARDS	EXTRA CREDIT FOR EXCEEDING STATE-OF-THE-ART
IR3	ROOFPOINT PROFESSIONAL	SUPPORT AND CONFIRM PROJECT DESIGN	USE ROOFPOINT CERTIFIED PROFESSIONAL

Table 2: RoofPoint sections and credits (pilot draft)

Sections

As illustrated in Table 2, the RoofPoint guideline is organized into five key sections, or functional areas, representing the primary energy and environmental contributions of modern low-slope roof systems:

- Energy Management: Reducing building and environmental energy demands through roof system thermal efficiency and production of clean energy
- Materials Management: Reducing the effects of roofing materials through waste management, reuse, recycling and the use of reduced impact products

- Water Management: Reducing building water demands and environmental impacts on rivers and lakes through roof storm water management and diversion
- Durability/Life-cycle Management: Increasing the effective service life of roofing materials through increased durability and proactive service life management
- Innovation in Roofing: Expanding the environmental contribution of roof systems through innovation in design and product use

Although the employment of broad environmental categories provides a useful way to divide RoofPoint into manageable sections, it also offers a holistic approach to environmental innovation in which all major aspects of environmental impact may be emphasized and balanced. Although the achievement of environmental goals in any single category is important, a holistic approach to environmental innovation emphasizes the importance of all categories.

Credits

Each section of RoofPoint is further organized into a series of credits or operational strategies designed to optimize performance within each section. The potential benefit of each credit is defined qualitatively as a broad objective ("intent") and quantitatively as a specific achievement criterion ("requirement"). Similar to the structure of credits within other green building rating systems, the intent/requirement concept offers several benefits. First, the stated intent serves as a checkpoint to verify that the strategy embodied by each credit serves to advance the section's overall environmental agenda.

In addition, the stated intent for each credit also serves to test the requirement's validity as a meaningful measure of the credit.

Intents

Intents identified in RoofPoint are focused on critical energy and environmental impacts associated with each section. Key intents within Energy Management include reduction of internal building energy use, mitigation of external energy effects such as heat island effects, and production of clean energy or energy offsets. Key intents within Materials Management and Water Management include reduction of solid waste and mitigation of material-related environmental impacts. Key intents within Durability include reduction of roof deterioration associated with moisture infiltration, roof traffic and severe weather. Key intents within Life-cycle Management focus on critical events and processes throughout all stages of a roof system's life cycle.

Requirements

Requirements identified in RoofPoint provide measureable criteria to assess and confirm the achievement of the strategies available in each credit. RoofPoint requirements embody the best available standards and practices as identified by the CEIR Research Committee and vetted through a two-stage industry review process. Primary resource references for RoofPoint requirements include ASHRAE 189.1-2009, "Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings[5]," LEED 2009 for New Construction and Major Renovations[7] and a variety of state and regional standards. In addition to these recognized standard

references, the RoofPoint guideline also employs a number of widely recognized industry best practices to supplement formal standards. Examples of industry best practices in RoofPoint include the use of insulation cover boards and multiple insulation layers, construction moisture management and roof traffic protection.

Many RoofPoint requirements are *prescriptive*, especially when underlying reference standards are available and reasonably represent a credit's stated intent. Examples of prescriptive requirements in RoofPoint include criteria for roof system R-value, roof surface reflectivity and wind-uplift resistance. However**,** when calculation and operational verification are critical to the achievement of RoofPoint goals, *performance-based* requirements also are employed. Examples of performance requirements include criteria for achieving daylighting levels, roof drainage design and water use reduction.

In addition to prescriptive and performance requirements, a number of RoofPoint requirements are *process-based*. The use of process-based requirements is particularly common for RoofPoint credits associated with life-cycle management. Examples of process-based requirements include the use of formal procedures for moisture analysis, project installation quality, roof traffic protection and ongoing roof maintenance. Table 3 provides a summary of the prescriptive, performance and process requirements employed in the RoofPoint Pilot Draft, along with the primary industry reference used to develop each requirement.

CREDIT	TITLE	REQUIREMENT	REFERENCE
SECTION 1: ENERGY MANAGEMENT			
E1	HIGH R ROOF SYTEMS (You	PRESCRIPTIVE	ASHRAE 189.1-2009[5]

	can make an argument that "High R-Value" is more precise; however, we already have published it as "High R")		TABLES A1-A8
E2	BEST THERMAL PRACTICES	PRESCRIPTIVE	RECOGNIZED BEST PRACTICES
E3	ROOF SURFACE THERMAL CONTRIBUTION	PRESCRIPTIVE	CEC TITLE 24 (2008)[6] AND OTHERS
E4	ROOF AIR BARRIER	PRESCRIPTIVE	ASHRAE 189.1-2009[6] APPENDIX B
E5	ROOFTOP ENERGY SYSTEMS	PRESCRIPTIVE	RATED POWER OUTPUT (VARIOUS)
E6	ROOF DAYLIGHTING	PERFORMANCE	LEED 2009[7] CREDIT IE-8.1
SECTION 2: MATERIALS MANAGEMENT			
M1	RECYCLED CONTENT	PRESCRIPTIVE	LEED 2009[7] CREDIT MR-4
M2	MATERIAL REUSE	PRESCRIPTIVE	LEED 2009[7] CREDIT MR-3
M3	WASTE MANAGEMENT	PERFORMANCE	LEED 2009[7] CREDIT MR-2
M4	LOW-VOC MATERIALS	PRESCRIPTIVE	OTC MODEL RULE (2007)[8]
SECTION 3: WATER MANAGEMENT			
W1	ROOF STORM WATER RETENTION	PRESCRIPTIVE	VARIOUS STANDARDS

W2	ROOF-RELATED WATER USE REDUCTION	PERFORMANCE	LEED 2009[7] CREDIT WE-1
SECTION 4: DURABILITY/LIFE-CYCLE MANAGEMENT			
D1	DURABLE ROOF INSULATION	PRESCRIPTIVE	INDUSTRY BEST PRACTICES
D2	ROOF DRAINAGE DESIGN	PERFORMANCE	INDUSTRY BEST PRACTICES
D3	ROOF TRAFFIC PROTECTION	PRESCRIPTIVE / PROCESS	INDUSTRY BEST PRACTICES
D4	INCREASED WIND RESISTANCE	PRESCRIPTIVE	ANSI/SPRI WD-1[9]
D5	HYGROTHERMAL ANALYSIS	PROCESS	WUFI-ORNL/IBP[10]
D5	CONSTRUCTION MOISTURE MANAGEMENT	PROCESS	INDUSTRY BEST PRACTICES
D6	DURABILITY ENHANCEMENTS	PROCESS	INDUSTRY BEST PRACTICES
L1	ROOF MAINTENANCE PROGRAM	PROCESS	INDUSTRY BEST PRACTICES
L2	PROJECT INSTALLATION QUALITY	PROCESS	ISO 9000 OR SIMILAR

Table 3: Prescriptive, performance, process requirements[11]

Scoring System

To calibrate and validate the value of each RoofPoint credit, the initial scoring methodology for RoofPoint will be more qualitative than anticipated in future versions. During RoofPoint's pilot program phase, all credits will be assumed to be equal in

importance, and each credit will be evaluated according to the following broad assessment categories:

- No Credit: The roofing project does not meet the credit requirement.
- Meets Intent: The roofing project fulfills the broad intent of the credit though specific conditions of the project do not support full compliance with the credit requirement.
- Meets Requirement: The roofing project meets the credit requirement.
- Exceeds Requirement: The roofing project substantially exceeds the credit requirement and provides a tangible benefit by exceeding the requirement.
- Not Applicable: The credit does not provide a suitable measure of energy or environmental benefit for the roofing project being evaluated.

To complete the evaluation of each roofing project, the number of credits assigned to each assessment category will be tallied and compared with similar evaluations for other roof systems. In addition, the number of eligible credits within each key section of RoofPoint will be identified and compared. The comparison of different roof systems during the evaluation also will be used to determine threshold levels for project certification, establish different performance levels within credits and evaluate the overall suitability of each credit.

RoofPoint in 2011

Starting in the first quarter of 2011, CEIR members are working to identify and qualify roofing projects for an initial pilot program. The pilot program's objectives include the refinement of RoofPoint as an effective decision tool, developing professional expertise

in the use of the RoofPoint system and building public awareness of RoofPoint's value. In support of this effort, members of the CEIR Research Committee are working designers, owners and managers with the application of RoofPoint. The pilot program is scheduled continue throughout 2011, culminating with the public recognition of the first RoofPoint Certified Roofing Systems evaluated and qualified under the pilot draft.

After the conclusion of the pilot program, CEIR intends to formalize the roof system certification process and make the program available to the general public. In addition, using the experience gained by the initial subject experts, CEIR will develop a certification program for "RoofPoint Registered Professionals" to support the roofing project certification process. To ensure the RoofPoint guideline will evolve into an established industry standard, CEIR also will begin work on developing a formal development model for the ongoing support of the RoofPoint system, using an ANSI or similar consensus process. Finally, additional versions of RoofPoint will be published, starting with a residential version targeted toward home builders and homeowners.

The RoofPoint Opportunity for the Roofing Industry

Roofing Decision Model: Because RoofPoint addresses a broad array of roof conditions and design issues, it offers an unmatched opportunity for detailed comparison among many different design and product alternatives. At the same time, it must be recognized that RoofPoint is complex in scope and indefinite in output. As a consequence, the effective use of RoofPoint as a decision model likely will require the oversight of a professional roofing practitioner with specialized knowledge and experience. However, when managed by an experienced roofing professional, RoofPoint may provide an ideal

format to guide end-users through the options and trade-offs required for effective roof system selection and management.

Life-cycle Management Tool: Because it combines principles of inherent material durability with design and management processes to ensure and optimize roof system service life, RoofPoint also may serve as a template for effective life-cycle management of roof systems. And because RoofPoint relies not only on formal material and system standards but also the best in recognized industry practice, roof management strategies may be identified that otherwise might be overlooked by a more empirical approach to service life management.

Training Curriculum: The same features that allow RoofPoint to serve as a compelling decision model and life-cycle management tool also make it an attractive basis to develop an industry curriculum for training roof designers and practitioners. CEIR's intention to develop a formal certification program for RoofPoint practitioners also will stimulate the development of a new training agenda within the roofing industry.

Research Agenda: The broad scope of RoofPoint also may help identify critical gaps in roofing knowledge that must be addressed by additional research. It is interesting to note how closely the primary categories and key credits of RoofPoint coincide with key research issues identified by the Roofing Industry Research Summit[12] convened by the RCI Foundation in 2009. Hopefully, after the conclusion of the International Roofing Symposium, interested industry stakeholders, including CEIR and the RCI Foundation,

can work together to develop and promote a common research agenda for the roofing industry.

Critical Issues Going Forward

Any program with the scope and ambition of RoofPoint will face many critical issues as it moves forward. Because the pilot phase of the program has just been launched as this paper is written, CEIR will provide a more detailed report addressing emerging issues during the presentation of this paper at the 2011 International Roofing Symposium. Critical issues expected to be addressed include:

- Developing an Effective Weighting and Scoring System: By design, the pilot program scoring system is overly qualitative to assess RoofPoint's overall cohesiveness and each credit's general effectiveness. In future versions of RoofPoint, it is anticipated that a more qualitative and robust weighting and scoring methodology will be required.
- Addressing Additional Energy and Environmental Impacts: The CEIR Research Committee already has identified a number of energy and environmental impacts that might be addressed by additional credits within future versions of RoofPoint. These include:
    - Manufacture of roofing products under Responsible Care Management or similar environmental management programs
    - Product environmental impact reporting such as Environmental Product Declarations (EPDs)

- Total roof system environmental impact evaluation using Life-cycle Assessment (LCA)
- The use of rapidly renewable, bio-based and regionally sourced roofing materials
- New technologies and strategies to extend service life through periodic renewal of critical roof system components
- Health and safety requirements for roofing and maintenance workers

- Establishing an Ongoing Development Process: To serve as a widely recognized and referenced guideline for roofing, RoofPoint should evolve into a recognized national/international standard supported by a public consensus process.

[1] CEIR (2010). *Non-Residential Roofing and National Energy Transformation*. Washington, DC: Center for Environmental Innovation in Roofing (CEIR). (www.roofingcenter.org)

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[10] ORNL (2010) WUFI-ORNL/IBP Moisture Design Tool for Architects and Engineers v 3.0. Oak Ridge, TN: Oak Ridge National Laboratory (ORNL). (http://www.ornl.gov/sci/btc/apps/moisture/index.html)

[11] Section 5: Innovation in Roofing has been omitted from this table because innovative materials and methods may not be addressed using existing reference standards.

[12] Hoff, J.L. (2010). “Report for the Roofing Industry Research Summit.” *Proceedings of the 25th RCI International Trade Show and Convention*. Raleigh, NC: RCI, Inc.