

# TIOCOAT™ Green Building Performance Assessment



Prepared For:

Jonathan Ursini  
DuROCK Alfacing International Ltd.  
101-B Roytec Rd.  
Woodbridge, Ontario, L4L 8A9

Prepared By:

Yvonne Crichton  
Kyle Anders, MAsc., LEED® AP Homes  
Derek Satnik, P.Eng., LEED® AP  
Mindscape Innovations  
30 Duke St. W, Suite 702  
Kitchener, ON N2H 3W5  
[www.mi-group.ca](http://www.mi-group.ca)

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## EXECUTIVE SUMMARY

This report assesses the performance of DuROCK Alfacing International Ltd.'s (hereinafter referred to as DuROCK) TIOCOAT™ (TIOCOAT), a white, elastomeric, reflective roof coating, within the various LEED® (LEED) green building rating systems. We are pleased to advise you that for a typical building, TIOCOAT contributes towards the following in each of the various rating systems assessed:

Green Building Rating System	LEED Point Threshold				TIOCOAT Related Pts	Potential TIOCOAT Point Contribution
	Certified	Silver	Gold	Platinum		
LEED 2009 NC	40 – 49	50 - 59	60 - 79	≥80	30	4
LEED 2009 NC Schools					29	4
LEED Canada - NC 2009					30	3
LEED 2009 Retail					30	4
LEED 2009 Core and Shell					31	3
LEED Canada - Core and Shell 2009					31	2
LEED 2009 EBOM					30	4
LEED Canada – EBOM 2009					30	3
LEED 2009 Healthcare					38	4
LEED 2009 Neighborhood Development					12	2
LEED Homes Multifamily Mid-Rise (2010)	45 – 59	60 – 74	75 - 89	90 - 136	45	4

It should be noted that the potential of TIOCOAT in directly contributing points in LEED is dependent on several factors such as building design, building type and, in particular, climate zone. It is recommended that DuROCK more precisely determine the expected energy savings their product would earn for a range of different climate zones and building types, and keep an appropriately comprehensive set of case studies available for sales staff to reference as and when appropriate. There is an available Roof Savings Calculator for residential and commercial buildings to assess the energy savings potential from cool roofs and this may be a helpful resource for such an analysis. The tool is available online at [RoofCalc.com](http://RoofCalc.com)<sup>1</sup>, Oak Ridge National Laboratory and Lawrence Berkeley National Laboratory developed the tool.

In addition to the contributions made in the above green rating systems, further noteworthy environmental benefits of TIOCOAT should be promoted:

<sup>1</sup> U.S. Department of Energy. Guidelines for Selecting Cool Roofs. July 2010. Accessed online 2011/10/05

- Can be applied to many suitable existing roofing substrates including: BUR, Mod-bit, Concrete, Metal and Asphalt, and therefore does not require any additional roofing material<sup>3</sup>;
- Made to withstand Canada's extreme climate<sup>3</sup>;
- Reduces impact on electrical grid by reducing 'peak' electrical demand level during cooling season<sup>3</sup>;
- Complies with the 'ECO-ROOF' program grant from City of Toronto<sup>3</sup>;
- Water based product, with no harmful chemicals.

Lastly, because of the relationship Mindscape enjoys with [www.OntarioGreenSpec.ca](http://www.OntarioGreenSpec.ca), we have added your product into their listing database online under the category "Materials and Resources / Roofing / White Roofing". For additional membership benefits and promotional opportunities, please refer to [http://www.ontariogreenspec.ca/membership\\_rates\\_benefits](http://www.ontariogreenspec.ca/membership_rates_benefits). You may wish to consider promotional opportunities both there and in other online green databases such as U.S. based Greenspec® (see [www2.buildinggreen.com/about/gc-listing-process](http://www2.buildinggreen.com/about/gc-listing-process)).

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## 1.0 INTRODUCTION

Thank you for contracting Mindscape Innovations Group Inc. (Mindscape) to assess your eligibility for points in the various LEED® rating system. Mindscape is one of Canada's leading professional services firms in the commercial and residential energy ratings market, and is proud to have played a key role in founding the LEED Canada-Homes (2008) program especially. We provide consulting and certification services for all LEED Canada programs and matching US programs: residential and commercial, existing buildings and new. We are most actively engaged in the LEED for Homes market (low-rise, mid-rise, and high-rise), and are recognized experts in the LEED rating systems generally, on both sides of the border: US and Canada.

DuROCK can play a key role in energy efficient and environmentally responsible design of buildings. The purpose of this report is to assess the performance and point eligibility of their TIOCOAT product in the green building rating systems listed below.

### 1.1 TERMS DEFINED

Before delving into a point by point assessment of the various rating systems, it is important first to clarify and define several terms commonly used therein:

**USGBC:** the United States Green Building Council: an industry body active in the green building industry which, among other activities, creates and delivers the LEED rating systems and related programs. The USGBC is the global originator of the LEED brand, and controls the global intellectual property rights, licensing them out to other national Green Building Council's such as the **CaGBC** for development in their own countries.

**CaGBC:** the Canada Green Building Council: an industry body active in the green building industry which, among other activities, is a licensee of the USGBC's LEED products, and which creates and delivers **LEED rating systems** and related programs in Canada.

**LEED:** "Leadership in Energy and Environmental Design": a green building program designed to quantify the environmental benefit of various green building strategies in a rating system format, which ultimately includes a certification program that places a certification label on the constructed building.

**LEED Rating System:** the LEED program includes several "Rating Systems" which have been defined for niche markets, such as "LEED for New Construction and Major Renovations" (LEED NC), or "LEED for Existing Buildings: Operation and Maintenance" (LEED EB:OM), or "LEED for Homes". Each rating system has the same general structure of **pre-requisites** and **credits**, and the same general process of **certification**, but the technical content will be customized to suit the intended target market, and the process may include specialized parties relevant only to that target market (such as home energy raters in the LEED for Homes rating system).

**LEED Points:** points are the central measuring stick in LEED **rating systems**, and are grouped by common strategies into **credits**. LEED **rating systems** will tend to have anywhere from 70 to ~130 total points, grouped into anywhere from 35 to 44 **credits**. Many **credits** will offer multiple points for progressively greater achievement on the same theme, such as increased energy efficiency, increased water efficiency, etc.

**LEED Pre-requisite:** a single mandatory strategy for sustainability that has been defined and made measurable. Whereas **credits** include optional measures that earn **points**, pre-requisites are not optional and do not earn points: every LEED certified building is required to achieve all the pre-requisites in the relevant **rating system**.

**LEED Credit:** a single optional strategy for sustainability that has been defined and made measurable, which may include one or several **points**, and where increased **points** could be earned under the same strategy for increased performance (e.g.: for increased energy efficiency, increased water efficiency, or some other measure as defined in the Credit).

**LEED Certification:** the process used by the USGBC and CaGBC to audit a building's design and to verify its constructed performance. Buildings which meet all the **pre-requisites** in the **rating system**, and which achieve a minimum number of **points**, are eligible to be certified at the "Certified", "Silver", "Gold", and "Platinum" levels, each representing progressively greater achievement within the program. The nature and number of **pre-requisites** and the number of **points** required to meet each threshold varies with the specific LEED **rating system** (e.g.: LEED for Homes is different than LEED NC), but the process of certification is essentially the same in all LEED programs.

**Local / Regional Content:** goods are defined as being "local" or "regional" within all forms of LEED if they are extracted, processed, manufactured and shipped from within 800km (500mi) of the jobsite when shipped by truck; for Canadian forms of LEED, "local" or "regional" boundary criteria is expanded to within 2400km (1500mi) when shipped by rail or boat, or a proportional combination of these two (e.g. 600 km by truck,  $\frac{3}{4}$  the truck limit, and 600 km by boat,  $\frac{1}{4}$  the boat limit).

## 1.2 GREEN BUILDING RATING SYSTEMS

This report will assess the eligibility of TIOCOAT for points in the following rating systems:

1. **LEED 2009 for New Construction and Major Renovations (NC)**, owned and delivered by the US Green Building Council (USGBC) in the United States of America (USA) and internationally where other LEED programs or allied programs are not available – for construction of new commercial office and institutional buildings, including offices, institutional buildings (libraries, museums, churches, etc.), hotels and residential buildings of 4 or more habitable stories;
2. **LEED 2009 for Schools: New Construction and Major Renovations (NCS)**, owned and delivered by the USGBC, for certifying the construction or major renovation of academic buildings on K-12 school grounds;
3. **LEED Canada for New Construction and Major Renovations 2009 (NC)**, owned and delivered by the Canada Green Building Council (CaGBC) in Canada – for construction of new commercial office and institutional buildings, including offices, institutional buildings (libraries, museums, churches, etc.), hotels and residential buildings of 4 or more habitable stories;
4. **LEED 2009 for Retail (NCR)**, owned and delivered by the USGBC – for certifying new construction and major renovations of retail buildings (as defined by standard building codes), including grocery, restaurant, apparel, specialty, and banks;
5. **LEED 2009 for Core and Shell (CS)**, owned and delivered by the USGBC – for certifying projects where the developer controls the design and construction of the entire

core and shell base building (e.g., mechanical, electrical, plumbing, and fire protection systems), but has no control over the design and construction of the tenant fit-out. Examples include commercial office building, medical office building, retail center, warehouse, and lab facility. The owner must occupy ≤50% of the building's leasable square footage;

6. **LEED Canada for Core and Shell 2009 (CS)**, owned and delivered by the CaGBC – for certifying projects where the developer controls the design and construction of the entire core and shell base building (e.g., mechanical, electrical, plumbing, and fire protection systems), but has no control over the design and construction of the tenant fit-out. Examples include commercial office building, medical office building, retail center, warehouse, and lab facility. The owner must occupy ≤50% of the building's leasable square footage;
7. **LEED 2009 for Existing Buildings: Operation and Maintenance (EBOM)**, owned and delivered by the USGBC, for certifying ongoing operations of existing commercial and institutional buildings, including offices, retail and service establishments, institutional buildings (libraries, schools, museums, churches, etc.), hotels and residential buildings of four or more habitable stories;
8. **LEED Canada for Existing Buildings: Operation and Maintenance 2009 (EBOM)**, owned and delivered by the CaGBC, for certifying ongoing operations of existing commercial and institutional buildings (i.e. buildings regulated by Subsection 2.1.2 of Canada's National Building Code), including offices, retail and service establishments, institutional buildings (libraries, schools, museums, churches, etc.), hotels and residential buildings of four or more habitable stories;
9. **LEED 2009 for Healthcare (HC)**, owned and delivered by the USGBC, for construction and operation of buildings that are predominantly institutional occupancies as defined by the local building code, such as acute care hospitals, where regulatory requirements have created particular needs;
10. **LEED 2009 for Neighborhood Development (ND)**, owned and delivered by the USGBC, for certifying development projects that constitute whole neighborhoods, portions of neighborhoods or multiple neighborhoods, and having a minimum of two habitable buildings and maximum area (with exceptions) of 320 acres;
11. **LEED for Homes Multifamily Mid-Rise (2010)**, owned and delivered by the USGBC, for construction of multifamily mid-rise residential buildings between 4 and 6 stories and on application basis up to 9 stories.

### 1.3 RATING METHODOLOGY

Each of the ratings systems will be analyzed in the same way, using the following table:

**Table 1: Standard Evaluation Table**

<b>[Rating System] Credit</b>	<b>Total Available Points</b>	<b>Relevant Benefit of TIOCOAT Product</b>	<b>Potential TIOCOAT Point Contribution</b>
<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>

This report will (1) reference the specific rating system that is being assessed, (2) list the total number of points which may potentially be affected by TIOCOAT under the various credits defined in the referenced rating systems, (3) briefly explain how the product fulfills the intent of the referenced credits, and (4) include an opinion of the actual potential number of points that TIOCOAT would directly contribute towards earning within the referenced rating system (which is typically expected to be less than the total points available for a given credit). The indicated “Potential TIOCOAT Point Contribution” reflects available industry standard resources and Mindscape’s professional experience in our own projects and is in no way a guarantee of future project performance.

Please note that it is important to understand the difference between claiming that a certain product will *earn* points as opposed to claiming that it will *contribute towards* points. The reality is that the **LEED programs reward buildings, not products**, so although your product may have been a vital contributor towards an earned point, it may not be the only contributor for that point. For example, if a point is earned by an insulated concrete form product (ICF) for recycled content in LEED 2009 (NC) under credit MRc2 because there was sufficient recycled content included in the concrete used on the job, then the ICF product will very likely have contributed strongly to this point. However, so may the concrete in the foundation and floors, and it may be true that the ICF portion of the total concrete used was not sufficient to earn a point without also including the content used in the floors.

It is recommended that DuROCK avoid needing to educate their clients on this sensitivity by simply stating that you “*contribute towards*” the points referenced in Sections 2.0 below. The added benefit to this approach is that you then have the ability to make seemingly larger claims which are no less true. For example, although it is true that in LEED 2009 NC (see Section 3.1 below) under credit EAc1 you would likely earn 1 point directly, it is equally true that you are contributing towards the full 19 points that are available under that credit. For clarity, you cannot claim to have *earned* points until after the Green Building Council’s auditing consultants have verified that your product was in fact responsible for the points directly, but you can always claim to be *contributing towards* the total number of points available in a given credit. Sample claims that could be made are included later in this report after each assessment table to offer further clarity.



## 2.0 PRODUCT STUDY FINDINGS & ASSUMPTIONS

TIOCOAT is a white, elastomeric, reflective roof coating, with the following environmental attributes:

- Solar Reflectance:
  - Solar Reflectance Index (SRI)  $\geq 78^2$  and a solar reflectivity of 89%<sup>3</sup>;
  - Aids with reducing the “heat island” effect in urban settings<sup>3</sup>;
  - Lowers solar heat gain; translates into lower roof temperatures<sup>3</sup>.
- Energy savings: because of the reduced solar gains through the roof...
  - Reduces space cooling costs by 20 – 30%:<sup>3</sup>
    - Increases the efficiency of roof-mounted HVAC units by reducing roof surface temperature by 20-60°C;<sup>4</sup>
    - Reduces the temperature inside the building it covers by up to 6-9°C due to high solar reflectance properties<sup>4</sup>;
  - Provides up to a 30%<sup>5</sup> increase in efficiency of double bifacial solar panels by reflecting UV rays from roof back towards PV array.
- Durable: Provides longer roof life as white roof coating protects roofing material from UV degradation and high surface temperatures (slows premature aging of roof)<sup>4</sup>;
- Emissions: Is water based, containing no harmful chemicals<sup>3</sup>;

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<sup>2</sup> Product specification on Tiocoat Performance Requirements sheet, accessed online 2011/10/27 @:  
<http://www.tiocoat.com/burs.doc>

<sup>3</sup> Benefits provided on Tiocoat info sheet, accessed online 2011/10/25 @:  
<http://www.tiocoat.com/tiocoatinfo.pdf>

<sup>4</sup> Product benefits provided on Tiocoat’s Step by Step Installation Guide, accessed online 2011/10/27 @:  
<http://www.tiocoat.com/buri.pdf>

<sup>5</sup> Product info, accessed online 2011/10/25 @: <http://www.tiocoat.com/solar.html>

## 2.1 QUANTIFYING ENERGY SAVINGS

No energy performance measurements were directly performed by Mindscape for this assessment. For the purpose of this report, the potential energy savings achieved by TIOCOAT was determined based on product performance specifications provided by DuROCK; as listed above, TIOCOAT can provide buildings with cooling energy cost savings of 20 – 30%.<sup>2</sup>

To examine how this affects the overall energy use of buildings, take the example of a typical commercial building. As shown in Figure 1, a typical commercial building in Canada uses 5% of its total energy consumption for space cooling.

TIOCOAT's potential cooling energy savings of 30% could therefore be expected to provide a potential reduction in overall building energy costs of  $5\% \times 0.30 = 1.5\%$  for a typical Canadian commercial building. This same calculation methodology is used to determine the possible energy savings found in Table 2 for various building types.

### Energy Use - Canadian Commercial Buildings

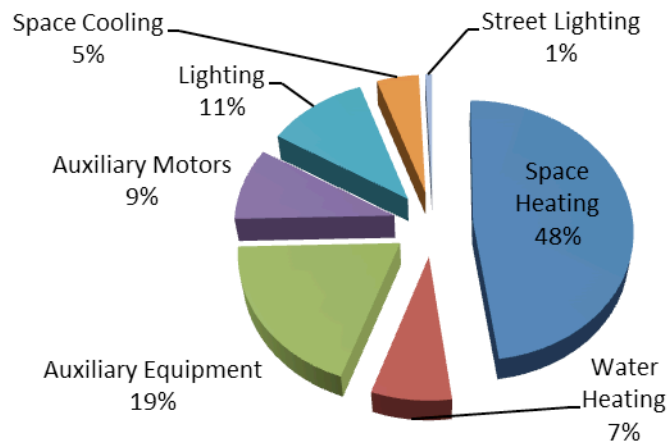


Figure 1: Average energy end-use breakdown in Canadian commercial buildings in 2008.<sup>6</sup>

<sup>6</sup> Source: Energy Use Data Handbook Tables (Canada) - Commercial/Institutional Sector, Natural Resources Canada, Table 1. Accessed online on 11/1/11

**Table 2: Potential cooling energy savings for different building types with TIOCOAT**

Building Type		Energy Use for Cooling (%)	TIOCOAT Max. Space Cooling Savings TIOCOAT (%)	Potential Reduction in Overall Energy with TIOCOAT (%)	Relevant LEED Rating System
Commercial	U.S.	7.9	30%	2.4	NC, EBOM, CS,
	CAN	4.6		1.4	
Schools	U.S.	9.6		2.9	NCS, NC, EBOM, CS
	CAN	4.6		1.4	
Retail	U.S.	7.9		2.4	NCR, NC, EBOM, CS
	CAN	4.8		1.4	
Multi-Unit Residential	U.S.	4.9		1.5	LHMR, NC, EBOM, CS
	CAN	1.1		0.3	
Healthcare	U.S.	7.5		2.3	HC, NC, EBOM, CS
	CAN	4.7		1.4	

TIOCOAT also has the potential to provide up to a 30% increase in the efficiency of double bifacial solar panels by reflecting solar energy from the roof surface back up towards the PV panels.<sup>5</sup> As an example, if TIOCOAT provided a 30% greater performance for a 1 MWh/yr PV array, this would increase the system's total energy yield to 1.3 MWh/yr, of which TIOCOAT contributed 0.3 MWh/yr. TIOCOAT could therefore contribute towards the following percentage of on-site solar PV energy generation:  $0.3 \text{ MWh} / 1.3 \text{ MWh} = 23\%$ . Suppose a building aims to achieve 13% of building energy supplied by on-site generation. Of this 13%, the potential energy percentage contributed by TIOCOAT through the 30% increase in PV efficiency would therefore be:  $13\% \times 0.23 = 3.0\%$ . In this case TIOCOAT would have been responsible for the corresponding increase in LEED points.

The potential cooling energy savings and increased efficiency of PVs are not guaranteed for each project, and depend upon numerous factors such as building type and climate zone.

### 3.0 RATING SYSTEM ASSESSMENTS

#### 3.1 LEED 2009 FOR NEW CONSTRUCTION AND MAJOR RENOVATIONS

LEED 2009 NC	Total Available Points	Relevant Benefit of TIOCOAT	Potential TIOCOAT Point Contribution
SSc7.2 Heat Island Effect – Roof	1	<p>TIOCOAT provides a Solar Reflectance Index (SRI) <math>\geq 78</math> when installed and maintained properly<sup>2</sup>, and can therefore contribute towards reducing the heat islanding effect on roofs:</p> <p>OPTION 1: Use roofing materials with a minimum solar reflectance index (SRI) of 78 and 29 for low-sloped (<math>\leq 15\%</math> slope) and steep-sloped (<math>&gt; 15\%</math> slope) roofs, respectively. This must be achieved for <math>\geq 75\%</math> of the roof surface area.</p> <p>OPTION 2: Install high-albedo and vegetated roof surfaces that, in combination, meet the following criteria:</p> $\frac{\text{Area Roof Meeting Minimum SRI}}{0.75} + \frac{\text{Area of Vegetated Roof}}{0.5} \geq \text{Total Roof Area}$	1
EAp2: Minimum Energy Performance	(required)	<p>TIOCOAT can reduce cooling energy costs, as covered in 2.1 , and can therefore help improve a building’s minimum energy performance levels:</p> <p>OPTION 1: 10% energy cost savings for new buildings or 5% for major renovations relative to the baseline building performance (ASHRAE 90.1-2007), <b>or</b></p> <p>OPTION 2: ASHRAE Advanced Energy Design Guide for small office buildings/retail buildings/warehouses and self-storage <b>or</b></p> <p>OPTION 3: Advanced Buildings Core Performance Guide™ developed by the New Buildings Institute.</p>	No Points Available (NPA)

LEED 2009 NC	Total Available Points	Relevant Benefit of TIOCOAT	Potential TIOCOAT Point Contribution
EAc1: Optimize Energy Performance	19	TIOCOAT can reduce cooling energy costs, as covered in Section 2.1, and can therefore contribute towards optimizing building energy performance. Credit is earned based on the percentage reduction in energy costs of the proposed versus the baseline building (ASHRAE 90.1-2007). As quantified in Section 2.1, TIOCOAT could help reduce overall energy costs for a typical commercial building by 2.4%. This could earn 1 point (see Appendix A - Table A.1), so long as minimum energy performance requirements for EAp2 were met through other means.	1
EAc2: On-Site Renewable Energy	7	Projects are rewarded 1-7 pts for meeting 1-13% of their energy demand through on-site renewable energy generation sources such as solar PV. TIOCOAT's high albedo surface can increase the efficiency of double bifocal PV arrays by up to 30% by reflecting solar energy from the roof back up towards the array. As covered in section 2.1, this would represent up to 23% of a PV system's total output. For projects maximizing their LEED credits for on-site renewable energy, this could therefore contribute towards $0.23 \times 13\% \approx 3\%$ of the building's total energy, or 2 points. (See Appendix B – Table B.1 for point thresholds)	2
MRc1.1: Building Reuse – Maintain Existing Walls, Floors and Roof	3	TIOCOAT's polyurethane modified acrylic elastomeric coating acts as a weather resilient membrane and therein helps provide longer roof life <sup>4</sup> . Furthermore, the coating protects roofing material from UV degradation and is designed to effectively be installed on existing roofing systems. These enhanced durability features help extend the lifecycle of existing buildings and conserve resources by enabling the reuse of existing building structures (including structural floor and roof decking) and envelope (exterior skin and framing). Credit is given to projects that reuse 55% - 95% (1-3 pts) of the surface areas of major existing structural and envelope elements.	<1

LEED 2009 NC	Total Available Points	Relevant Benefit of TIOCOAT	Potential TIOCOAT Point Contribution
<b>Total:</b>	<b>30</b>	Of the 30 total LEED 2009 NC points which TIOCOAT contributes towards, it could directly take credit for 4 points.	<b>4</b>

Based on the data shown in the above table, TIOCOAT may confidently claim that it makes a valuable contribution towards the available and related 30 points in the LEED 2009 NC rating system, and further that it could contribute as many as 4 points directly.

It should be noted that the potential of TIOCOAT in directly contributing points in LEED is dependent on several factors such as building design, building type and, in particular, climate zone. It is recommended that DuROCK more precisely determine the expected energy savings their product would earn for a range of different climate zones and building types, and keep an appropriately comprehensive set of case studies available for sales staff to reference as and when appropriate. The Roof Savings Calculator, available online at [www.RoofCalc.com](http://www.RoofCalc.com)<sup>7</sup>, was developed by Oak Ridge National Laboratory and Lawrence Berkeley National Laboratory to evaluate energy savings from cool roofing technologies for both residential and commercial buildings, and may be a helpful resource for such an analysis.

<sup>7</sup> U.S. Department of Energy. Guidelines for Selecting Cool Roofs. July 2010. Accessed online 2011/10/05

**3.2 LEED 2009 FOR SCHOOLS**

LEED 2009 NCS	Total Available Points	Relevant Benefit of TIOCOAT	Potential TIOCOAT Point Contribution
SSc7.2 Heat Island Effect – Roof	1	<p>TIOCOAT provides a Solar Reflectance Index (SRI) <math>\geq 78</math> when installed and maintained properly<sup>2</sup>, and can therefore contribute towards reducing the heat islanding effect on roofs:</p> <p>OPTION 1: Use roofing materials with a minimum solar reflectance index (SRI) of 78 and 29 for low-sloped (<math>\leq 15\%</math> slope) and steep-sloped (<math>&gt; 15\%</math> slope) roofs, respectively. This must be achieved for <math>\geq 75\%</math> of the roof surface area.</p> <p>OPTION 2: Install high-albedo and vegetated roof surfaces that, in combination, meet the following criteria:</p> $\frac{\text{Area Roof Meeting Minimum SRI}}{0.75} + \frac{\text{Area of Vegetated Roof}}{0.5} \geq \text{Total Roof Area}$	1
EAp2: Minimum Energy Performance	(required)	<p>TIOCOAT can reduce energy costs through a number of ways, as covered in Section 2.1, and can therefore help improve a building's minimum energy performance levels:</p> <p>OPTION 1: 10% energy cost savings for new buildings or 5% for major renovations relative to the baseline building performance (ASHRAE 90.1-2007), <b>or</b></p> <p>OPTION 2: ASHRAE Advanced Energy Design Guide for K-12 school buildings <b>or</b></p> <p>OPTION 3: Advanced Buildings Core Performance Guide™ developed by the New Buildings Institute.</p>	No Points Available (NPA)

LEED 2009 NCS	Total Available Points	Relevant Benefit of TIOCOAT	Potential TIOCOAT Point Contribution
EAc1: Optimize Energy Performance	19	TIOCOAT can reduce energy costs through a number of ways, as covered in Section 2.1, and can therefore contribute towards optimizing building energy performance. Credit is earned based on the percentage reduction in energy costs of the proposed versus the baseline building (ASHRAE 90.1-2007). As quantified in Section 2.1, TIOCOAT could help reduce overall energy costs for a typical school building by 2.9%. This could earn 1 point (see Appendix A - Table A.1), so long as minimum energy performance requirements for EAp2 were met through other means.	1
EAc2: On-Site Renewable Energy	7	Projects are rewarded 1-7 pts for meeting 1-13% of their energy demand through on-site renewable energy generation sources such as solar PV. TIOCOAT's high albedo surface can increase the efficiency of double bifocal PV arrays by up to 30% by reflecting solar energy from the roof back up towards the array. As covered in section 2.1, this would represent up to 23% of a PV system's total output, and for project's maximizing their LEED credit for on-site renewable energy, could therefore contribute towards $0.23 \times 13\% \approx 3\%$ of the building's total energy, or 2 points. (See Appendix B – Table B.1 for point thresholds)	2
MRc1.1: Building Reuse – Maintain Existing Walls, Floors and Roof	2	TIOCOAT's polyurethane modified acrylic elastomeric coating acts as a weather resilient membrane and therein helps provide longer roof life <sup>4</sup> . Furthermore, the coating protects roofing material from UV degradation and is designed to effectively be installed on existing roofing systems. These enhanced durability features help extend the lifecycle of existing buildings and conserve resources by enabling the reuse of existing building structures (including structural floor and roof decking) and envelope (exterior skin and framing). Credit is given to projects that reuse 75% - 95% (1-2 pts) of the surface areas of major existing structural and envelope elements.	<1



<b>LEED 2009 NCS</b>	<b>Total Available Points</b>	<b>Relevant Benefit of TIOCOAT</b>	<b>Potential TIOCOAT Point Contribution</b>
<b>Total:</b>	<b>29</b>	Of the 29 total LEED 2009 NCS points which TIOCOAT contributes towards, it could directly take credit for 4 points.	<b>4</b>

Based on the data shown in the above table, TIOCOAT may confidently claim that it makes a valuable contribution towards the available and related 29 points in the LEED 2009 NCS rating system, and further that it could directly contribute 4 points.

As in Section 3.1, it is recommended that case studies be performed under different project scenarios and made available to sales personnel.

**3.3 LEED CANADA FOR NEW CONSTRUCTION AND MAJOR RENOVATION 2009**

LEED Canada- NC 2009 Credit	Total Available Points	Relevant Benefit of TIOCOAT	Potential TIOCOAT Point Contribution
SSc7.2 Heat Island Effect – Roof	1	<p>TIOCOAT provides a Solar Reflectance Index (SRI) <math>\geq 78</math> when installed and maintained properly<sup>2</sup>, and can therefore contribute towards reducing the heat islanding effect on roofs:</p> <p>OPTION 1: Use roofing materials with a minimum solar reflectance index (SRI) of 78 and 29 for low-sloped (<math>\leq 15\%</math> slope) and steep-sloped (<math>&gt; 15\%</math> slope) roofs, respectively. This must be achieved for <math>\geq 75\%</math> of the roof surface area.</p> <p>OPTION 2: Install high-albedo and vegetated roof surfaces that, in combination, meet the following criteria:</p> $\frac{\text{Area Roof Meeting Minimum SRI}}{0.75} + \frac{\text{Area of Vegetated Roof}}{0.5} \geq \text{Total Roof Area}$	1
EAp2: Minimum Energy Performance	(required)	<p>TIOCOAT can reduce energy costs through a number of ways, as covered in Section 2.1, and can therefore help improve a building’s minimum energy performance levels:</p> <p>OPTION 1: reduce design energy consumption by 23% (new buildings) or 19% (major renovations) relative to consumption of the reference building designed to the Model National Energy Code for Buildings 1997 (MNECB), <b>or</b></p> <p>OPTION2: reduce design energy cost by 10% (new building) or 5 % (major renovations) relative to reference building designed to ASHRAE 90.1-2007 specifications.</p>	No Points Available (NPA)

LEED Canada- NC 2009 Credit	Total Available Points	Relevant Benefit of TIOCOAT	Potential TIOCOAT Point Contribution
EAc1: Optimize Energy Performance	19	TIOCOAT can reduce energy costs through a number of ways, as covered in Section 2.1, and can therefore contribute towards optimizing building energy performance. Credit is earned based on the percentage reduction in energy costs of the proposed vs. baseline building (ASHRAE 90.1-2007). As quantified in Section 2.1, DuROCK could help reduce overall energy costs for a typical Canadian commercial building by over 1.4%. This could directly earn <1 points (see Appendix A-Table A.1), so long as minimum energy performance requirements for EAp2 were met through other means.	<1
EAc2: On-Site Renewable Energy	7	Projects are rewarded 1-7 pts for meeting 1-13% of their energy demand through on-site renewable energy generation sources such as solar PV. TIOCOAT's high albedo surface can increase the efficiency of double bifocal PV arrays by up to 30% by reflecting solar energy from the roof back up towards the array. As covered in section 2.1, this would represent up to 23% of a PV system's total output, and for project's maximizing their LEED pts for on-site renewable energy, could therefore contribute towards $0.23 \times 13\% \approx 3\%$ of the building's total energy, or 2 points. (See Appendix B – Table B.1 for point thresholds)	2
MRc1.1: Building Reuse – Maintain Existing Walls, Floors and Roof	3	TIOCOAT's polyurethane modified acrylic elastomeric coating acts as a weather resilient membrane and therein helps provide longer roof life <sup>4</sup> . Furthermore, the coating protects roofing material from UV degradation and is designed to effectively be installed on existing roofing systems. These enhanced durability features help extend the lifecycle of existing buildings and conserve resources by enabling the reuse of existing building structures (including structural floor and roof decking) and envelope (exterior skin and framing). Credit is given to projects that reuse 55% - 95% (1-3 pts) of the surface areas of major existing structural and envelope elements.	<1
<b>Total:</b>	<b>30</b>	Of the 30 total LEED Canada-NC 2009 points which TIOCOAT contributes towards, it could directly take credit for 3 points.	<b>3</b>

Based on the data shown in the above table, TIOCOAT may confidently claim that it makes valuable contributions towards the available and related 30 points in the LEED Canada-NC 2009 rating system, and further that it could directly contribute 3 points.

As in Section 3.1, it is recommended that case studies be performed under different project scenarios and made available to sales personnel.

**3.4 LEED 2009 FOR RETAIL**

LEED 2009 NCR Credit	Total Available Points	Relevant Benefit of TIOCOAT	Potential TIOCOAT Point Contribution
SSc7.2 Heat Island Effect – Roof	1	<p>TIOCOAT provides a Solar Reflectance Index (SRI) <math>\geq 78</math> when installed and maintained properly<sup>2</sup>, and can therefore contribute towards reducing the heat islanding effect on roofs:</p> <p>OPTION 1: Use roofing materials with a minimum solar reflectance index (SRI) of 78 and 29 for low-sloped (<math>\leq 15\%</math> slope) and steep-sloped (<math>&gt; 15\%</math> slope) roofs, respectively. This must be achieved for <math>\geq 75\%</math> of the roof surface area.</p> <p>OPTION 2: Install high-albedo and vegetated roof surfaces that, in combination, meet the following criteria:</p> $\frac{\text{Area Roof Meeting Minimum SRI}}{0.75} + \frac{\text{Area of Vegetated Roof}}{0.5} \geq \text{Total Roof Area}$	1
EAp2: Minimum Energy Performance	(required)	<p>TIOCOAT can reduce energy costs through a number of ways, as covered in Section 2.1, and can therefore help improve a building's minimum energy performance levels:</p> <p>OPTION 1: 10% energy cost savings for new buildings or 5% for major renovations relative to the baseline building performance (ASHRAE 90.1-2007), <b>or</b></p> <p>OPTION 2: ASHRAE Advanced Energy Design Guide for Small Retails Buildings 2006 <b>or</b></p> <p>OPTION 3: Advanced Buildings Core Performance Guide™ developed by the New Buildings Institute.</p>	No Points Available (NPA)

LEED 2009 NCR Credit	Total Available Points	Relevant Benefit of TIOCOAT	Potential TIOCOAT Point Contribution
EAc1: Optimize Energy Performance	19	TIOCOAT can reduce energy costs through a number of ways, as covered in Section 2.1, and can therefore contribute towards optimizing building energy performance. Credit is earned based on the percentage reduction in energy costs of the proposed versus the baseline building (ASHRAE 90.1-2007). As quantified in Section 2.1, TIOCOAT could help reduce overall energy costs for a typical retail building by 2.4%. This could directly earn <1 points (see Appendix A - Table A.1), so long as minimum energy performance requirements for EAp2 were met through other means.	1
EAc2: On-Site Renewable Energy	7	Projects are rewarded 1-7 pts for meeting 1-13% of their energy demand through on-site renewable energy generation sources such as solar PV. TIOCOAT's high albedo surface can increase the efficiency of double bifocal PV arrays by up to 30% by reflecting solar energy from the roof back up towards the array. As covered in section 2.1, this would represent up to 23% of a PV system's total output, and for project's maximizing their on-site renewable energy contribution in LEED, could therefore contribute towards $0.23 \times 13\% \approx 3\%$ of the building's total energy, or 2 points. (See Appendix B – Table B.1 for point thresholds)	2
MRc1.1: Building Reuse – Maintain Existing Walls, Floors and Roof	3	TIOCOAT's polyurethane modified acrylic elastomeric coating acts as a weather resilient membrane and therein helps provide longer roof life <sup>4</sup> . Furthermore, the coating protects roofing material from UV degradation and is designed to effectively be installed on existing roofing systems. These enhanced durability features help extend the lifecycle of existing buildings and conserve resources by enabling the reuse of existing building structures (including structural floor and roof decking) and envelope (exterior skin and framing). Credit is given to projects that reuse 55% - 95% (1-3 pts) of the surface areas of major existing structural and envelope elements.	<1

LEED 2009 NCR Credit	Total Available Points	Relevant Benefit of TIOCOAT	Potential TIOCOAT Point Contribution
<b>Total:</b>	<b>30</b>	Of the 30 total LEED 2009 NCR points which TIOCOAT contributes towards, it could directly take credit for 4 points.	<b>4</b>

Based on the data shown in the above table, TIOCOAT may confidently claim that it makes valuable contributions towards the available and related 30 points in the LEED 2009 NCR rating system, and further that it could directly contribute as many as 4 points.

As in Section 3.1, it is recommended that case studies be performed under different project scenarios and made available to sales personnel.

**3.5 LEED 2009 FOR CORE AND SHELL**

LEED 2009 CS Credit	Total Available Points	Relevant Benefit of TIOCOAT	Potential TIOCOAT Point Contribution
SSc7.2 Heat Island Effect – Roof	1	<p>TIOCOAT provides a Solar Reflectance Index (SRI) <math>\geq 78</math> when installed and maintained properly<sup>2</sup>, and can therefore contribute towards reducing the heat islanding effect on roofs:</p> <p>OPTION 1: Use roofing materials with a minimum solar reflectance index (SRI) of 78 and 29 for low-sloped (<math>\leq 15\%</math> slope) and steep-sloped (<math>&gt; 15\%</math> slope) roofs, respectively. This must be achieved for <math>\geq 75\%</math> of the roof surface area.</p> <p>OPTION 2: Install high-albedo and vegetated roof surfaces that, in combination, meet the following criteria:</p> $\frac{\text{Area Roof Meeting Minimum SRI}}{0.75} + \frac{\text{Area of Vegetated Roof}}{0.5} \geq \text{Total Roof Area}$	1
EAp2: Minimum Energy Performance	(required)	<p>TIOCOAT can reduce energy costs through a number of ways, as covered in Section 2.1, and can therefore help improve a building's minimum energy performance levels:</p> <p>OPTION 1: 10% energy cost savings for new buildings or 5% for major renovations relative to the baseline building performance (ASHRAE 90.1-2007), <b>or</b></p> <p>OPTION 2: ASHRAE Advanced Energy Design Guide for small office buildings/retail buildings /warehouses and self-storage <b>or</b></p> <p>OPTION 3: Advanced Buildings Core Performance Guide™ developed by the New Buildings Institute.</p>	No Points Available (NPA)



LEED 2009 CS Credit	Total Available Points	Relevant Benefit of TIOCOAT	Potential TIOCOAT Point Contribution
EAc1: Optimize Energy Performance	21	TIOCOAT can reduce energy costs through a number of ways, as covered in Section 2.1, and can therefore contribute towards optimizing building energy performance. Credit is earned based on the percentage reduction in energy costs of the proposed versus the baseline building (ASHRAE 90.1-2007). As quantified in Section 2.1, TIOCOAT could help reduce overall energy costs for a typical commercial building by 2.4%. This could directly earn 1 point (see Appendix A - Table A.2), so long as minimum energy performance requirements for EAp2 were met through other means.	1
EAc2: On-Site Renewable Energy	4	Projects are rewarded 4 pts for meeting 1% of their energy demand through on-site renewable energy generation sources such as solar PV. TIOCOAT's high albedo surface can increase the efficiency of double bifocal PV arrays by up to 30% by reflecting solar energy from the roof back up towards the array. As covered in section 2.1, this would represent up to 23% of a PV system's total output, and for project's maximizing their on-site renewable energy contribution in LEED, could therefore contribute towards $0.23 \times 1\% \approx 0.23\%$ of the building's total energy, or ~1 point. (See Appendix B – Table B.2 for point thresholds)	1
MRc1.1: Building Reuse – Maintain Existing Walls, Floors and Roof	5	TIOCOAT's polyurethane modified acrylic elastomeric coating acts as a weather resilient membrane and therein helps provide longer roof life <sup>4</sup> . Furthermore, the coating protects roofing material from UV degradation and is designed to effectively be installed on existing roofing systems. These enhanced durability features help extend the lifecycle of existing buildings and conserve resources by enabling the reuse of existing building structures (including structural floor and roof decking) and envelope (exterior skin and framing). Credit is given to projects that reuse 25% - 75% (1-5 pts) of the surface areas of major existing structural and envelope elements.	<1

<b>LEED 2009 CS Credit</b>	<b>Total Available Points</b>	<b>Relevant Benefit of TIOCOAT</b>	<b>Potential TIOCOAT Point Contribution</b>
<b>Total:</b>	<b>31</b>	Of the 31 total LEED 2009 CS points which TIOCOAT contributes towards, it could directly take credit for 3 point.	<b>3</b>

Based on the data shown in the above table, TIOCOAT may confidently claim that it makes a valuable contribution towards the available and related 31 points in the LEED 2009 CS rating system, and further that it could directly contribute as many as 3 point.

As in Section 3.1, it is recommended that case studies be performed under different project scenarios and made available to sales personnel.

**3.6 LEED CANADA FOR CORE & SHELL 2009**

LEED Canada CS 2009 Credit	Total Available Points	Relevant Benefit of TIOCOAT	Potential TIOCOAT Point Contribution
SSc7.2 Heat Island Effect – Roof	1	<p>TIOCOAT provides a Solar Reflectance Index (SRI) <math>\geq 78</math> when installed and maintained properly<sup>2</sup>, and can therefore contribute towards reducing the heat islanding effect on roofs:</p> <p>OPTION 1: Use roofing materials with a minimum solar reflectance index (SRI) of 78 and 29 for low-sloped (<math>\leq 15\%</math> slope) and steep-sloped (<math>&gt; 15\%</math> slope) roofs, respectively. This must be achieved for <math>\geq 75\%</math> of the roof surface area.</p> <p>OPTION 2: Install high-albedo and vegetated roof surfaces that, in combination, meet the following criteria:</p> $\frac{\text{Area Roof Meeting Minimum SRI}}{0.75} + \frac{\text{Area of Vegetated Roof}}{0.5} \geq \text{Total Roof Area}$	1
EAp2: Minimum Energy Performance	(required)	<p>TIOCOAT can reduce energy costs through a number of ways, as covered in Section 2.1, and can therefore help improve a building's minimum energy performance levels:</p> <p>OPTION 1: reduce design energy consumption by 23% (new buildings) or 19% (major renovations) relative to consumption of the reference building designed to the Model National Energy Code for Buildings 1997 (MNECB), <b>or</b></p> <p>OPTION2: reduce design energy cost by 10% (new building) or 5 % (major renovations) relative to reference building designed to ASHRAE 90.1-2007 specifications.</p>	No Points Available (NPA)

LEED Canada CS 2009 Credit	Total Available Points	Relevant Benefit of TIOCOAT	Potential TIOCOAT Point Contribution
EAc1: Optimize Energy Performance	21	TIOCOAT can reduce energy costs through a number of ways, as covered in Section 2.1, and can therefore contribute towards optimizing building energy performance. Credit is earned based on the percentage reduction in energy costs of the proposed vs. baseline building (ASHRAE 90.1-2007). As quantified in Section 2.1, TIOCOAT could help reduce overall energy costs for a typical Canadian commercial building by over 1.4%. This could directly earn <1 points (see Appendix A-Table A.2), so long as minimum energy performance requirements for EAp2 were met through other means.	<1
EAc2: On-Site Renewable Energy	4	Projects are rewarded 2 - 4 pts for meeting 0.5 -1% of their energy demand through on-site renewable energy generation sources such as solar PV. TIOCOAT's high albedo surface can increase the efficiency of double bifocal PV arrays by up to 30% by reflecting solar energy from the roof back up towards the array. As covered in section 2.1, this would represent up to 23% of a PV system's total output, and for project's maximizing their on-site renewable energy contribution in LEED, could therefore contribute towards $0.23 \times 1\% \approx 0.23\%$ of the building's total energy, or ~ 1 point. (See Appendix B – Table B.2 for point thresholds)	1
MRc1.1: Building Reuse – Maintain Existing Walls, Floors and Roof	5	TIOCOAT's polyurethane modified acrylic elastomeric coating acts as a weather resilient membrane and therein helps provide longer roof life <sup>4</sup> . Furthermore, the coating protects roofing material from UV degradation and is designed to effectively be installed on existing roofing systems. These enhanced durability features help extend the lifecycle of existing buildings and conserve resources by enabling the reuse of existing building structures (including structural floor and roof decking) and envelope (exterior skin and framing). Credit is given to projects that reuse 25% - 75% (1-5 pts) of the surface areas of major existing structural and envelope elements.	<1

LEED Canada CS 2009 Credit	Total Available Points	Relevant Benefit of TIOCOAT	Potential TIOCOAT Point Contribution
<b>Total:</b>	<b>31</b>	Of the 31 total LEED Canada – CS 2009 points which TIOCOAT contributes towards, it could directly take credit for 2 points.	<b>2</b>

Based on the data shown in the above table, TIOCOAT may confidently claim that it makes valuable contributions towards the available and related 31 points in the LEED Canada – CS 2009 rating system, and further that it could directly contribute as many as 2 points.

As in Section 3.1, it is recommended that case studies be performed under different project scenarios and made available to sales personnel.

## 3.7 LEED 2009 EXISTING BUILDINGS: OPERATION AND MAINTENANCE

LEED 2009 EBOM Credit	Total Available Points	Relevant Benefit of TIOCOAT	Potential TIOCOAT Point Contribution
SSc7.2 Heat Island Effect – Roof	1	<p>TIOCOAT provides a Solar Reflectance Index (SRI) <math>\geq 78</math> when installed and maintained properly<sup>2</sup>, and can therefore contribute towards reducing the heat islanding effect on roofs:</p> <p>OPTION 1: Use roofing materials with a minimum solar reflectance index (SRI) of 78 and 29 for low-sloped (<math>\leq 15\%</math> slope) and steep-sloped (<math>&gt; 15\%</math> slope) roofs, respectively. This must be achieved for <math>\geq 75\%</math> of the roof surface area.</p> <p>OPTION 2: Install high-albedo and vegetated roof surfaces that, in combination, meet the following criteria:</p> $\frac{\text{Area Roof Meeting Minimum SRI}}{0.75} + \frac{\text{Area of Vegetated Roof}}{0.5} \geq \text{Total Roof Area}$	1
EAp2: Minimum Energy Performance	(required)	<p>TIOCOAT can reduce energy costs through a number of ways, as covered in Section 2.1, and can therefore help improve an existing building's minimum energy performance levels to achieve an energy performance rating of <math>\geq 69</math> through the EPA's ENERGY STAR Portfolio Manager, or demonstrate an increase in energy efficiency of <math>\geq 19\%</math> versus the national average for similar building types.</p>	No Points Available (NPA)
EAc1: Optimize Energy Efficiency Performance	18	<p>TIOCOAT can reduce energy costs through a number of ways, as covered in Section 2.1, and can therefore contribute towards increasing an existing building's energy efficiency performance by <math>\geq 21\%</math> versus the national average. Assuming TIOCOAT can contribute a maximum overall energy savings of 2.4% for a typical existing commercial building in the U.S. (see Section 2.1), a potential contribution of 2 points can directly be earned (see Appendix A-Table A.3), so long as the minimum energy performance requirements for EAp2 were met through other means.</p>	2

LEED 2009 EBOM Credit	Total Available Points	Relevant Benefit of TIOCOAT	Potential TIOCOAT Point Contribution
EAc4: On-site and Off-site Renewable Energy	6	Projects are rewarded 1-6 pts for meeting 3-12% of their energy demand through on-site renewable energy generation sources such as solar PV. Projects are awarded 1-6 pts for meeting 25 – 100% of their energy demand through off-site renewable energy generation sources. TIOCOAT's high albedo surface can increase the efficiency of double bifocal PV arrays by up to 30% by reflecting solar energy from the roof back up towards the array. As covered in section 2.1, this would represent up to 23% of a PV system's total output, and for project's maximizing their on-site renewable energy contribution in LEED, could therefore contribute towards $0.23 \times 12\% \approx 3\%$ , or a contribution towards 1. (See Appendix B – Table B.3 for point thresholds)	1
MRc1.1: Building Reuse – Maintain Existing Walls, Floors and Roof	5	TIOCOAT's polyurethane modified acrylic elastomeric coating acts as a weather resilient membrane and therein helps provide longer roof life <sup>4</sup> . Furthermore, the coating protects roofing material from UV degradation and is designed to effectively be installed on existing roofing systems. These enhanced durability features help extend the lifecycle of existing buildings and conserve resources by enabling the reuse of existing building structures (including structural floor and roof decking) and envelope (exterior skin and framing). Credit is given to projects that reuse 25% - 75% (1-5 pts) of the surface areas of major existing structural and envelope elements.	<1
<b>Total:</b>	<b>30</b>	Of the 30 total LEED 2009 EBOM points which TIOCOAT contributes towards, it could directly take credit for 4 points.	<b>4</b>

Based on the data shown in the above table, TIOCOAT may confidently claim that it make a valuable contribution towards the available and related 30 points in the LEED 2009 EBOM rating system, and further that it could directly contribute as many as 4 points for a typical existing commercial building.

As in Section 3.1, it is recommended that case studies be performed under different project scenarios and made available to sales personnel.

**3.8 LEED CANADA - EXISTING BUILDINGS: OPERATION AND MAINTENANCE 2009**

LEED Canada – EBOM 2009 Credit	Total Available Points	Relevant Benefit of TIOCOAT	Potential TIOCOAT Point Contribution
SSc7.2 Heat Island Effect - Roof	1	<p>TIOCOAT provides a Solar Reflectance Index (SRI) <math>\geq 78</math> when installed and maintained properly<sup>2</sup>, and can therefore contribute towards reducing the heat islanding effect on roofs:</p> <p>OPTION 1: Use roofing materials with a minimum solar reflectance index (SRI) of 78 and 29 for low-sloped (<math>\leq 15\%</math> slope) and steep-sloped (<math>&gt; 15\%</math> slope) roofs, respectively. This must be achieved for <math>\geq 75\%</math> of the roof surface area.</p> <p>OPTION 2: Install high-albedo and vegetated roof surfaces that, in combination, meet the following criteria:</p> $\frac{\text{Area Roof Meeting Minimum SRI}}{0.75} + \frac{\text{Area of Vegetated Roof}}{0.5} \geq \text{Total Roof Area}$	1
EAp2: Minimum Energy Performance	(required)	<p>TIOCOAT can reduce energy costs through a number of ways, as covered in Section 2.1, and can therefore help improve an existing building’s minimum energy performance levels to achieve an energy performance rating of <math>\geq 69</math> through the EPA’s ENERGY STAR Portfolio Manager, or demonstrate an increase in energy efficiency of <math>\geq 19\%</math> versus the national average for similar building types.</p>	No Points Available (NPA)
EA c1: Optimize Energy Efficiency Performance	18	<p>TIOCOAT can reduce energy costs through a number of ways, as covered in Section 2.1, and can therefore contribute towards increasing an existing building’s energy efficiency performance by <math>\geq 21\%</math> versus the national average. Assuming TIOCOAT can contribute a maximum overall energy savings of 1.4% for a typical existing commercial building in Canada (see Section 2.1), a potential contribution of 1 point can directly be earned (see Appendix A-Table A.3), so long as the minimum energy performance requirements for EAp2 were met through other means.</p>	1



LEED Canada – EBOM 2009 Credit	Total Available Points	Relevant Benefit of TIOCOAT	Potential TIOCOAT Point Contribution
EAc4: On-site and Off-site Renewable Energy	6	Projects are rewarded 1-6 pts for meeting 3-12% of their energy demand through on-site renewable energy generation sources such as solar PV. Projects are awarded 1-6 pts for meeting 25 – 100% of their energy demand through off-site renewable energy generation sources. TIOCOAT's high albedo surface can increase the efficiency of double bifocal PV arrays by up to 30% by reflecting solar energy from the roof back up towards the array. As covered in section 2.1, this would represent up to 23% of a PV system's total output, and for project's maximizing their on-site renewable energy contribution in LEED, could therefore contribute towards $0.23 \times 12\% \approx 3\%$ , or a contribution towards 1 point. (Seed Appendix B - Table B.3 for point thresholds)	1
MRc1.1: Building Reuse – Maintain Existing Walls, Floors and Roof	5	TIOCOAT's polyurethane modified acrylic elastomeric coating acts as a weather resilient membrane and therein helps provide longer roof life <sup>4</sup> . Furthermore, the coating protects roofing material from UV degradation and is designed to effectively be installed on existing roofing systems. These enhanced durability features help extend the lifecycle of existing buildings and conserve resources by enabling the reuse of existing building structures (including structural floor and roof decking) and envelope (exterior skin and framing). Credit is given to projects that reuse 25% - 75% (1-5 pts) of the surface areas of major existing structural and envelope elements.	<1
<b>Total:</b>	<b>30</b>	Of the 30 total LEED Canada EBOM 2009 points which TIOCOAT contributes towards, it could directly take credit for 3 points.	<b>3</b>

Based on the data shown in the above table, TIOCOAT may confidently claim that it make a valuable contribution towards the available and related 30 points in the LEED Canada EBOM 2009 rating system, and further that it could directly contribute as many as 3 points.

As in Section 3.1, it is recommended that case studies be performed under different project scenarios and made available to sales personnel.

**3.9 LEED 2009 FOR HEALTHCARE**

LEED 2009 HC Credit	Total Available Points	Relevant Benefit of TIOCOAT	Potential TIOCOAT Point Contribution
SSc7.2 Heat Island Effect - Roof	1	<p>TIOCOAT provides a Solar Reflectance Index (SRI) <math>\geq 78</math> when installed and maintained properly<sup>2</sup>, and can therefore contribute towards reducing the heat islanding effect on roofs:</p> <p>OPTION 1: Use roofing materials with a minimum solar reflectance index (SRI) of 78 and 29 for low-sloped (<math>\leq 15\%</math> slope) and steep-sloped (<math>&gt; 15\%</math> slope) roofs, respectively. This must be achieved for <math>\geq 75\%</math> of the roof surface area.</p> <p>OPTION 2: Install high-albedo and vegetated roof surfaces that, in combination, meet the following criteria:</p> $\frac{\text{Area Roof Meeting Minimum SRI}}{0.75} + \frac{\text{Area of Vegetated Roof}}{0.5} \geq \text{Total Roof Area}$	1
EAp2: Minimum Energy Performance	(required)	<p>TIOCOAT can reduce energy costs through a number of ways, as covered in Section 2.1, and can therefore help improve a building's minimum energy performance levels:</p> <p>OPTION 1: 10% energy cost savings for new buildings or 5% for major renovations relative to the baseline building performance (ASHRAE 90.1-2007), <b>or</b></p> <p>OPTION 2: ASHRAE Advanced Energy Design Guide for Small Hospitals and Healthcare Facilities, <b>or</b></p> <p>OPTION 3: Green Guide for Health Care v2.2 Prescriptive Path for Energy Improvements in Hospitals.</p>	No Points Available (NPA)

LEED 2009 HC Credit	Total Available Points	Relevant Benefit of TIOCOAT	Potential TIOCOAT Point Contribution
EAc1: Optimize Energy Performance	24	TIOCOAT can reduce energy costs through a number of ways, as covered in Section 2.1, and can therefore contribute towards optimizing building energy performance. Credit is earned based on the percentage reduction in energy costs of the proposed versus the baseline building (ASHRAE 90.1-2007). As quantified in Section 2.1, TIOCOAT could help reduce overall energy costs for a typical school building by 2.3%. This could earn 1 point (see Appendix A - Table A.4), so long as minimum energy performance requirements for EAp2 were met through other means.	1
EAc2: On-Site Renewable Energy	8	Projects are rewarded 1-8 pts for meeting 1-40% of their energy demand through on-site renewable energy generation sources such as solar PV. TIOCOAT's high albedo surface can increase the efficiency of double bifocal PV arrays by up to 30% by reflecting solar energy from the roof back up towards the array. As covered in section 2.1, this would represent up to 23% of a PV system's total output, and for project's maximizing their on-site renewable energy contribution in LEED, could therefore contribute towards $0.23 \times 40\% \approx 9\%$ of the building's total energy, or contributes towards 2 points. (See Appendix B – Table B.4 for point thresholds)	2
MRc1.1: Building Reuse – Maintain Existing Walls, Floors and Roof	5	TIOCOAT's polyurethane modified acrylic elastomeric coating acts as a weather resilient membrane and therein helps provide longer roof life <sup>4</sup> . Furthermore, the coating protects roofing material from UV degradation and is designed to effectively be installed on existing roofing systems. These enhanced durability features help extend the lifecycle of existing buildings and conserve resources by enabling the reuse of existing building structures (including structural floor and roof decking) and envelope (exterior skin and framing). Credit is given to projects that reuse 25% - 75% (1-5 pts) of the surface areas of major existing structural and envelope elements.	<1

LEED 2009 HC Credit	Total Available Points	Relevant Benefit of TIOCOAT	Potential TIOCOAT Point Contribution
<b>Total:</b>	<b>38</b>	Of the 38 total LEED 2009 Healthcare points which TIOCOAT contributes towards, it could directly take credit for 4 points.	<b>4</b>

Based on the data shown in the above table, TIOCOAT may confidently claim that it make a valuable contribution towards the available and related 38 points in the LEED 2009 Healthcare rating system, and further that it could directly contribute as many as 4 points.

As in Section 3.1, it is recommended that case studies be performed under different project scenarios and made available to sales personnel.

**3.10 LEED 2009 FOR NEIGHBORHOOD DEVELOPMENT**

<b>LEED 2009 for ND</b>	<b>Total Available Points</b>	<b>Relevant Benefit of TIOCOAT</b>	<b>Potential TIOCOAT Point Contribution</b>
GIBp1: Certified Green Building	(required)	By helping contribute towards certification of individual buildings in the various LEED rating systems (i.e. New Construction, Core and Shell, Homes, Retail, Schools), DuROCK helps encourage green building practices. The prerequisite requires for one whole building within the project to be certified through one of these programs.	No Points Available (NPA)
GIBp2: Minimum Building Energy Efficiency	(required)	TIOCOAT can reduce energy costs through a number of ways, as covered in Section 2.1, and can therefore help achieve minimum energy performance requirements for new developments:  Non-residential buildings: 90% of the floor area of all buildings must demonstrate 10% energy cost savings for new buildings or 5% for major renovations relative to the baseline building performance (ASHRAE 90.1-2007). New single-family residential and new multi residential buildings (3 stories or fewer): 90% of the building must meet ENERGY STAR or equivalent.	No Points Available (NPA)
GIBc1: Certified Green Buildings	5	By helping contribute towards certification of individual buildings in the various LEED rating systems (i.e. New Construction, Core and Shell, Homes, Retail, Schools), TIOCOAT helps encourage green building practices. Credit is earned if 10-50% (1-5 points) of the project's total building square footage is certified through one of these programs.	<1
GIBc2: Building Energy Efficiency	2	TIOCOAT can reduce energy costs through a number of ways, as covered in Section 2.1, and can therefore help improve building energy efficiency. Credit is earned by the following:  Non-residential buildings: 90% of the floor area of all buildings must demonstrate 18-26% (1-2 points) energy cost savings for new buildings or 14-22% (1-2 points) for major renovations relative to the baseline building performance (ASHRAE 90.1-2007). New single-family residential and new multi residential buildings (3 stories or fewer): 90% of the building must achieve a HERS score of $\geq 75$ .	<1

LEED 2009 for ND	Total Available Points	Relevant Benefit of TIOCOAT	Potential TIOCOAT Point Contribution
GIBc5: Existing Building Reuse	1	<p>TIOCOAT's polyurethane modified acrylic elastomeric coating acts as a weather resilient membrane and therein helps provide longer roof life<sup>4</sup>. Furthermore, the coating protects roofing material from UV degradation and is designed to effectively be installed on existing roofing systems. These enhanced durability features help extend the lifecycle of existing buildings and conserve resources by enabling the reuse of existing building structures and envelope. Credit is given to projects that reuse either 50% of one existing building structure and envelope, or 20% of the total existing building stock (i.e. reuse surface areas of major existing structural and envelope elements)</p>	<1
GIBc9: Heat Island Reduction	1	<p>TIOCOAT provides a Solar Reflectance Index (SRI) <math>\geq 78^2</math> when installed and maintained properly and can therefore contribute towards reducing the heat island effect on roofs:</p> <p>OPTION 1: Use roofing materials with a minimum solar reflectance index (SRI) of 78 and 29 for low-sloped (<math>\leq 15\%</math> slope) and steep-sloped (<math>&gt; 15\%</math> slope) roofs, respectively. This must be achieved for <math>\geq 75\%</math> of the roof surface area.</p> <p>OPTION 2: Combinations of SRI-compliant and vegetated roofs can be used provided they collectively cover 75% of the roof area of all new buildings</p> <p>OPTION 3: Mixed non-roof and roof measures</p> <p>Use any of the strategies listed under Options 1 and 2 that in combination meet the following criterion:</p> $\begin{array}{r} \frac{\text{Area of Nonroof Measures}}{0.5} + \frac{\text{Area of SRI Roof}}{0.75} \\ + \frac{\text{Area of Vegetated Roof}}{0.5} \\ \geq \frac{\text{Total Site Hardscape Area}}{1} + \frac{\text{Total Roof Area}}{1} \end{array}$	1

LEED 2009 for ND	Total Available Points	Relevant Benefit of TIOCOAT	Potential TIOCOAT Point Contribution
GIBc11: On-Site Renewable Energy Sources	3	Projects are rewarded 1-3 pts for meeting 5-20% of their energy demand through on-site renewable energy generation sources such as solar PV. TIOCOAT's high albedo surface can increase the efficiency of double bifocal PV arrays by up to 30% by reflecting solar energy from the roof back up towards the array. As covered in section 2.1, this would represent up to 23% of a PV system's total output, and for project's maximizing their on-site renewable energy contribution in LEED, could therefore contribute towards $0.23 \times 20\% \approx 5\%$ of the building's total energy, or contributes towards 1 point. (See Appendix B – Table B.5 for point thresholds)	1
<b>Total:</b>	<b>12</b>	Of the 12 total LEED 2009 ND points which TIOCOAT contributes towards, it could directly take credit for 2 points.	<b>2</b>

Based on the data shown in the above table, TIOCOAT may confidently claim that it makes valuable contributions towards the available and related 12 points in the LEED 2009 Neighborhood Development rating system, though due to the macro-scale nature of neighborhood development projects it would directly contribute as many 2 points.

As in Section 3.1, it is recommended that case studies be performed under different project scenarios and made available to sales personnel.

**3.11 LEED FOR HOMES MULTIFAMILY MID-RISE**

<b>LHMR Credit</b>	<b>Total Available Points</b>	<b>Relevant Benefit of TIOCOAT</b>	<b>Potential TIOCOAT Point Contribution</b>
SSc3.2: Heat Island Effect - Roof	1	<p>TIOCOAT provides a Solar Reflectance Index (SRI) <math>\geq 78</math> when installed and maintained properly<sup>2</sup>, and can therefore contribute towards reducing the heat islanding effect on roofs:</p> <p>OPTION 1: Use roofing materials with a minimum solar reflectance index (SRI) of 78 and 29 for low-sloped (<math>\leq 15\%</math> slope) and steep-sloped (<math>&gt; 15\%</math> slope) roofs, respectively. This must be achieved for <math>\geq 75\%</math> of the roof surface area.</p> <p>OPTION 2: Install high-albedo and vegetated roof surfaces that, in combination, meet the following criteria:</p> $\frac{\text{Area Roof Meeting Minimum SRI}}{0.75} + \frac{\text{Area of Vegetated Roof}}{0.5} \geq \text{Total Roof Area}$	1
EAc1.1: Optimizing Energy Performance	(required)	TIOCOAT can reduce cooling energy costs, as covered in 2.1 , and can therefore help improve a building’s minimum energy performance levels to meet 15% energy cost savings for new buildings relative to the baseline building performance (ASHRAE 90.1-2007)	No Points Available (NPA)
EA1.3: Optimizing Energy Performance	34	TIOCOAT can reduce cooling energy costs, as covered in Section 2.1, and can therefore contribute towards optimizing building energy performance. Credit is earned based on the percentage reduction in energy costs of the proposed versus the baseline building (ASHRAE 90.1-2007). As quantified in Section 2.1, TIOCOAT could help reduce overall energy costs for a typical mid-rise residential building in the U.S. by 1.5%. This could earn 1 point (see Appendix A - Table A.5), so long as minimum energy performance requirements for EAp2 were met through other means.	1



LHMR Credit	Total Available Points	Relevant Benefit of TIOCOAT	Potential TIOCOAT Point Contribution
EA10: Renewable Energy <sup>8</sup>	10	Projects are rewarded 1-10 pts for meeting 3-30% of their energy demand through on-site renewable energy generation sources such as solar PV. TIOCOAT's high albedo surface can increase the efficiency of double bifocal PV arrays by up to 30% by reflecting solar energy from the roof back up towards the array. As covered in section 2.1, this would represent up to 23% of a PV system's total output, and for project's maximizing their on-site renewable energy contribution in LEED, could therefore contribute towards $0.23 \times 30\% \approx 7\%$ of the building's total energy, or contributes towards 2 points. (See Appendix B – Table B.6 for point thresholds)	2
<b>Total:</b>	<b>45</b>	Of the 45 total LEED for Homes Multifamily Mid-Rise points which TIOCOAT contributes towards, it could directly take credit for 4 points.	<b>4</b>

Based on the data shown in the above table, TIOCOAT may confidently claim that it makes valuable contributions towards the available and related 45 points in the LEED for Homes rating system, and further that it could directly contribute over as many as 4 points.

As in Section 3.1, it is recommended that case studies be performed under different project scenarios and made available to sales personnel.

<sup>8</sup> Please note that LEED for Homes includes both a “performance” path of calculated energy use (EAc1) and a prescriptive path (EAc2-6). These two paths are mutually exclusive, so only one can be used. For the purpose of this report, only EAc1 has been summed into the point total.

#### 4.0 ADDITIONAL MARKETABLE ENVIRONMENTAL ATTRIBUTES

Noting that the above rating systems award buildings, and not products, there are often significant and meaningful benefits offered by product suppliers which are noteworthy, but which unfortunately cannot earn points in these building rating systems. In addition to the contributions made in the above green rating systems, TIOCOAT has the following noteworthy environmental benefit and should be promoted:

- Can be applied to many suitable existing roofing substrates including: BUR, Mod-bit, Concrete, Metal and Asphalt, and therefore does not require any additional roofing material<sup>3</sup>;
- Made to withstand Canada's extreme climate<sup>3</sup>;
- Reduces impact on electrical grid by reducing 'peak' electrical demand level during cooling season<sup>3</sup>;
- Complies with the 'ECO-ROOF' program grant from City of Toronto<sup>3</sup>;
- Water based product, with no harmful chemicals.

It is recommended that these benefits be expressed as the legitimate benefits they are, and communicated in targeted and appropriate ways, alongside the benefits referenced to the specific rating systems above.

## 5.0 CONCLUSIONS & RECOMMENDATIONS

The various green building rating systems recognize top industry leadership in building design and construction. Regardless of the type of building constructed, TIOCOAT will contribute positively towards a more sustainable built environment, and is recognized in the various green building rating systems. A performance summary of TIOCOAT's products in the various green building programs outlined in this report is shown below in Table 3.

**Table 3: TIOCOAT Green Building Program Performance Summary**

Green Building Rating System	LEED Point Threshold				TIOCOAT Related Pts	Potential TIOCOAT Point Contribution
	Certified	Silver	Gold	Platinum		
LEED 2009 NC	40 – 49	50 - 59	60 - 79	≥80	30	4
LEED 2009 NC Schools					29	4
LEED Canada - NC 2009					30	3
LEED 2009 Retail					30	4
LEED 2009 Core and Shell					31	3
LEED Canada - Core and Shell 2009					31	2
LEED 2009 EBOM					30	4
LEED Canada – EBOM 2009					30	3
LEED 2009 Healthcare					38	4
LEED 2009 Neighborhood Development					12	2
LEED Homes Multifamily Mid-Rise (2010)	45 – 59	60 – 74	75 - 89	90 - 136	45	4

It should be noted that the potential of TIOCOAT in directly contributing points in LEED is dependent on several factors such as building design, building type and climate zone. White roof energy savings are particularly influenced by climate zones. There is an available Roof Savings Calculator for residential and commercial buildings to assess the energy savings potential from cool roofs and this may be a helpful resource for such an analysis. The tool is available online at [www.RoofCalc.com](http://www.RoofCalc.com)<sup>1</sup>, Oak Ridge National Laboratory and Lawrence Berkeley National Laboratory developed the tool.

It is recommended that DuROCK more precisely determine the expected energy savings their product would earn for a range of different climate zones and building types, and keep an appropriately comprehensive set of case studies available for sales staff to reference as and when appropriate.

Lastly, because of the relationship Mindscape enjoys with [www.OntarioGreenSpec.ca](http://www.OntarioGreenSpec.ca), we have added your product into their listing database online under the category "Materials and Resources / Roofing / White Roofing". For additional membership benefits and promotional opportunities, please refer to [http://www.ontariogreenspec.ca/membership\\_rates\\_benefits](http://www.ontariogreenspec.ca/membership_rates_benefits). You may wish to consider promotional opportunities both there and in other online green databases such as U.S. based Greenspec® (see [www2.buildinggreen.com/about/gs-listing-process](http://www2.buildinggreen.com/about/gs-listing-process)).

## **APPENDIX A: ENERGY CREDIT TABLES**

**Table A.1: LEED 2009 NC, LEED 2009 NCS, LEED 2009 Canada-NC, and LEED 2009 NCR energy cost savings point threshold versus baseline ASHRAE 90.1-2007 Standard.**

New Buildings	Existing Building Renovations	Points
12%	8%	1
14%	10%	2
16%	12%	3
18%	14%	4
20%	16%	5
22%	18%	6
24%	20%	7
26%	22%	8
28%	24%	9
30%	26%	10
32%	28%	11
34%	30%	12
36%	32%	13
38%	34%	14
40%	36%	15
42%	38%	16
44%	40%	17
46%	42%	18
48%	44%	19

≈ 0.5 pts per  
1% energy savings

**Table A.2: LEED 2009 CS, LEED 2009 Canada-CS energy cost savings point threshold versus baseline ASHRAE 90.1-2007 Standard.**

New Buildings	Existing Building Renovations	Points
12%	8%	3
14%	10%	4
16%	12%	5
18%	14%	6
20%	16%	7
22%	18%	8
24%	20%	9
26%	22%	10
28%	24%	11
30%	26%	12
32%	28%	13
34%	30%	14
36%	32%	15
38%	34%	16
40%	36%	17
42%	38%	18
44%	40%	19
46%	42%	20
48%	44%	21

≈ 0.5 pts per  
1% energy savings

**Table A.3: LEED 2009 EBOM and LEED Canada EBOM 2009 energy performance point thresholds.**

Percentile level above the national median (for buildings not eligible for ENERGY STAR energy performance rating)	Points
21	1
23	2
24	3
25	4
26	5
27	6
28	7
29	8
30	9
31	10
32	11
33	12
35	13
37	14
39	15
41	16
43	17
45	18

≈ 0.75 pts per  
1% above national  
median

**Table A.4: LEED 2009 Healthcare energy cost savings point threshold versus baseline ASHRAE 90.1-2007 Standard.**

New Buildings	Existing Building Renovations	Points
12%	8%	1
14%	10%	2
16%	12%	3
18%	14%	5
20%	16%	7
22%	18%	9
24%	20%	11
26%	22%	13
28%	24%	14
30%	26%	15
32%	28%	16
34%	30%	17
36%	32%	18
38%	34%	19
40%	36%	20
42%	38%	21
44%	40%	22
46%	42%	23
48%	44%	24

≈ 0.67 pts per  
1% energy savings

**Table A.5: LEED for Homes Mid-Rise (2010) energy cost savings point threshold versus baseline ASHRAE 90.1-2007 Standard.**

Energy Cost Savings Above ASHRAE 90.1-2007	LEED for Homes Mid-Rise Points
15%	
16%	3
17%	4
18%	5
19%	6
20%	7
21%	8
22%	9
23%	10
24%	11
25%	12
26%	13
27%	14
28%	15
29%	16
30%	17
31%	18
32%	19
33%	20
34%	21
35%	22
36%	23
37%	24
38%	25
39%	26
40%	27
41%	28
42%	29
43%	30
44%	31
45%	32
46%	33
47%	34
48%	Maximum 34 Points Available
49%	
50%	

≈ 0.89 pts per 1% energy savings



## **APPENDIX B: RENEWABLE ENERGY CREDIT TABLES**

**Table B.1: LEED 2009 NC, LEED 2009 NCS, LEED Canada NC 2009, and LEED 2009 NCR renewable energy point thresholds.**

Percentage Renewable Energy	Points
1%	1
3%	2
5%	3
7%	4
9%	5
11%	6
13%	7

≈ 0.5 pts per  
1% RE energy

**Table B.2: LEED 2009 CS and LEED Canada CS 2009 renewable energy point thresholds.**

PERCENTAGE RENEWABLE ENERGY	POINTS
0.5%	2
1%	4

≈ 4 pts per 1% RE  
energy savings

**Table B.3: LEED 2009 EBOM and LEED Canada EBOM 2009 renewable energy point thresholds.**

On-site renewable energy		Off-site renewable energy certificates	Points
3%	or	25%	1
4.5%	or	37.5%	2
6%	or	50%	3
7.5%	or	62.5%	4
9%	or	75%	5
12%	or	100%	6

≈ 0.5 pts per 1%  
RE energy savings

**Table B.4: LEED 2009 HC renewable energy point thresholds.**

Percentage Renewable Energy	Points
1%	1
3%	2
10%	5
20%	6
30%	7
40%	8

≈ 0.2 pts per 1%  
RE energy savings

**Table B.5: LEED 2009 ND renewable energy point thresholds.**

Percentage of annual electrical and thermal energy cost	Points
5%	1
12.5%	2
20%	3

≈ 0.15 pts per 1%  
RE energy savings

**Table B.6: LEED for Homes Mid-Rise (2010) renewable energy point thresholds.**

Percentage of Renewable Energy	Points
3%	1
6%	2
9%	3
12%	4
15%	5
18%	6
21%	7
24%	8
27%	9
30%	10