TRANE

SUSTAINABLE BUILDING DESIGN

LEED® and HVAC

How Trane can help.

HVAC and LEED® 2009 BUILDING DESIGN AND CONSTRUCTION (BD+C)...

Building on its past success, the U.S. Green Building Council (USGBC), the nonprofit organization that developed the Leadership in Energy and Environmental Design (LEED) Green Building Rating System™, continues to gain momentum. As of August 2009, 35,000 projects are participating in the LEED system, comprising over 4.5 billion square feet of construction space in all 50 states and 91 countries. LEED Accredited Professionals (APs) has topped 131,000.

USGBC's LEED version 3 (v3)—includes LEED 2009[1], a new LEED accreditation and certification process, and LEED Online version 3. LEED 2009 for Green Building Design and Construction covers LEED for New Construction (NC), Core & Shell (CS), and Schools rating systems. This approach is to ensure consistency across different rating systems.

Highlights from LEED 2009:

- A new "bookshelf" concept was implemented. Each credit is a separate "book" and is the same for all applicable LEED rating systems. Each rating system consists of its own "bookshelf" of credits.
- Credit weighting was changed.
- New regional variations were introduced.
- In response to the marketplace, USGBC committed to a two-year development cycle, so the next changes will be LEED 2011. This provides stability to the marketplace, but still allows USGBC to respond rapidly when necessary.
- LEED now requires submission of actual energy and water use on an ongoing basis.

BUILDING CERTIFICATION...

The Green Building Certification Institute (GBCI), a new organization spun off from USGBC, began administering the building certification process in January 2009. GBCI concentrates on certification and USGBC focuses on development of the LEED products.

LEED 2009 RATING SYSTEM...

The USGBC identified energy efficiency and climate change as urgent priorities; the changing allocation of points among LEED credits reflects that shift. The re-weighting resulted in the redistribution of the available points in LEED so that a given credit's point value more accurately reflects its potential impact on the environment. For example, Energy and Atmosphere (EA) section is weighted as 25 percent of the total points in LEED version 2.2, but increased its importance to 35 percent of the total points in LEED 2009.

The new LEED 2009 rating system consists of 100 points. Thresholds required for certification are:

- Certified–40
- Silver – 50
- Gold – 60
- Platinum – 80

Additionally, there are 10 bonus points that can be used to help a project achieve its desired certification level:

- 5 bonus points for Innovation and Design,
- 4 bonus points for Regional Priority and
- 1 point for a LEED Accredited Professional as a member of the project team.

The relative value and weight of the top three categories (Sustainable Sites, Water Efficiency, and Energy and Atmosphere) comprises more than 70 percent of the 100 base points. What does this mean for the HVAC practitioner? More than ever, reduced energy consumption and a smaller carbon footprint will be at the forefront of all LEED building designs and projects. For more information on LEED 2009 changes, please refer to Trane Engineers Newsletter volume 38-1[2].

The intent of this document is to help you review LEED projects as they relate to Trane products, systems, and services. This document will:

- Highlight the LEED points that are impacted by HVAC equipment and systems.
- Provide suggestions on how to achieve LEED points through enhancements to the HVAC systems.

PREREQUISITE OR CREDIT...	HOW TRANE CAN HELP...
EAp1 Energy & Atmosphere Prerequisite 1 (EAp1): Fundamental Commissioning of the Building Energy Systems Intent: verify that the project's energy-related systems are installed, calibrated, and perform according to the owner's project requirements, basis of design, and construction documents.	Commissioning process activities need to be completed for the following energy-related systems, at a minimum: HVAC&R systems and associated controls, lighting and daylighting controls, domestic hot-water systems, and renewable energy systems. Follow the requirements outlined in USGBC's LEED Reference Guide for selecting the commissioning agent and for writing the owner's project requirements, basis of design, commissioning plan, commissioning specification, performance verification, and commissioning report. **How Trane can help:** Trane HVAC equipment is available with factory-mounted and factory-commissioned controls, which can significantly reduce the time required for on-site commissioning. Trane Performance Climate Changer and Custom Climate Changer air handlers, and many Trane chillers, can be witness-tested at the factory to verify performance. Trane's Tracer building automation system can help generate commissioning reports, log performance data, view trends, and gather alarms or diagnostic messages from the equipment-level controllers. This reduces the time required to collect data throughout the commissioning process. Finally, HVAC system commissioning is part of Trane's comprehensive solutions offering. To ensure consistency, Trane has created a building systems commissioning manual for use on projects where Trane performs the commissioning functions.
EAp2 EAp2: Minimum Energy Performance Intent: establish the minimum level of energy efficiency for the proposed building and systems. **Option 1: performance compliance path** • Mandatory provision (5.4, 6.4, 7.4, 8.4, 9.4, and 10.4) • Include all building energy cost • Baseline building complies with Appendix G Building Performance Rating Method • Proposed building:10% better than 90.1-2007 for new construction, 5% better for existing building **Option 2: prescriptive compliance path** • ASHRAE AEDG for small office buildings 2004 • ASHRAE AEDG for small retail buildings 2006 • ASHRAE AEDG for small warehouses and self-storage buildings 2008 **Option 3: prescriptive compliance path** Advanced Buildings Core Performance Guide	For new buildings using the performance compliance path (Option 1), the overall annual energy cost of the proposed building will need to be at least 10 percent less than that of a baseline building, as defined in Appendix G of ASHRAE Standard 90.1-2007. For major upgrades to existing buildings, the overall annual energy cost will need to be at least five percent less than the baseline building. Both regulated energy cost (lighting, HVAC, and service water heating) and process energy cost (miscellaneous equipment, computers, elevators and escalators, kitchen cooking and refrigeration, laundry washing and drying, special lighting, and others) must be included in the analysis. The ASHRAE 90.1-2007 User's Manual contains worksheets that can be used to document compliance. For Option 2 and 3, EAp2 offers two prescriptive compliance paths by following ASHRAE Advanced Energy Design Guides or the New Buildings Institute Advanced Buildings™ Core Performance Guide. **How Trane can help:** Trane offers a wide portfolio of energy-efficient equipment and control systems to meet the mandatory and prescriptive (or performance) requirements of ASHRAE Standard 90.1-2007. Trane's TRACE® 700 building energy and economic analysis software can be used to model the building in accordance with Appendix G of ASHRAE 90.1-2007. Trane also offers Advanced Engineering Support services to assist engineering firms or owners who are in need of building energy modeling for LEED compliance.

EAp3

EAp3: Fundamental Refrigerant Management

Intent: reduce ozone depletion.

Do not use CFC-based refrigerants in new HVAC&R systems. When reusing existing HVAC equipment, complete a comprehensive CFC phase-out conversion prior to project completion. Phase-out plans extending beyond the project completion date will be considered on their merits.

In new buildings, CFCs (such as CFC-11 and CFC-12) are prohibited from being used in HVAC&R equipment or systems. Note: This does not prohibit the use of HFCs (such as HFC-134a) or HCFCs (such as HCFC-22 or HCFC-123).

How Trane can help:
Trane equipment no longer uses CFC refrigerants.

For existing CFC equipment, Trane's R'newal service program can be used to convert the existing equipment to use a non-CFC refrigerant. Alternatively, many Trane chillers are designed to fit through standard doors, so they can be used to replace existing CFC chillers.

EAc1

Energy & Atmosphere Credit 1 (EAc1): Optimize Energy Cost (1-19 points)

Intent: achieve increasing levels of energy performance above the prerequisite standard.

Option 1: performance compliance path (1-19 points)
- Mandatory provision (5.4, 6.4, 7.4, 8.4, 9.4, and 10.4)
- Baseline building complies with Appendix G Building Performance Rating Method of ASHRAE 90.1-2007 (with errata but without addenda)
- Process energy cost is at least 25% of the total energy cost

Option 2: prescriptive compliance path (1 point)
- ASHRAE AEDG for small office buildings 2004
- ASHRAE AEDG for small retail buildings 2006
- ASHRAE AEDG for small warehouses and self-storage buildings 2008

Option 3: prescriptive compliance path
Advanced Buildings Core Performance Guide

For Option 1 in new buildings, overall annual energy cost savings of 12 percent less than a baseline building, as defined in Appendix G of ASHRAE Standard 90.1-2007, will achieve the first point for NC and Schools, and three points for CS. Beyond that, every additional two percent energy cost savings will achieve another point (up to the possible 19 points for NC and Schools, and 21 points for CS).

For Option 1 in a major renovation to an existing building, overall annual energy cost savings of eight percent will achieve the first point for NC and Schools, and three points for CS, and every additional two percent energy cost savings will achieve another point (up to the available 19 points for NC and Schools, and 21 points for CS).

The primary method for achieving EAc1 points is to conduct a whole-building energy simulation, following the requirements of the Performance Rating Method (Appendix G) in ASHRAE Standard 90.1-2007. The proposed building, including process energy loads, is modeled using computer software. The baseline building is then defined according to Appendix G. The proposed building energy cost is compared to the baseline building energy cost to determine the percentage savings and number of points achieved.

EAc1 offers two prescriptive compliance paths that can achieve up to three points. For building types and sizes that qualify for prescriptive compliance paths, the ASHRAE *Advanced Energy Design Guides* or the New Buildings Institute *Advanced Buildings™ Core Performance Guide* can be used, without the need to conduct a whole-building energy simulation.

To minimize building energy cost, designers should consider a holistic approach that accounts for the interaction of building orientation, envelope, construction method, and insulation with lighting and HVAC systems.

How Trane can help:
Trane offers a wide portfolio of energy-efficient equipment and control systems, as well as the system application expertise to help our customers "build green." For example, Trane CenTraVac® centrifugal chillers are 10 - 15 percent more efficient than other similar centrifugal chillers. Trane EarthWise™ chilled-water VAV systems can reduce HVAC energy use by as much as 30 percent through reducing the flow rates of conditioned air and chilled water.

New, high-efficient Trane direct-drive plenum fans eliminate fan belts and can save 5 - 20 percent of fan energy. Trane energy-recovery wheels can reduce ventilation costs by up to

Energy & Atmosphere Credit 1 (EAc1): Optimize Energy Cost
continued...

80 percent. Advanced dehumidification options, like the Trane CDQ™ (cool, dry, quiet) desiccant system, can save up to 30 percent over reheat systems. Trane-provided advanced low pressure filters can lower filter pressure drops by 60 percent.

Trane educational resources, such as *Engineers Newsletters, Engineers Newsletter Live* broadcasts, and application manuals, provide advice and best practices for various energy-saving strategies for airside systems, waterside systems, refrigeration systems, and controls.

TRACE 700 building energy and economic analysis software is widely used to model LEED buildings according to the requirements of the Performance Rating Method (Appendix G) in ASHRAE Standard 90.1-2007. TRACE can model various "green" strategies (such as daylighting, shading, optimized control sequences, and thermal storage) and simplifies the calculation process by automatically rotating the baseline building and generating a pre-formatted LEED compliance report. Trane also offers Advanced Engineering Support services to assist with modeling a building for energy simulation and LEED compliance.

The HVAC energy efficiency ideas presented above and more are summarized in Trane's HVAC Resource Guide[3].

EAc2: On-Site Renewable Energy (7 points)

Intent: encourage and recognize increasing levels of on-site renewable energy self-supply in order to reduce environmental and economic impacts associated with fossil fuel energy use.

Calculate project performance by expressing the energy produced by the renewable systems as a percentage of the building's annual energy cost. Use the building annual energy cost calculated for EAc1, or the U.S. Department of Energy's Commercial Buildings Energy Consumption Survey database, to determine the estimated electricity use.

Ground-source (geothermal) heat pump systems, using earth as a heat exchanger, do not qualify for EAc2. The geothermal (deep-earth water or steam) heating systems and geothermal electric systems may be eligible for this credit.

How Trane can help:
TRACE 700 building energy and economic analysis software can be used to model the baseline building according to the requirements of the Performance Rating Method (Appendix G) in ASHRAE Standard 90.1-2007.

Ingersoll Rand, the parent company of Trane, manufactures high-efficiency microturbines which generate on-site electricity. Ingersoll Rand microturbines provide an opportunity for facilities to economically generate their own clean, reliable power on site at the point of use. Microturbines produce high quality exhaust heat with extremely low emissions without post-combustion clean-up. When integrated with the internal cogeneration option, the exhaust heat can be captured into water for a wide variety of Combined Heat and Power (CHP) applications.

If a facility has access to a renewable fuel such as biogas, using it with an Ingersoll Rand microturbine to generate electricity can help meet facility loads or may qualify for export revenue in the form of credits, feed-in tariffs, or green energy certificates.

EAc3: Enhanced Commissioning (2 points)

Intent: begin the commissioning process early in the design process and execute additional activities after systems performance verification is completed.

To earn this point, the owner will need to hire a third party commissioning agent to perform additional commissioning tasks, including a design phase review, commissioning documentation review, development of a systems manual, and review of building operation 10 months after completion.

How Trane can help:
Trane HVAC equipment is available with factory-mounted and factory-commissioned controls, which can significantly reduce the time required for on-site commissioning. They also allow for ongoing monitoring of the equipment.

Trane's Tracer building automation system can help generate commissioning reports, log performance data, view trends, and gather alarms or diagnostic messages from the equipment-level controllers. This reduces the time required to collect data throughout the commissioning process.

Tracer Summit Energy Services™ software can monitor and store actual energy use over time, allowing building performance to be benchmarked and compared to the original design estimates.

Finally, HVAC system commissioning is part of Trane's comprehensive solutions offering. Trane can be the commissioning agent or part of the commissioning team. To ensure consistency, Trane has created a building systems commissioning manual for use on projects where Trane performs the commissioning functions.

EAc4: Enhanced Refrigerant Management (2 points)

Intent: reduce ozone depletion and support early compliance with the Montreal Protocol while minimizing direct contributions to climate change.

Avoid the use of refrigerants or limit the direct environmental impact of the refrigerants used.

No man-made refrigerant automatically achieves EAc4. To achieve this credit, one can either use no refrigerant on the project, or perform a calculation using properties and quantities of refrigerants installed in the equipment for the project. Achieving EAc4 depends on the global warming potential and ozone depletion potential of the refrigerant, and life of the equipment. The calculation procedure and required default values are included in the LEED Reference Guide.

For buildings with several pieces of equipment, there is a "weighted average" equation to evaluate the overall project. Because of the weighted-average equation, some refrigerants (such as HFC-410A) that may not earn this credit alone, may be used in combination with other equipment and still earn this credit.

Small HVAC units and other equipment (refrigerators, water coolers, etc.) with less than 0.5 lbs of refrigerant are not considered in the calculation for this credit.

How Trane can help:
Trane high-efficiency CenTraVac® chillers (with HCFC-123 refrigerant) have the lowest documented leakage rate (0.5%/year) which significantly reduces the environmental impact. This leakage rate has been approved by the USGBC in its administrative Credit Interpretation Ruling (CIR) to allow the selection of extremely efficient chillers to achieve EAc4. Note: As of Aug. 31, 2009, this CIR is in discussion on its applicability for all projects in USGBC. Project team can select the use of this CIR on its own discretion.

Many of Trane's products, such as centrifugal chillers, helical-rotary chillers, absorption chillers, packaged rooftops, water-source heat pumps (WSHP), and other unitary products, can meet the requirements of this credit. To aid in performing the calculations, a spreadsheet is available at www.trane.com/green

EAc5: Measurement & Verification (3 points for EA, 2 points for Schools)

Intent: provide for the ongoing accountability of building energy consumption over time.

Option 1:
- M&V plan consistent with Option D: Calibrated Simulation as specified in IPMVP Volume III
- M&V period must cover at least 1 year of post-construction occupancy
- Provide a process for corrective action if the energy savings are not being achieved

Option 2:
- M&V plan consistent with Option B: Energy Conservation Measure Isolation as specified in IPMVP Volume III
- M&V period must cover at least 1 year of post-construction occupancy
- Provide a process for corrective action if the energy savings are not being achieved

Option 1 uses the Calibrated Simulation approach described in the International Performance Measurement & Verification Protocol (IPMVP, Option D). This option is most suitable for buildings with a large number of Energy Conservation Measures (ECMs) or systems that are interactive, or where the building design is integrated and holistic, rendering isolation and M&V of individual ECMs impractical or inappropriate. It essentially requires comparing the actual energy use of the building and its systems with the performance predicted by a calibrated computer model.

Option 2 uses the Energy Conservation Measure Isolation approach described in the IPMVP (Option B). This option is suitable for smaller and/or simpler buildings that may be appropriately monitored by isolating the main energy systems on an individual basis. Projects following Option 2 may also need to implement whole-building metering and tracking to satisfy the intent of this credit.

How Trane can help:
TRACE 700 building energy and economic analysis software can be used to create the calibrated building model for Option 1.

Trane's Tracer building automation system can log data and view performance trends over time. Tracer Summit Energy Services software can monitor and store the actual energy use over time, allowing the building performance to be benchmarked and compared to the calibrated model estimates.

Sensors and controls on Trane equipment provide ongoing feedback on performance, communicating with the Trane Tracer building automation system. For example, Piezometers provide accurate measurement of fan airflow in Trane air handlers, and Traq™ dampers are available on several air-handler and rooftop models to accurately measure and control outdoor airflow.

EAc6

EAc6: Green Power (2 points)

Intent: encourage the development and use of grid-source, renewable energy technologies on a net-zero pollution basis.

Engage in at least a two-year renewable energy contract to provide at least 35 percent of the building's electricity from renewable sources, as defined by the Center for Resource Solutions' Green-e Energy product certification requirements.

All purchases of green power shall be based on the quantity of energy consumed, not the cost.

Use the building annual electricity consumption calculated from EAc1, or the U.S. Department of Energy's Commercial Buildings Energy Consumption Survey database to determine the estimated building electricity use.

How Trane can help:
TRACE 700 building energy and economic analysis software can be used to model the baseline building according to the requirements of the Performance Rating Method (Appendix G) in ASHRAE Standard 90.1-2007.

IEQp1

Indoor Environmental Quality Prerequisite 1 (IEQp1): Minimum IAQ Performance

Intent: establish minimum indoor air quality (IAQ) performance to enhance indoor air quality in buildings, thus contributing to the comfort and well-being of the occupants.

The building must comply with Sections 4 through 7 of ASHRAE Standard 62.1-2007, *Ventilation for Acceptable Indoor Air Quality* (with errata but without addenda). Mechanical ventilation systems shall be designed using the Ventilation Rate Procedure (not the IAQ Procedure) or the applicable local code, whichever is more stringent. For naturally ventilated spaces, ASHRAE Standard 62.1-2007, Paragraph 5.1 (with errata but without addenda) is used.

How Trane can help:
TRACE 700 building energy and economic analysis software can be used to perform the calculations prescribed by the ASHRAE 62.1 Ventilation Rate Procedure (VRP). Several Trane *Engineers Newsletters*, and an *Engineers Newsletter Live* broadcast walk through the details of the VRP calculations.

Most Trane airside products and systems meet the requirements in Section 5 of ASHRAE 62.1-2007. For VAV systems, the ventilation optimization algorithm in Trane's Tracer building automation system can dynamically recalculate the required system-level intake airflow as operating conditions change, properly ventilating the building without using energy to condition excess outdoor air. Trane Traq dampers are available on several air-handler and rooftop models to accurately measure and control outdoor airflow entering the system.

One of the requirements of ASHRAE Standard 62.1 is to design the HVAC system so that indoor relative humidity (RH) does not exceed 65 percent when performance is analyzed at design dew point conditions. Conventional, constant-volume DX systems may not meet this requirement without some enhancement to the system or the use of a dedicated outdoor-air system. Trane equipment is available with a wide range of dehumidification enhancements, from hot-gas reheat on packaged rooftop units and water-source or ground-source heat pumps to the Trane CDQ™ (cool, dry, quiet) desiccant system in air handlers.

IEQp2: Environmental Tobacco Smoke (ETS) Control

Intent: minimize exposure of building occupants, indoor surfaces, and ventilation air distribution systems to Environmental Tobacco Smoke (ETS).

Prohibit smoking in the building and designate outdoor smoking areas at least 25 ft away from entries, outdoor-air intakes, and operable windows. If the building will include smoking rooms, they must be designed to contain, capture and remove ETS from the building (impermeable deck-to-deck partitions, local exhaust to maintain a negative pressure differential with the surrounding spaces, testing and verification of pressure controls when the doors to the smoking rooms are closed). Refer to the LEED Reference Guide for additional requirements for residential and hospitality projects.

How Trane can help:
Trane's Tracer building automation system can operate the HVAC systems according to the specific pressure differential requirement. Trending or Tracer Summit Energy Services can help verify pressure differential between spaces and exhaust airflow rates.

IEQp3: Minimum Acoustical Performance (Schools)

Intent: provide quiet classrooms so that teachers can speak to the class without straining their voices and students can effectively communicate with each other and the teacher.

Design classrooms and other core learning spaces as specified in ANSI Standard S12.60-2002, *Acoustical Performance Criteria, Design Requirements and Guidelines for Schools*. Achieve a maximum background noise level from HVAC systems in classrooms and other core learning spaces of 45 dBA. For classrooms and core learning spaces less than 20,000 sq ft, all of the ceiling area or other acoustical finishes that equal or exceed the total ceiling area of all classroom and core learning spaces must have an NRC of 0.70 or higher materials. For spaces larger than 20,000 sq ft, the calculation will be based on ANSI Standard S12.60-2002 with a reverberation time of 1.5 seconds or less.

How Trane can help:
VariTrane VAV terminals, water-source heat pumps, and fan-coils can be installed above the corridor or other non-classroom space to limit airborne and breakout sound. Also, applying optional attenuators can be an effective sound-reduction strategy.

Air-handling units or larger terminal equipment (including water-source or ground-source heat pumps) can be located in a remote mechanical room to limit sound transmission. In addition, installing isolation rails or special roof curbs can reduce sound transmission from roof-mounted equipment.

Acoustical analysis software, such as the Trane Acoustics Program (TAP™), can help to accurately predict and compare system sound levels. TAP can quickly compare the sound characteristics of several system alternatives and choose the one that best satisfies the design criteria.

IEQc1

Indoor Environmental Quality Credit 1 (IEQc1): Outdoor Air Delivery Monitoring (1 point)

Intent: provide capacity for ventilation system monitoring to help promote occupant comfort and well-being.

Monitor carbon dioxide (CO_2) concentrations in each densely-occupied space (greater than or equal to 25 people per 1000 sq ft). CO_2 sensors must be installed between 3 and 6 feet above the floor.

For each mechanical ventilation system, in which at least 20 percent of the design minimum outdoor airflow serves non-densely occupied spaces, provide a direct outdoor airflow measurement device capable of measuring the minimum outdoor airflow rate with an accuracy of plus or minus 15 percent of the design minimum outdoor airflow rate, as defined by ASHRAE Standard 62.1-2007.

How Trane can help:
For single-zone systems, Trane offers a variety of equipment that can be equipped with a CO_2 sensor to monitor the carbon-dioxide concentration in the space.

For VAV systems, the ventilation optimization algorithms in Trane's Tracer building automation system combine demand-controlled ventilation at the zone level (using a CO_2 sensor in each densely-occupied zone) with ventilation reset control at the system level to dynamically recalculate the required intake airflow based on current operating conditions.

Trane Traq airflow-measuring dampers are available in several air handler and rooftop models to both modulate and measure intake airflow. Traq dampers are factory-mounted, low-leak dampers that use industry-proven, flow-ring technology to measure outdoor airflow within the accuracy required by IEQc1.

In addition, Trane's Tracer building automation system can monitor CO_2 sensors and measure intake airflow to provide performance trends over time.

IEQc2

IEQc2: Increased Ventilation (1 point)

Intent: provide additional outdoor air ventilation to improve indoor air quality for improved occupant comfort, well-being and productivity.

Increase breathing zone outdoor air ventilation rates to all occupied spaces by at least 30 percent above the minimum rates required by ASHRAE Standard 62.1-2007 (with errata but without addenda) as determined by IEQp1.

For mechanical ventilation systems, consider using exhaust-air energy recovery to minimize the impact of this additional outdoor air on equipment capacity and energy consumption. For naturally-ventilated spaces, refer to LEED Reference Guide for details.

How Trane can help:
Increasing the ventilation rate by 30 percent is an owner's decision. Trane's TRACE 700 building energy and economic analysis software can be used to determine the impact of increased ventilation on equipment capacity and energy consumption.

Several Trane air handler and packaged rooftop models (such as M-Series™, T-Series™ and Custom Climate Changers®, IntelliPak®, Voyager™, and Precedent™ rooftop units, and classroom unit ventilators) are available with exhaust-air energy recovery options. Trane energy-recovery wheels can reduce ventilation costs by up to 80 percent, reducing the impact of the additional outdoor air on equipment size and energy use.

For VAV systems, the ventilation optimization algorithms in Trane's Tracer building automation system combines demand-controlled ventilation at the zone level (using CO_2 sensors, occupancy sensors, or time-of-day schedules) with ventilation reset control at the system level to dynamically recalculate the required intake airflow as operating conditions change, minimizing the energy used to condition outdoor air for ventilation.

IEQc3.1

IEQc3.1: Construction IAQ Management Plan: During Construction (1 point) (referred as IEQc3 in CS)

Intent: reduce indoor air quality problems resulting from construction or renovation and promote the comfort and well-being of construction workers and building occupants.

During construction, meet or exceed the recommended control measures of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) *IAQ Guidelines For Occupied Buildings Under Construction*, 2nd Edition 2007, ANSI/SMACNA 008-2008 (Chapter 3).

Protect stored on-site and installed absorptive materials from moisture damage.

If permanently installed air handlers are used during construction, filtration media with a Minimum Efficiency Reporting Value (MERV) of at least 8, as determined by ASHRAE Standard 52.2-1999 (with errata but without addenda), must be used at each return-air grille. Replace all filtration media immediately prior to occupancy.

How Trane can help:
Trane offers a variety of air handlers, packaged rooftop units, and terminal equipment that can be equipped with a MERV 8 filter.

IEQc3.2

IEQc3.2: Construction IAQ Management Plan: Before Occupancy (1 point)

Intent: reduce indoor air quality problems resulting from the construction or renovation to promote the comfort and well-being of construction workers and building occupants.

Develop and implement a (IAQ) management plan after all finishes have been installed and the building has been completely cleaned before occupancy. Flushing out or air testing the building are two options to earn this point. It does not matter if the building is occupied during the flush-out period. The total volume of 14,000 cubic feet of outdoor air per square foot of floor area is required.

How Trane can help:
Trane's Tracer building automation system can be used to coordinate the flush out of the building with required total air volume.

IEQc4.1-4.2

IEQc4.1-4.2: Low-Emitting Materials (2 points)

Intent: reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.

IEQc4.1 (adhesives and sealants) and IEQc4.2 (paints and coatings) place limits on the volatile organic compounds (VOCs) emitted by adhesives, sealants, paints, and coatings.

However, the rating system explicitly states that adhesives, sealants, paint, or coatings that are "used on the interior of the building (defined as inside of the weatherproofing system and applied on-site)" shall comply with the requirements.

Mechanical and electrical systems normally have these components applied before leaving the factory (rather than on-site), so they are excluded from these requirements. However, any insulating materials that are applied on-site will need to comply with these requirements.

How Trane can help:
All adhesives, sealants, paints, and coatings on Trane mechanical and electric components are (or can be) applied in the factory. Therefore, they would be excluded from these requirements.

IEQc5

IEQc5: Indoor Chemical & Pollutant Source Control (1 point)

Intent: minimize building occupants exposure to potentially hazardous particulates and chemical pollutants.

Employ permanent entryway systems at least 10 feet long in the primary direction of travel. Sufficiently exhaust each space where hazardous gases or chemicals may be present or used to create negative pressure with respect to adjacent spaces when the doors to the room are closed. And, provide containment for appropriate disposal of hazardous liquid wastes.

Prior to occupancy in mechanically-ventilated buildings, provide regularly occupied areas of the building with air-filtration media that meets a Minimum Efficiency Reporting Value (MERV) of 13 or better. Filtration should be applied to process both return and outside air that is delivered as supply air.

How Trane can help:
Trane offers a variety of air handlers and packaged rooftop units that can be equipped with a MERV 13 filter. In addition water-source heat pumps and some terminal equipment can be used with a duct-mounted filter rack with a MERV 13 filter.

Trane controllers can monitor the pressure drop across the filter and the Tracer building automation system can notify building maintenance personnel when changing filters is necessary.

The Trane Catalytic Air Cleaning System includes a minimum MERV 13 filter that would help qualify for this credit.

IEQc6.1

IEQc6.1: Controllability of Systems: Lighting (1 point)

Intent: provide a high level of lighting system control by individual occupants or groups in multi-occupant spaces (e.g., classrooms and conference areas) and promote their productivity, comfort and well-being.

Provide individual lighting controls for 90 percent (minimum) of the building occupants to enable adjustments to suit individual task needs and preferences.

AND

Provide lighting system controls for all shared multi-occupant spaces to enable adjustments to meet group needs and preferences.

The lighting controls in the administrative offices and other regularly-occupied spaces in schools use the same requirement in LEED for New Construction. In addition, the classrooms in schools require a lighting system to operate in at least two modes: general illumination and A/V.

How Trane can help:
Trane's Tracer building automation system can help provide lighting system controls to the satisfaction of the individual or multi-occupant spaces according to LEED requirements.

IEQc6.2

IEQc6.2: Controllability of Systems: Thermal Comfort (1 point)

Intent: provide a high level of thermal comfort system control by individual occupants or by specific groups in multi-occupant spaces (i.e. classrooms or conference areas) to promote the productivity, comfort and well-being of building occupants.

Provide individual comfort controls for 50% (minimum) of the building occupants to enable adjustments to meet individual task needs and preferences. Operable windows will need to meet ASHRAE 62.1-2007 paragraph 5.1 Natural Ventilation requirements.

AND

Provide comfort system controls for all shared multi-occupant spaces to enable adjustments that meet group needs and preferences.

ASHRAE Standard 55-2004 describes the primary factors (air temperature, radiant temperature, air speed, and humidity) that affect thermal comfort. For the purpose of IEQc6.2, comfort system control is defined as a provision to control at least one of these primary factors in the occupant's local environment.

At least 50 percent of the individually-occupied spaces (such as private offices, open plan work-stations, reception stations, ticket booths, etc.) will need to have at least one means of individual control over thermal comfort.

CS projects that do not purchase and/or install the mechanical system or operable windows (or a combination of both) have not met the intent of this credit.

How Trane can help:
Trane terminal products (such as VAV terminals, fan coils, unit ventilators, or water-source heat pumps), along with the Tracer building automation system, can help provide comfort to individual or multi-occupant spaces.

IEQc7.1

IEQc7.1: Thermal Comfort: Design (1 point)

Intent: provide a comfortable thermal environment that promotes occupant productivity and well-being.

Design HVAC systems and the building envelope to meet the requirements of ASHRAE Standard 55-2004, *Thermal Comfort Conditions for Human Occupancy*.

Project teams need to describe how thermal comfort conditions were established for the project and how the design of the HVAC systems address the thermal comfort design criteria.

The core-and-shell base building mechanical system must allow for the tenant buildout to meet the requirements of this credit. Project teams that design their project for mechanical ventilation and do not purchase or install the mechanical system are not eligible to achieve this credit.

How Trane can help:
Trane equipment, along with the Tracer building automation system, can help provide comfort to the individual or multi-occupant spaces.

One of the primary factors affecting thermal comfort is humidity. Trane equipment is available with a wide range of dehumidification enhancements, from hot-gas reheat on packaged rooftop units and water-source or ground-source heat pumps, to the Trane CDQ™ desiccant system in air handlers.

Trane's Tracer building automation system can take advantage of any thermal mass in the building to save energy and improve comfort by cooling down the mass before occupancy.

IEQc8.1

IEQc8.1: Daylight and Views - Daylight (1 point for NC and CS, 1-3 points for Schools)

Intent: provide for the building occupants with a connection between indoor spaces and the outdoors through the introduction of daylight and views into the regularly occupied areas of the building.

There are four options in gaining this daylight credit including simulation, prescriptive, measurement, and combination.

Demonstrate through computer simulations that 75 percent (NC, Schools & CS) or 90 percent (Schools Only) or more of all regularly-occupied spaces achieve daylight illuminance levels of a minimum of 25 footcandles (fc) and a maximum of 500 fc in a clear sky condition on September 21 at 9 a.m. and 3 p.m.

How Trane can help:
Trane's TRACE 700 building energy and economic analysis software can be used to model daylighting and demonstrate that a prescribed minimum daylight illumination level of 25 fc exists in 75 percent or more of all regularly-occupied spaces.

IEQc9

IEQc9: Enhanced Acoustical Performance (1 point for Schools)

Intent: provide classrooms that facilitate better teacher-to-student and student-to-student communications through effective acoustical design.

Design the building shell, classroom partitions, and other core learning space partitions as specified in Sound Transmission Class requirements of ANSI Standard S12.60-2002, *Acoustical Performance Criteria, Design Requirements and Guidelines for Schools*, except windows, which must meet a STC rating of at least 35. And, achieve a maximum background noise level from HVAC systems in classrooms and other core learning spaces below 40 dBA.

How Trane can help:
VariTrane VAV terminals, water-source and ground-source heat pumps, and fan-coils can be installed above the corridor or other non-classroom space to limit airborne and duct breakout sound. Also, applying optional attenuators can be an effective sound reduction strategy.

Air-handling units or larger terminal equipment (including water-source or ground-source heat pumps) can be located in a remote mechanical room to limit sound transmission. In addition, isolation rails or special roof curbs can reduce the sound transmission from roof-mounted equipment. Trane direct-drive plenum fans eliminate fan belts and can improve acoustics performance.

Acoustical analysis software, such as the Trane Acoustics Program (TAP™), can make it easy to accurately predict and compare system sound levels. TAP can quickly compare the sound characteristics of several system alternatives and choose the one that best satisfies the design criteria.

IEQc10: Mold Prevention (1 point for Schools)

Intent: reduce the potential presence of mold in schools through preventive design and construction measures.

Project teams must achieve the following credits in order to receive this point:

IEQ Credit 3.1: Construction Indoor Air Quality Management Plan—During Construction
IEQ Credit 7.1: Thermal Comfort—Compliance
IEQ Credit 7.2: Thermal Comfort—Verification

Provide HVAC systems and controls designed to limit space relative humidity to 60 percent or less during all load conditions, both occupied and unoccupied.

Develop and implement, on an ongoing basis, an IAQ management program for buildings based on the U.S. Environmental Protection Agency (EPA) document; *Building Air Quality: A Guide for Building Owners and Facility Managers*, EPA reference number 402-F-91-102, December 1991.

How Trane can help:
VAV systems and water-source heat pump (WSHP) systems with a hot-gas reheat option provide inherent control of humidity due to supply-air temperatures being maintained at or near 55°F. This is ideal for schools because it is a passive or "built-in" benefit of VAV system design.

Trane equipment is available with a wide range of dehumidification enhancements, from hot-gas reheat on packaged rooftop units and WSHPs to the Trane CDQ™ desiccant system to improve thermal comfort conditions.

IDc1: Innovation in Design (1-5 points for NC and CS, 1-4 points for Schools)

Intent: provide design teams and projects the opportunity to achieve exceptional performance above the requirements set by the LEED Green Building Rating System and/or innovative performance in Green Building categories not specifically addressed by the LEED Green Building Rating System.

An Innovation and Design Catalog is posted on the USGBC website providing the project team innovation ideas that have been used on previous projects (http://www.usgbc.org/ShowFile.aspx?DocumentID=3569)

How Trane can help:
A documented innovation example in USGBC's Innovation and Design Catalog is to use flat screen monitors to reduce non-regulated load with productivity improvements and life-cycle benefits.

Another innovation design idea is to use EarthWise™ System design concepts. EarthWise Systems, low-flow, low temperature, and high-efficiency design concepts are similar to traditional system designs, with several notable differences. EarthWise Systems use low supply temperatures and a larger temperature differential. This results in lower flow rates, which inherently can reduce the size of the supply fans, ductwork, pumps, piping, and other HVAC equipment. It provides an opportunity to reduce the first-cost investment in the system infrastructure with reduced operating costs. Drier air created by a low airflow design not only provides a comfortable space humidity but also allows for higher space temperature setpoints. The EarthWise System space temperature setpoint can be 76°-77°F and still provide the same comfort level as the normal 75°F. This integrated design approach will impact at least three LEED categories; energy (EA), materials (MR) and indoor environmental quality (IEQ).

To demonstrate the innovative design, the project can provide the lifecycle cost analysis using a comprehensive system simulation program to evaluate economic and environmental impact for different system options. Provide the evidence of acoustics improvement as an additional benefit.

IDc2: LEED Accredited Professional (1 point)

Intent: support and encourage the design integration required by LEED to streamline the application and certification process.

At least one principal participant of the project team shall be a LEED Accredited Professional.

How Trane can help:
Trane has the highest number of LEED APs in the HVAC industry who are ready to assist you in your LEED projects.

IDc3: The school as a teaching tool (1 point for Schools)

Intent: integrate the sustainable features of a school facility with the school's educational mission.

Design a curriculum based on the high-performance features of the building, and commit to implementing the curriculum within 10 months of LEED certification. The curriculum should not only describe the features themselves, but explore the relationship between human ecology, natural ecology and the building. Curriculum must meet local or state curriculum standards, be approved by school administrators and provide 10 or more hours of classroom instruction per year, per full-time student.

How Trane can help:
Here are examples of learning opportunities that HVAC systems can provide:

Prominently displayed meters for measuring the impact of high-performance features, such as water-use reduction or energy reduction, can be checked by students on a daily, weekly, and seasonal basis. Trane's Tracer building automation system can log water and energy data and view performance trends over time. Trane can also provide 3D graphics to enrich the visual display of the content to enhance learning.

For school projects with a Tracer building automation system installed, the Trane Education Dash Board, an interactive tool, educates students on their impact on energy and the environment, and provides teachers with an integrated curriculum guide. The Education Dash Board can also assist facilities management efforts to reduce operating spending through controlling, monitoring and tracking implemented energy initiatives.

Visual and/or physical access to building infrastructure (e.g., HVAC equipment) can be viewed through windows in halls or integrated into the structure of the building. Students can track the performance of these systems based on outside weather conditions.

RPc1

RPc1: Regional Priority (1-4 points)

Intent: provide an incentive for the achievement of credits that address geographically specific environmental priorities.

Earn one to four of the six Regional Priority credits identified by the USGBC regional councils and chapters as having environmental importance for a project's region. A database of Regional Priority credits and their geographic applicability is available on the USGBC website: http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1984

One point is awarded for each Regional Priority credit achieved; no more than four credits identified as Regional Priority credits may be earned. Projects outside of the U.S. are not eligible for Regional Priority credits.

How Trane can help:
Trane is working with many regional chapters to determine regional priorities. Many of these regional priorities are related to energy, water, or indoor environmental quality issues.

WEp1

WEp1: Water Use Reduction (required)

Intent: increase water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems.

Employ strategies that, in aggregate, use 20 percent less water than the water use baseline calculated for the building (not including irrigation).

Calculate the baseline according to the commercial and/or residential baselines. Calculations are based on estimated occupant usage and must include only the following fixtures and fittings: water closets, urinals, lavatory faucets, showers, kitchen sink faucets and pre-rinse spray valves. Water used by the HVAC system is not included in this calculation. The calculated water use reduction for the project is the difference between the calculated design case and a baseline case. The percentage is determined by dividing the design case use by the baseline use.

How Trane can help:
Collecting condensate water from cooling coils, for use in the fixtures listed above, will reduce the quantity of potable water used.

TRACE 700 building energy and economic analysis software can be used to estimate the volume of condensate produced by the cooling coils over the course of a year. This condensate water can be pumped into the gray water system. Trane's Tracer building automation system and/or Tracer Summit Energy Services software can be use to track water usage.

WEc1

WEc1: Water Efficient Landscape (2-4 points)

Intent: limit or eliminate the use of potable water or other natural surface or subsurface water resources available on or near the project site for landscape irrigation.

OPTION 1: Reduce by 50%
(2 points)
OPTION 2: No Potable Water Use or Irrigation
(4 points)

To earn the first two points (Option 1), the project must reduce potable water used for irrigation by 50 percent from a calculated midsummer baseline. To earn all four points (Option 2), the project must use no potable water for irrigation. One approach is to use non-potable water (such as collected rainwater, recycled wastewater, or collected condensate water) for irrigation. Another approach is to install landscaping that does not require permanent irrigation systems.

How Trane can help:
Collecting condensate water from cooling coils to be used for irrigation will reduce the quantity of potable water used.

TRACE 700 building energy and economic analysis software can be used to estimate the volume of condensate produced by the cooling coils over the course of a year.

Trane's Tracer building automation system and/or Tracer Summit Energy Services software can be use to track potable and non-potable water usage.

WEc3

WEc3: Water Use Reduction (2-4 points)

Intent: further increase water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems.

Employ strategies that in aggregate use 30, 35, or 40 percent less water than the water use baseline calculated for the building (not including irrigation).

Calculate the baseline according to the commercial and/or residential baselines. Calculations are based on estimated occupant usage and must include only the following fixtures and fittings: water closets, urinals, lavatory faucets, showers, kitchen sink faucets and pre-rinse spray valves. Water used by the HVAC system is not included in this calculation. The calculated water use reduction for the project is the difference between the calculated design case and a baseline case. The percentage is determined by dividing the design case use by the baseline use.

How Trane can help:
Collecting condensate water from cooling coils, for use in the fixtures listed above, will reduce the use of water.

TRACE 700 building energy and economic analysis software can be used to estimate the volume of condensate produced by the cooling coils over the course of a year. This condensate water can be pumped into the gray water system and/or cooling tower. Typical cooling tower make-up water requires chemical treatment to reduce the mineral concentration, water softening, pH adjusting, etc. As pure water collected through cooling coils, the requirement for chemical treatment can be reduced.

Trane's Tracer building automation system and/or Tracer Summit Energy Services software can be use to track water usage.

TRANE'S COMMITMENT...

Trane, as a key member of the U.S. Green Building Council, is a strong supporter of the Leadership in Energy & Environmental Design (LEED) with over 600 LEED APs on staff, six registered LEED buildings and one certified LEED building.

We believe that sustainable construction and reduced environmental impact are simply good business and wise ways to safeguard people, our planet and profits. Trane continues to demonstrate its commitment to the high performance, high-efficiency and sustainable building movement through innovative products, controls, systems, services, and green building industry involvement.

Our active role with the USGBC LEED rating systems coupled with our leadership in ASHRAE technical committees reinforces our commitment to the development of present and future building standards that support green initiatives worldwide. Our involvement helps us remain at the forefront of knowledge and understanding of LEED requirements allowing us to keep you informed as you develop green building targets.

Many local Trane sales offices are also aligned with local USGBC chapters to better serve building owners. Contact your local Trane representatives for LEED-related questions and updates.

References

[1] U.S. Green Building Council (USGBC). (2009). LEED 2009 Green Building Rating System. Retrieved Aug. 15, 2009 from the World Wide Web: http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1971

[2] Schwedler, M. 2009. "Green progress, change for the better, LEED® 2009". Trane Engineers Newsletter. Vol. 38-1.

[3] Trane, 2009 "HVAC Resource Guide", ENV-SLB002-EN.

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www.trane.com/LEED

Contact local Trane representatives for LEED related questions and updates or visit www.trane.com/LEED.

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For more information, contact your local Trane office or e-mail us at comfort@trane.com