

top ten frequently asked questions (FAQ) on LEED® and HVAC

Buildings are some of the largest consumers of natural resources and largest generators of carbon emissions. According to the U.S. Green Building Council (USGBC), each year, buildings are responsible for 39 percent of CO₂ emissions in the U.S. and 36 percent of greenhouse gas emissions worldwide. Buildings also consume 70 percent of U.S. electricity; use 15 trillion gallons of water; and consume 40 percent of raw materials globally. This significant impact of buildings on the environment means that buildings can also be a significant part of the solution: Green buildings use 36 percent less energy than conventional buildings, and reduce CO₂ emissions by 30 to 50 percent.

USGBC is a non-profit organization devoted to shifting the building industry towards sustainability (see page 2 inset), targeting how buildings are designed, built and operated. USGBC is best known for its development of the Leadership in Energy and Environmental Design (LEED) green building rating system.

USGBC's LEED program

LEED, one of the most practiced green building rating system in the U.S., promotes a whole-building approach to sustainability by recognizing performance in six key areas: sustainable sites (SS), water efficiency (WE), energy & atmosphere (EA), materials & resources (MR), indoor environmental quality (EQ), and innovation & design process (ID). There are four levels of LEED certification. Applicants must meet prerequisites and accumulate credit points for various design elements of the building

to reach a specific level of certification. A project can achieve certification by meeting at least 40 percent of the total possible points.

A challenge to building professionals was set in November of 2006 by Rick Fedrizzi, president, CEO and founding chairman of USGBC "10,000 LEED buildings and 1 million LEED homes by 2010; 1 million LEED buildings and 10 million LEED homes by 2020."^[1]

With these ambitious goals, USGBC made several improvements to the LEED certification process, most notably a LEED online submission tool to speed up the certification process. One thing is certain Trane is seeing more projects interested in LEED and more questions on how HVAC systems (modeling, equipment efficiency level, refrigerant, installation, commissioning, and controls) can help achieve LEED points. The following are the top ten questions.

Q1: I do not keep up with different LEED products and revisions. Could you please review them and point out the differences? The differences between the various LEED products are explained in Table 1.

Three previous *Engineers Newsletters* have addressed LEED related topics (available at www.trane.com/engineersnewsletter).

- EN32-3 introduced many different energy and environmental organizations.
- EN34-2 discussed refrigerant selection.
- EN34-3 demonstrated how EAc1 credit points can be obtained through energy modeling in compliance with ASHRAE Standard 90.1-2004.

What's New in LEED?

- Two mandatory points needed for EAc1— optimize energy performance. LEED has set a higher standard for building energy efficiency. As of June 26, 2007, all projects certified under LEED-NC (new construction and major renovations) must achieve a minimum of two points under EA credit 1, which means they must reduce overall energy cost by at least 14 percent. This does not mean that every piece of equipment must be at least 14 percent more efficient— rather, it means that the overall building energy cost needs to be at least 14 percent less than 90.1-2004. Improvements to the building envelope and more efficient lighting systems, for example, reduce building load and also help reduce HVAC energy cost. This type of holistic, integrated approach, coupled with optimized control strategies, can help the designer achieve this goal.

For the other LEED products, a minimum of two EAc1 points are also mandatory. For a building to receive LEED-EB (existing buildings or high performance operation) certification, for example, the Energy Star score must be at least 67.^[2]

- Acoustic performance has been incorporated into the new *LEED for Schools* rating system to enhance student learning and communication. A room noise level of 45 dBA is a prerequisite, 40 dBA is needed to achieve one EQc9 — enhanced acoustical performance point, and 35 dBA is needed to achieve two EQc9 points.
- *LEED for Homes* is the newest rating system, now published and available for use.
- *LEED for Neighborhood Development (ND)* is in pilot mode. Currently there are a lot of ND pilot projects in the pipeline.
- *LEED for Health Care* is also being developed, with a focus on those aspects particular to hospitals and the healthcare market.

Table 1. Overview of LEED rating products

LEED rating product		Targeted projects			Rating levels (points required)		When to use it for building certification
Identifier	Current version, (status)	Type	Applicability	Target audience			
LEED-NC	Version 2.2	New construction, major renovations	Construction affects > 50% of occupants	Owners	Certified (26-32 pt) Silver (33-38 pt) Gold (39-51 pt) Platinum (52-69 pt)		One-time event with option to recertify ongoing building performance under LEED-EB
LEED-EB (under name High Performance Operation)	Version 2.0 (under 2nd public comment period)	Existing buildings	Construction affects < 50% of occupants	Owners	Certified (32-39 pt) Silver (40-47 pt) Gold (48-63 pt) Platinum (64-85 pt)		Initial certification of existing buildings, which lasts 5 years Ongoing recertification of buildings already certified under LEED-NC or -EB ^a
LEED-CI	Version 2.0	Commercial interiors	Tenant spaces in office, retail, and institutional buildings	Tenants, designers	Certified (21-26 pt) Silver (27-31 pt) Gold (32-41 pt) Platinum (42-57 pt)		One-time event
LEED-CS	Version 2.0	Core and shell	Building core, shell, and site selection; excludes tenant fit-out	Developers, designers	Certified (23-27 pt) Silver (28-33 pt) Gold (34-44 pt) Platinum (45-61 pt)		New buildings address sustainable design for new core and shell construction. Pre-certification is unique to LEED-CS providing the owner/ developer with the ability to market to potential tenants and financiers
LEED-ND	Version 1.0 (pilot)	Neighborhood development	Urban revitalization, neighborhood/ community planning	Developers, consumers, policymakers	Certified (40-49 pt) Silver (50-59 pt) Gold (60-79 pt) Platinum (80-106 pt)		LEED-ND integrates the principles of smart growth, new urbanism, and green building together in one standard
LEED-H	Version 1.11a (pilot)	Homes	Residential dwellings	Owners, developers	Certified (45-59 pt) Silver (60-74 pt) Gold (75-89 pt) Platinum (90-128 pt)		The pilot LEED for Homes is open to participating LEED for Homes Providers - who were chosen by USGBC. Targeted rollout Greenbuild 2007 conference.
LEED for Schools	Version 2007	Schools new construction and major renovations	New construction and major renovations projects in K-12 educational spaces.	School district officials, designers	Certified (29-36 pt) Silver (37-43 pt) Gold (44-57 pt) Platinum (58-79 pt)		LEED for Schools addresses issues such as classroom acoustics, master planning, mold prevention, and environmental site assessment.
LEED for Retail	Version 2 (pilot)	Retail new construction and major renovations	New construction and major renovations projects in retail spaces.	Retailers, developers, designers	Certified (26-32 pt) Silver (33-38 pt) Gold (39-51 pt) Platinum (52-70 pt)		Address the specific needs of retail spaces including daylighting, sites, security, energy and water concerns.

^a To maintain LEED-EB certification, a recertification application must be filed at least once every 5 years; however, tying recertification to annual performance reviews, annual budget planning, or space leasing contracts can enable more timely improvement of building upgrades, operations, and maintenance programs.

Q2: I heard that ASHRAE 90.1-2004 is a prerequisite of LEED. What aspects of the HVAC system are required by ASHRAE Standard 90.1-2004? ASHRAE 90.1-2004 covers the building envelope, HVAC, service-water heating, lighting, and electrical motors. Within each of these sections, there are mandatory and prescriptive (or performance) requirements.

Designers often use the following compliance path to fulfill the Mandatory plus Prescriptive requirements. The major requirements are listed below, along with a few highlights.

Mandatory Provisions

- Equipment efficiencies: both full load and part load
- Load calculations: in accordance with industry-accepted practices

Sustainability development:

"Meeting the needs of the present generation without compromising the ability of future generations to meet their own needs."
Brundtland commission, 1987.

"Sustainable development is a moving target. It represents the continuous effort to balance and integrate the three pillars of social well-being, economic prosperity and environmental protection for the benefit of present and future generations."
Gisbert Glaser, senior advisor of International Council for Science, 2004.

- Controls:
 - Automatic shutdown (systems > 15,000 Btu/h)
 - Setback controls in all but the most humid climates
 - Optimum start (systems > 10,000 cfm)
- Construction and insulation: duct and piping insulation requirements
- Completion requirements: drawings, manuals, balancing, and commissioning

Prescriptive requirements

- Economizers: specified by system size and climate zone
- Simultaneous heating and cooling limitation: with exceptions for variable-air-volume (VAV) systems, use of recovered energy, and humidity control
- Air-system design and control: maximum fan power usage, fan-pressure optimization required on VAV systems with direct-digital controls (DDC), variable-frequency drives (VFD), or similar performance, required on VAV fans 15 hp and larger
- Hydronic system design and control: requires variable flow in many systems
- Heat rejection equipment: requires fan speed reduction for 7.5 hp and above
- Energy recovery:
 - Airside systems (>5,000 cfm of supply air and >70% outdoor air) require energy recovery effectiveness of 50%.
 - Waterside systems require to recover heat from water-cooled chiller's condenser when all of the following are met:
 - Operates 24 hours per day
 - Heat rejection load is greater than 6,000,000 Btu/h (450 ton plant)
 - Design service water heating load is 1,000,000 Btu/h

Q3: I'm designing a large chilled-water system. Can an HFC refrigerant automatically achieve EA Credit 4 (one point)? If not, which refrigerants can achieve

EA Credit 4? No man-made refrigerant automatically achieves EA Credit 4 (EAc4), Enhanced Refrigerant Management. EAc4 changed substantially between LEED-NC versions 2.1 and 2.2.

To achieve this credit, one can either use no refrigerants, or perform a calculation using the properties and quantities of the refrigerants used in the equipment. Attaining EAc4 depends on refrigerant global warming potential, refrigerant ozone depletion potential, annual leakage rate, and equipment life. Defaults are defined by the LEED NC 2.2 Reference Guide.

The equation, variable definitions and defaults are provided below. The calculation can be performed using a spreadsheet available at: www.trane.com/green.

$$LCGWI_d + LCODI \times 10^5 \leq 100$$

$$LCGWI_d = \frac{GWP_r \times R_c \times (L_r \times life + M_r)}{life}$$

$$LCODI = \frac{ODP_r \times R_c \times (L_r \times life + M_r)}{life}$$

where,
 $LCGWI_d$ = life-cycle direct global warming index, equivalent lb CO₂/ton-yr
 $LCODI$ = life-cycle ozone depletion index, equivalent lb CFC-11/ton-yr
 GWP_r = global warming potential of refrigerant, 0 < GWP_r < 12,000 lb CO₂/lb_r
 R_c = refrigerant charge, lb refrigerant/ton of cooling capacity
 L_r = refrigerant leakage rate, % of charge/yr (proposed default: 2%)
 $life$ = equipment life, yr
 10: Window air conditioning units and heat pumps
 15: Unitary, split, and packaged air-conditioning units and heat pumps
 20: Reciprocating and scroll chillers
 23: Centrifugal, absorption, and helical-rotary (screw) chillers
 M_r = end-of-life loss, % of charge (proposed default: 10%)
 ODP_r = ozone depletion potential of refrigerant, 0 < ODP_r < 0.2 lb CFC-11/lb_r

Table 2. 100-year ODP and GWP values for several common refrigerants

Refrigerant	ODP	GWP	Application
R-22	0.04	1,780	Unitary and chillers
R-123	0.02	76	Chillers
R-134a	~0	1,320	Chillers
R-407C		1,700	Unitary
R-410A		1,890	Unitary and chillers

Table 3 shows the maximum refrigerant charge (R_c) that would allow a piece of equipment to achieve EAc4. These values are determined by performing the calculation using the refrigerant properties and defaults for each refrigerant.

Table 3. Maximum refrigerant charge (lb/ton) allowable based on equipment life

Refrigerant	10 years	15 years	20 years	23 years
R-22	0.57	0.64	0.69	0.71
R-123	1.60	1.80	1.92	1.97
*Trane R-123 centrifugal chiller models CVHE,CVHF, CVHG,CDHF				5.15
R-134a	2.52	2.80	3.03	3.10
R-407C	1.95	2.20	2.35	2.41
R-410A	1.76	1.98	2.11	2.17

Higher efficiency equipment generally uses larger heat exchangers and requires a larger refrigerant charge for a given capacity. While calculations should always be performed, below is some general guidance if only one type of refrigerant is used on a project.

- R-22 equipment is unlikely to achieve EAc4
- High-efficiency R-410A equipment may not achieve EAc4
- High-efficiency R-134a equipment may not achieve EAc4
- *Due to being able to use a 0.5% leakage rate, all Trane R-123 chillers can achieve EAc4. (See the CIR issued by the USGBC in 2006 that allows use of this lower leakage rate for these specific chillers.)



If there is more than one piece of equipment in a project, a weighted equation may be used:

$$\frac{[\sum(LCGWP + LCODP \times 10^5) \times Q_{unit}]}{Q_{total}} \leq 100$$

where,

$LCGWP = LCGWl_d$

$LCODP = LCODI$

Q_{unit} = cooling capacity of an individual HVAC or refrigeration unit, tons

Q_{total} = total cooling capacity of all HVAC or refrigeration equipment, tons

In summary, EAc4 can be achieved if no refrigerant is used. If refrigerant is used, a calculation must be performed (no refrigerant gets a free pass). If the calculated result is ≤ 100 , EAc4 is achieved for the project. Using the weighted calculation may allow a project with varied equipment (and refrigerants, including R-22) attain EAc4.

Q4: I am designing a commercial building targeted for LEED gold rating. What are some practices for airside and waterside HVAC systems that help reduce overall building energy cost in order to achieve EAc1 (optimize energy performance) points?

To minimize overall building energy cost, design teams should use a holistic approach that considers the interaction of building orientation and envelope construction with lighting and HVAC systems. Improvements to the building envelope and more efficient lighting systems reduce the building load, which then has the added effect of reducing HVAC energy cost.

Airside design and control. A cold-air system designed with low flow rates can reduce the energy used to transport air and water throughout the building. Energy analyses show that this approach can reduce HVAC energy use by as much as 30 percent, depending on the climate (Figure 1). A low-flow design can also reduce material costs by using smaller air handlers, ductwork, piping, and pumps.

In addition, drier air often allows the space temperature setpoints to be raised. For example, the space temperature setpoint can often be raised to 76°F or 77°F and still provide the same comfort level as a conventional system with a 75°F setpoint (see Trane ENEWS-29/2, *Cold Air makes Good \$ense*).

Exhaust-air energy recovery (using an enthalpy wheel, for example) reduces the ventilation load on cooling and heating equipment. However, be sure to control the wheel properly and bypass the wheel when the airside economizer is activated (see Trane ENEWS-29/5, *Air-to-Air Energy Recovery*).

Control strategies.

- *Optimal start:* required by ASHRAE Standard 90.1-2004 for systems larger than 10,000 cfm, optimal start uses a building automation system (BAS) to determine the length of time required to bring each zone from current temperature to the occupied setpoint. The system waits as long as possible before starting, so that

the temperature in each zone reaches occupied setpoint just in time for occupancy. *Optimal stop* uses the BAS to determine how early heating and cooling can be shut off for each zone, so that the indoor temperature drifts only a few degrees from occupied setpoint.

- Supply-air-temperature reset should be used wisely, especially in a VAV system. Humidity control must be maintained and a comparison between fan and compressor energy use must be performed.
- Ventilation optimization reduces the amount of outdoor air during periods of partial occupancy (demand-controlled ventilation) and during times when system ventilation efficiency is higher in a VAV system (ventilation reset).

Trane EN35-4, *Energy-Saving Control Strategies for Rooftop VAV Systems*, further describes these optimized control strategies, and suggests a significant potential for energy savings (Figure 2).

Figure 1. Comparison of conventional and low-flow, high-efficiency systems

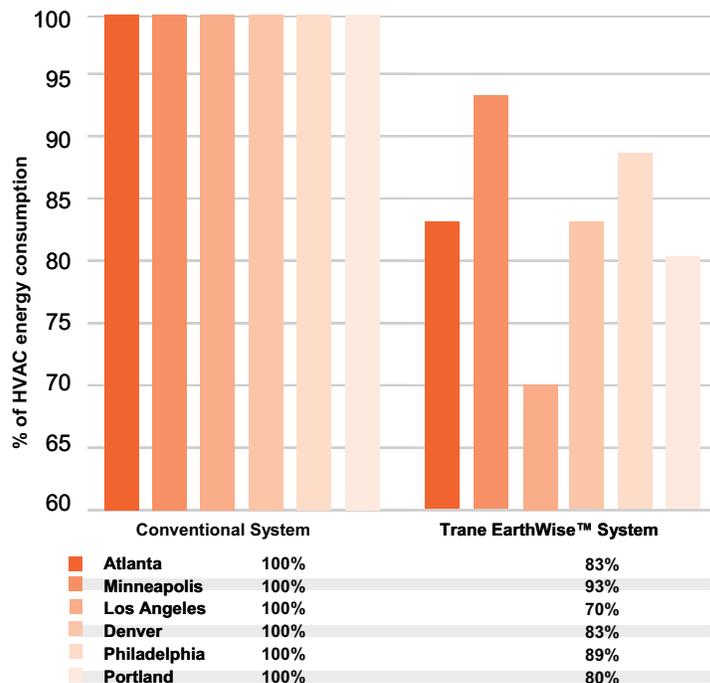
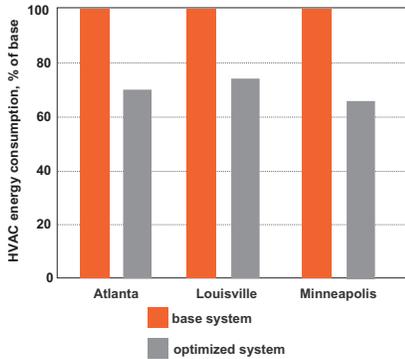


Figure 2. Demand and peak consumption reduction



Waterside Design and Control.

- Change the system design from primary-secondary (decoupled) to variable primary flow. Bahnfleth and Peyer have shown that doing so reduces installed costs by 4 to 8 percent and reduces energy cost by 3 to 8 percent.[3]
- The ASHRAE GreenGuide (edition 2) states, "...reducing chilled- and condenser-water flow rates (conversely, increasing the delta Ts) can not only reduce operating cost but, more importantly, can free funds normally used for infrastructure (ducts, pipes, fans and pumps) allowing them to be applied toward increasing overall efficiency elsewhere."
 - The CoolTools™ Chilled Water Plant Design Guide recommends starting with chilled-water temperature difference of 12°F to 20°F (6.7°C to 11°C). This guide shows chiller plus chilled-water pump energy use is reduced by more than 16%.
 - The CoolTools guide also recommends a design method that starts with a condenser water temperature difference of 12°F to 18°F (6.7°C to 10°C). This guide shows that the collective energy use of the chiller, condenser water pump and cooling tower is reduced by about 5 percent.[4]

- Consider a VFD on the chiller *if* the chiller will operate for enough hours of the year at low load conditions *and* the cooling-tower water temperature during those hours can be reduced. Compare the economics of adding a VFD to the chiller to the alternative of using the same amount of money to purchase a higher efficiency chiller. Or, consider purchasing a chiller with a high full-load efficiency and a VFD. Be sure to use a non-bin analysis tool, such as Trane's Chiller Plant Analyzer software program, and include the electrical demand charges in the analysis.
- Provide chiller-tower optimization control to reduce the sum of chiller and tower energy consumption.
- Consider pump-pressure optimization, which uses signals from DDC valves to provide the proper water flow at the lowest possible pressure.

Q5: I'm projecting water savings for LEED building certification. How much can condensate recovery from the cooling coils in the HVAC system reduce the use of cooling tower make-up water? To examine this question we need to know two things: (1) the amount of make-up water a cooling tower uses, and (2) the amount of condensate produced by the cooling coil. The following example calculates total make-up water usage of a 20-ton load at design conditions, provided by Marley cooling tower.

$$B = \frac{E + D - C \times D}{C - 1}$$

where,
C = Cycles of concentration
E = Evaporation, approximately
 gpm x °F range x 0.0008
D = Drift loss, approximately gpm x
 0.0002
B = Blow-down, gpm

Example:

A 20-ton cooling load (as part of a larger system) where the condenser water system is designed using 2 gpm/ton and a 14°F delta T. We'll assume 5 cycles of concentration, which is commonly used in water treatment decisions.

Step 1: Calculate the amount of make-up water the cooling tower uses.

$$E = (20 \text{ tons} \times 2 \text{ gpm/ton}) \times 14^\circ\text{F} \times 0.0008 = 0.448 \text{ gpm}$$

$$D = (20 \text{ tons} \times 2 \text{ gpm/ton}) \times 0.0002 = 0.008 \text{ gpm}$$

$$B = [0.448 + 0.008 - (5 \times 0.008)] / (5 - 1) = 0.104 \text{ gpm}$$

$$\text{Total make-up water} = 0.448 + 0.008 + 0.104 = 0.56 \text{ gpm}$$

$$\text{Total make-up water} = 0.56 \text{ gallons/minute} \times 60 \text{ minutes/hour} = 33.6 \text{ gallons/hour}$$

Step 2: Calculate the amount of condensate generated by the cooling coil.

Cooling coil operating conditions:

- Coil airflow = 6,100 cfm
- Entering coil conditions:
80°F dry bulb,
67°F wet bulb,
0.0112 lb of water/lb of dry air
- Leaving coil conditions
55°F dry bulb,
54.2°F wet bulb,
0.0087 lb of water/lb of dry air

Note: If the humidity ratio is determined from a Trane psychrometric chart, the units are given as grains of moisture/lb of dry air. There are 7000 grains of moisture per lb of water.

The amount of moisture removed by the coil (at these operating conditions) is determined by multiplying the mass flow rate of air through the coil by the

difference between the humidity ratio entering and leaving the coil.

- Humidity ratio difference:
 $0.0112 - 0.0087 = 0.0025$ lb of water/lb of dry air
- Moisture removed by coil:
 $(6,100 \text{ ft}^3/\text{min} \times 0.075 \text{ lb}/\text{ft}^3) \times 0.0025 \text{ lb of water}/\text{lb of dry air} = (1.14 \text{ lb of water}/\text{min}) / (8.33 \text{ lb}/\text{gallon}) = 0.14 \text{ gpm}$ or 8.24 gallons/hour

Note: The density of air is dependent on pressure (i.e., elevation) and temperature. Using the density of standard air (0.075 lb/ft³) is usually sufficient for most applications.

In the preceding example, 25 percent of the cooling tower make-up water can be supplied by recovering condensate from the cooling coil. Note that these savings are at design conditions. The overall water savings will vary depending on the application and the annual weather conditions. Trane's TRACE™ 700 software provides monthly values for cooling tower make-up water.

Q6: I'm designing a VAV system for a school. Does LEED-NC v2.2, EQc1 (outdoor air delivery monitoring) require a CO₂ sensor in every room? No. EQc1 requires a CO₂ sensor to indirectly monitor the ventilation rate per person in densely-occupied zones (those zones designed for 25 or more people per 1000 ft²). For systems that serve zones that are not densely occupied, EQc1 requires direct monitoring of the outdoor airflow rate. Using an airflow measurement station is one example. If one air handler serves both densely occupied and non-densely occupied zones, the densely occupied zones require CO₂ monitoring and the air handler requires a means to directly measure outdoor airflow at the intake. Whether monitoring CO₂, intake airflow, or both, the system must be configured to generate an alarm when the monitored condition varies from the currently required ventilation rate by more than 10 percent.

Q7: I'm designing an underfloor air distribution (UFAD) system. With LEED-NC v2.1, I could achieve one EQc2 point (ventilation effectiveness). Why can't I automatically get this credit anymore? Earlier versions of EAc2 attempted to improve breathing zone air quality by requiring a minimum zone air change effectiveness of 0.9. However, the credit didn't have the desired result for two reasons. First, most overhead cooling systems have zone air distribution effectiveness of 1.0 (because cool air drops into the breathing zone) so most conventional systems could receive this credit, not just UFAD or displacement ventilation systems. Second, ASHRAE Standard 62.1 (required by EQ Prerequisite 1) requires the designer to account for zone air distribution effectiveness (Ez) and increase zone airflow accordingly for minimum IAQ.^[5] In LEED-NC version 2.2, EQc2 was changed to require a 30 percent increase in minimum outdoor airflow to more directly improve indoor air quality.

Q8: I like air cleaners. Why can't I get any LEED-NC credits when I use the indoor air quality procedure (IAQP) — a valid approach for complying with ASHRAE Standard 62.1 — to determine the minimum required outdoor air intake flow? The ventilation rate procedure (VRP) is prescriptive in nature. Minimum zone outdoor airflow rates are prescribed for each occupancy category, along with specific calculation procedures to find system-level intake airflow for various ventilation system types. The designer need only make "judgments" related to zone population density and distribution. The IAQP, on the other hand, is performance-based. It requires the designer to make many judgments including identification of contaminants-of-concern (CC), the sources of each CC, the combined source strength for each CC, target concentration for each CC, and so on. Considering the number and nature of judgments involved, the design outcomes (in terms of intake airflow)

resulting from application of the IAQP can be expected to vary more widely than those resulting from the application of the VRP. For this reason, EQp1 only allows the VRP to be used.

Q9: I usually specify "high-efficiency, throw-away filters" with a 35 percent dust-spot efficiency rating. Do these high-efficiency filters qualify for EQc5.1 (indoor chemical & pollutant source control) credit?

No. ASHRAE publishes two particle-filter test methods: Standard 52.1 which results in a dust-spot efficiency value, and Standard 52.2 which results in a minimum efficiency reporting value (MERV). Although there is not a one-to-one comparison between the two tests and associated results, a throw-away filter with a 35 percent dust-spot (per Standard 52.1) efficiency would likely exhibit a minimum efficiency reporting value (from Standard 52.2) of about MERV 8. EQc5.1 requires at least MERV 13 filters. If you want to meet the filtration requirement for this credit, you should specify filters that have been tested in accordance with Standard 52.2 requirements and that have achieved a MERV of at least 13. Filters with at least 80 percent dust-spot efficiency often achieve MERV 13.

Q10: I'm a mechanical contractor working on the required documentation for a LEED submittal. Can Trane help fill out the MRc4.1 and MRc4.2 forms regarding the percent of recycled content used in the HVAC equipment? How about the MRc5.1 and MRc5.2 forms regarding the use of regional materials? How about the EQc4.1 and EQc4.2 forms regarding the use of low-emitting materials (such as adhesives, sealants, paints, and coating) on HVAC equipment? The LEED-NC rating system explicitly states that "mechanical, electrical and plumbing components ... shall not be included" in the calculations for recycled content (MRc4.1 and MRc4.2) or the calculations for regional materials (MRc5.1 and MRc5.2).

For EQc4.1 and EQc4.2 (low-emitting materials), the rating system 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 listed in these two credits. 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, insulation materials that are applied on-site will need to meet these requirements.

A Collaborative Effort

Governments and the building industry are collaborating to set examples and policies for sustainable building practices. Here are a few examples:

Edward Mazria, founder and executive director of Architecture 2030, initiated the 2030 Challenge to dramatically reduce greenhouse gas emission of new buildings to carbon-neutral by 2030. Organizations such as the U.S. DOE, U.S. EPA, U.S. conference of Mayors, USGBC, AIA, ASHRAE, and IESNA, academics, and other countries have joined the challenge.[6]

ASHRAE Standard 189P, Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings, is being developed through the joint efforts of ASHRAE, IESNA, and USGBC, and will be the first of its kind in the United States. Upon written completion in code language, Standard 189P will be an ANSI-accredited standard that can be incorporated into building code.[7]

On the international front, the Kyoto protocol has been ratified by many countries and became effective on February 16, 2005. By 2012, developed countries (listed under Annex I) are required to reduce their

greenhouse gas emissions by a collective average of 5% below their 1990 levels.[8]

The Clinton Climate Initiative, part of the former President Clinton's Foundation, created a global Energy Efficiency Building Retrofit Program to upgrade existing buildings through available funding and technologies for 40 large cities in the world. President Clinton said in the program's inauguration, "The businesses, banks and cities partnering with my foundation are addressing the issue of global warming because it's the right thing to do, but also because it's good for their bottom line. They're going to save money, make money, create jobs and have a tremendous collective impact on climate change all at once..."[9]

In California, the seventh largest economy in the world, Governor Schwarzenegger is leading by example to protect the environment. The Global Warming Solutions Act of 2006 requires carbon emissions reduction to 1990 levels by the year 2020, and 80 percent reduction from 1990 emissions level by 2050.[10]

Through these collaborative efforts to build green, the future of the sustainable built environment will accelerate. LEED continues to be an important topic for HVAC system designers. Although many products and systems often claim to *guarantee* LEED points, this is rarely the case. More accurately, products may *help* designers to achieve points. The best way to assure that the right decisions are made is to keep up-to-date on the LEED rating system. We welcome more questions from designers as these will help us generate the next *top ten* questions on LEED.

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*ASHRAE Standard 140, Standard Method of Test for Evaluation of Building Energy Analysis Computer Programs.



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