LEED 2009 Modeling and Energy Savings

USGBC continues to gain momentum in the market with support from the government, profit and non-profit organizations, and the building industry. In an effort to provide better understanding and less confusion among many LEED products, the LEED 2009 green building certification program was introduced this month after eight years of user feedback. It incorporates highly anticipated regional credits, extra points that have been identified as priorities within a project’s given environmental zone. LEED has also undergone re-weighting of credits, changing allocation of points among LEED credits to reflect climate change and energy efficiency as urgent priorities.

This presentation will cover the major changes in LEED 2009 and how they impact the HVAC practitioner.

After attending this event, you will be able to:
1. Summarize the differences between LEED NC 2.2 and LEED NC 2009.
2. Summarize the changes to the Project Certification and Professional Accreditation processes.
3. Explain how specific prerequisite changes affect the HVAC practitioner.
4. Identify ways in which energy modeling software can be leveraged to save energy, water, time and money when modeling for LEED 2009.

Proposed Outline:

1) Opening
   a) Welcome, agenda, introductions
   b) LEED 2009 Setup

2) LEED 2009 Major Changes
   a) Products
      i) LEED before 2009
      ii) LEED 2009
   b) Overview of NC, CS, CI, HealthCare, Homes, etc
      i) Harmonization
      ii) Combination
         (1) NC/Major renovation
         (2) EBOM
      iii) Reference Guides
   c) Redistribution
      i) USGBC study
      ii) Weighting distributions
      iii) New point values
      iv) Significant changes impacting HVAC practitioners
   d) Regional credits
      i) Based on local participation
      ii) EA TAG input
   e) Certification changes
      i) Tests
      ii) Effect on Present LEED AP

3) Major changes for HVAC practitioners
   a) Prerequisites
      i) EAp2 – 90.1-2007 minus 10%
### ii) EQp1 – 62.1-2007

**b) 4 Credits**

- **i) EA**
  - (1) EAc1
    - (a) Prescriptive methods (core performance Guides)
  - (2) Renewables
  - (3) Commissioning
  - (4) EAc4 – document if republished

- **ii) EQ**
  - (a) Appendix G and ventilation baseline

- **iii) Water efficiency**

### c) Possible responses to changes

- **i) Increased emphasis in energy efficiency**
- **ii) Water usage**

#### 4) EAc1 modeling

**a) Tool features and enhancements**

- **i) Capabilities you may not know about (provide handout)**
  - (1) Automatically calculate fan power
  - (2) Automatically rotate building
  - (3) Daylighting
  - (4) Thermal storage
  - (5) 8,760 – as of ten years ago (or so)
  - (6) Calculates water usage
    - (a) Cooling tower water usage
    - (b) Condensate recovery

- **ii) Enhanced capabilities**
  - (1) Hot water reset
  - (2) Marley make-up water usage calculation added

- **iii) System types**
  - (1) Underfloor Air Distribution
  - (2) Displacement Ventilation
  - (3) Chilled Beams
    - (a) Newsletter in November

- **iv) Output for LEED submission**
  - (1) Provide a document
  - (2) 90.1 Template

- **v) Reminder that energy savings are available with “off-the-shelf” systems (2008 ENL on LEED)**

### 5) Close
LEED 2009 Modeling and Energy Savings

Scott Hintz | marketing engineer | Trane
Scott joined Trane in July 2007 after spending more than eight years with Siemens Building Technologies. He earned his B.S. in Industrial Engineering from the Milwaukee School of Engineering. At Siemens, Scott held various positions including Applications Engineer and Project Manager for Room Level Automation Controls. In addition to his support role as a C.D.S. Marketing Engineer, Scott is responsible for customer training of C.D.S. software and project management of the new Trane Option Analyzer software. Scott is currently a consultant to the Energy Cost Budget Subcommittee of SSPC 90.1 and is a LEED Accredited Professional.

Chris Hsieh | systems engineer | Trane
Chris Hsieh specializes in all HVAC industry-related green and environmental initiatives locally and globally, including programs such as Energy Star®, LEED®, the Collaborative for High-Performance Schools. He holds bachelor and master’s degrees in electrical engineering from National Kaohsiung Institute of Technology in Taiwan and Southern Methodist University, respectively. Chris is currently a member of the TFM Green Building Advisory Board, a member of the CSI’s GreenFormat™ task team and the membership chair of ASHRAE La Crosse chapter. Chris is also a LEED Accredited Professional.

Mick Schwedler | manager, applications engineering | Trane
Mick has been involved in the development, training, and support of mechanical systems for Trane since 1982. With expertise in system optimization and control (in which he holds patents), and in chilled-water system design, Mick’s primary responsibility is to help designers properly apply Trane products and systems. To do so, he provides one-on-one support, writes technical publications, and presents seminars. To date, he has reached audiences throughout North America and in South America and the Far East.

A recipient of ASHRAE’s Distinguished Service Award, Mick is Chair of SSPC 90.1, which was responsible for writing ANSI/ASHRAE/IESNA 90.1-2007, a prerequisite for LEED. He also contributed to the ASHRAE GreenGuide and is a member of the LEED Energy and Atmospheric Technical Advisory Group (TAG). Mick earned his mechanical engineering degree from Northwestern University and holds a master’s degree from the University of Wisconsin Solar Energy Laboratory. He also is a registered professional engineer in the State of Wisconsin.
LEED 2009 Modeling and Energy Analysis

Engineers Newsletter Live

- “Trane” is a Registered Provider with The American Institute of Architects Continuing Education Systems. Credit earned on completion of this program will be reported to CES Records for AIA members. Certificates of Completion for non-AIA members available on request.
- This program is registered with the AIA/CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product. Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.
LEED 2009 Update

Agenda

- Major changes
- Impact for HVAC practitioners
- EAc1 modeling
- Summary

Today’s Presenters

Scott Hintz  
C.D.S. marketing engineer

Mick Schwedler  
manager, applications engineering

Chris Hsieh  
systems engineer
LEED 2009 Update

Building Facts

- 39% U.S. primary energy use
- 72% U.S. electricity consumption
- 14% U.S. potable water (15 trillion gallons)
- Million tons of construction waste
- 15% of Gross Domestic Product
- 40% of raw materials globally
USGBC

- LEED Green Building rating systems
- LEED building certification
- LEED AP
- Greenbuild conference

LEED® Green Building Rating System

- LEED: Leadership in Energy and Environmental Design
- Consensus-based, national standard for developing high-performance, sustainable buildings
  - Introduced and administered by U.S. Green Building Council
  - Voluntary, point-based rating system
  - Measures: Sustainable site development
    - Water savings
    - Energy efficiency
    - Materials selection
    - Indoor environmental quality
LEED
Addresses entire Building Lifecycle

<table>
<thead>
<tr>
<th>HOMES</th>
<th>NEIGHBORHOOD DEVELOPMENT (IN PILOT)</th>
<th>COMMERCIAL INTERIORS</th>
<th>CORE &amp; SHELL</th>
<th>NEW CONSTRUCTION</th>
<th>SCHOOLS, HEALTHCARE, RETAIL</th>
<th>EXISTING BUILDINGS OPERATIONS &amp; MAINTENANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DESIGN</td>
<td>CONSTRUCTION</td>
<td>OPERATIONS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: U.S. Green Building Council

Four Levels of LEED

Source: U.S. Green Building Council
Progress of LEED

- Projects registered: 17,047 in 2007, 212 in 2001
- NC certified projects: 2150 in 2008, 5 in 2001


Progress of USGBC

- USGBC membership: 17,846 in 2007, 1137 in 2001

Greenbuild

- 2008 (28,000 attendees)
  - Green Revolution
  - Look beyond first cost to total triple line ROI
  - Pennies upfront, payback in dollars
  - Green economy, jobs, and innovations

Greenbuild365.org website

LEED V3

- LEED 2009
  - Advancements to the rating system
- LEED certification process
  - Speed, capacity, performance
- LEED Online v3
  - Faster, smarter and better user experience
Comparison

- NC 2.2
- NC 2009

For LEED NC Prerequisites

<table>
<thead>
<tr>
<th>Category</th>
<th>2.2</th>
<th>2009</th>
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<tbody>
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<td>Sustainable Site</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Water Efficiency</td>
<td>0</td>
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<td>Energy &amp; Atmosphere</td>
<td>3</td>
<td>3</td>
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<tr>
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<td>1</td>
</tr>
<tr>
<td>Indoor Environmental Quality</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Innovation &amp; Design Process</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regional Bonus</td>
<td></td>
<td></td>
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</tbody>
</table>
For LEED NC Points distribution

<table>
<thead>
<tr>
<th>Category</th>
<th>2009</th>
<th>2009 Extra Points</th>
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</thead>
<tbody>
<tr>
<td>Sustainable Site</td>
<td>14</td>
<td>26</td>
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<tr>
<td>Water Efficiency</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Energy &amp; Atmosphere</td>
<td>17</td>
<td>35</td>
</tr>
<tr>
<td>Material &amp; Resources</td>
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<td>14</td>
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<tr>
<td>Indoor Environmental Quality</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Innovation &amp; Design Process</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Regional Bonus</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For LEED NC

Point distribution

- NC 2.2
  - S
  - W
  - E
  - A
  - M
  - R
  - Q
  - I
  - D

- NC 2009
  - S
  - W
  - E
  - A
  - M
  - R
  - Q

ID and regional 10%
Why Change?

- LEED use increasing
- LEED acceptance increasing
- LEED Accredited Professionals increasing in number
- High momentum
Why Change?

- LEED use increasing
- LEED acceptance increasing
- LEED Accredited Professionals increasing in number
- High momentum
- Products are becoming dissimilar
- LEED AP a bit nebulous
- Time for re-focus of LEED
- Need for future growth
LEED 2009

- LEED Prerequisite/Credit alignment and harmonization
- Predictable development (2 year)
- Transparent environmental/human impact credit rating
- Regionalization

Harmonization

- Make things that can be the same, the same
  - New Construction
    - Including retail, small schools
  - Schools
  - Healthcare (future)
  - Core & Shell
  - Commercial Interiors
  - Existing Buildings: Operation and Maintenance (EBOM)
BOOKS = LEED CREDITS

LEED 2009 Modeling and Energy Savings

Redistribution
LEED 2009 Credit Weighting

- 13 Impact Categories (top 6 by weighting)
  - Greenhouse gas emissions
  - Fossil fuel depletion
  - Water use
  - Indoor environmental quality
  - Particulates
  - Human health - cancer

Total 100 points excluding innovation and regional credits

Credits are positive integers with a minimum value of 1

Credits are static, independent values
**LEED 2009 Credit Weighting**  

**Activity Groups**

- Building systems  
  (specifically fuel and electricity consumption)
- Transportation (commuting and services)
- Water consumption (domestic and landscaping–related)
- Materials (core, shell, and finishings)
- Indoor Environmental Quality

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**LEED 2009 Credit Weighting**  

**LEED Credit Weighting Tool**

Impact Category x Activity Group x Association = Credit Weight

Sample scorecard comparing credit weightings for LEED-NC v2.2 with LEED v3.
**LEED 2009**

**Certification Thresholds**

- Certified: 40-49 points
- Silver: 50-59 points
- Gold: 60-79 points
- Platinum: 80+ points

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**LEED 2009**

**NC Scorecard**

<table>
<thead>
<tr>
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<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Regional Bonus</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Total points available</td>
<td>69</td>
<td>110</td>
</tr>
</tbody>
</table>
LEED 2009 Modeling and Energy Savings

Certification Changes

- Being performed by the Green Building Certification Institute (GBCI)
- Responsible for
  - Project certification
  - Accreditation

www.gbc.org
“Legacy” LEED Accredited Professionals

- Become “Legacy LEED AP”
- Do not have to retake the exam
- Must agree to the Code of Ethics
- To remain active as of June 2011:
  - Fee waived if you “opt in”
  - Biennial training requirements:
    30 hours (minimum 6 LEED specific)
  - Inactive can still use LEED AP title, but will not be in active directory

Credentials

- Three Tiers
- All required to agree to disciplinary policy and credentialing maintenance guidelines
- Maintenance
  - May use same credentialing hours as for (e.g.) PE, AIA
  - Credit for speaking and conferences
Tier 1: LEED Green Associate

- Demonstrate involvement in support of LEED projects
- Be employed in sustainable field or engaged in green education
- Submit to application audit
- Examination of basic information across all LEED products
- Biennial maintenance:
  - 15 hours
  - Minimum 3 LEED specific

Tier 2: LEED Accredited Professional

- In-depth knowledge in a particular field
Particular rating systems for LEED AP

- Commercial
  - Design & Construction
  - Operations & Maintenance
  - Interiors
- Residential Design & Construction
- Neighborhood Development

Tier 2: LEED Accredited Professional

- In-depth knowledge in a particular field
- Demonstrate professional experience on at least one LEED project
- Document work on a LEED project within the last 3 years
- Examination of specific LEED product
- Biennial maintenance:
  - 30 hours
  - Minimum 6 LEED specific
Tier 3: LEED AP Fellow

- Major contribution to the standards of practice and body of knowledge for achieving continuous improvement in the green building field
- Peer review of project portfolio

Rollout will be completed by September 1

- New LEED AP exams for BD+C and ID+C go live
- Volume registration, submittals and certification go live
- LEED AP “Core” exam goes live
- Rollout of LEED 2009 Workshops and Reference Guides
- LEED AP exam for HOMES goes live
- LEED 2009 goes live
- Preview of LEED 2009 Workshops
Project Certification

- Announced July 29, 2008
- 10 certification bodies
- GBCI
  - Developed ISO compliant certification process
  - Began administering January 2009
- Allows USGBC to focus on LEED

LEED 2009 Modeling and Energy Savings

Prerequisite Update
Prerequisite

- Energy and Atmosphere (EA)
  1: Fundamental commissioning of building energy systems
  2: Minimum energy performance
  3: Fundamental refrigerant management
- Indoor Environmental Quality (EQ)
  1: Minimum IAQ performance
  2: Environmental Tobacco Smoke control
- Water Efficiency (WE)
  1: Water Use Reduction
- Sustainable Sites (SS)
  1: Construction Activity Pollution Prevention
- Materials & Resources (MR)
  1: Storage & Collection of Recyclables

LEED NC 2009 : EA p2
Minimum energy performance

- Option 1: performance compliance path
  - Mandatory provision (5.4, 6.4, 7.4, 8.4, 9.4, and 10.4)
  - Baseline building complies with Appendix G Building PRM
  - 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
Major changes: EAp2
Minimum energy performance

<table>
<thead>
<tr>
<th>NC 2.2 Option 1: 90.1-2004</th>
<th>NC 2009 Option 1: 90.1-2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Mandatory provision (5.4, 6.4, 7.4, 8.4, 9.4, and 10.4)</td>
<td>• Mandatory provision (5.4, 6.4, 7.4, 8.4, 9.4, and 10.4)</td>
</tr>
<tr>
<td>• Prescriptive requirement (5.5, 6.5, 7.5, and 9.5)</td>
<td>• Baseline building complies with Appendix G Building Performance Rating Method (PRM)</td>
</tr>
<tr>
<td>• Baseline building complies with Appendix G Building Performance Rating Method (PRM)</td>
<td></td>
</tr>
<tr>
<td>• 14% better than 90.1-2004 for new construction, 7% better for existing building</td>
<td>• 10% better than 90.1-2007 for new construction, 5% better for existing building</td>
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</tbody>
</table>

Major changes: EAp2
Minimum energy performance

<table>
<thead>
<tr>
<th>NC 2.2 Option 2: prescriptive compliance path</th>
<th>NC 2009 Option 2: prescriptive compliance path</th>
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</thead>
<tbody>
<tr>
<td>• ASHRAE Advanced Energy Design Guide (AEDG) for small office buildings 2004</td>
<td>• ASHRAE AEDG for small office buildings 2004</td>
</tr>
<tr>
<td>• ASHRAE AEDG for small retail buildings 2006</td>
<td>• ASHRAE AEDG for small warehouses and self-storage buildings 2008</td>
</tr>
</tbody>
</table>
### Major Changes: EAp2

**Minimum energy performance**

<table>
<thead>
<tr>
<th>NC 2.2</th>
<th>NC 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>No option 3</td>
<td>Option 3: prescriptive compliance path</td>
</tr>
</tbody>
</table>

- Advanced Buildings Core Performance Guide

### Major Changes: EQp1

**Minimum IAQ performance**

<table>
<thead>
<tr>
<th>NC 2.2</th>
<th>NC 2009</th>
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</thead>
</table>

- Sections 4 through 7
- Mechanical ventilation systems design using ventilation rate procedure or the applicable local code, whichever is more stringent
- Nature ventilated buildings shall comply with ASHRAE 62.1-2004, paragraph 5.1

- Sections 4 through 7
- Mechanical ventilation systems design using ventilation rate procedure or the applicable local code, whichever is more stringent
- Nature ventilated buildings shall comply with ASHRAE 62.1-2007, paragraph 5.1
Major Changes: WEp1
Water Use Reduction

<table>
<thead>
<tr>
<th>NC 2.2</th>
<th>NC 2009</th>
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</thead>
<tbody>
<tr>
<td>none</td>
<td>20% water use reduction</td>
</tr>
</tbody>
</table>

- Uniform Plumbing Code or International Plumbing Code of 2006

Credits

<table>
<thead>
<tr>
<th>Sustainable Sites (SS)</th>
<th>2.2</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Site Selection</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2: Development Density &amp; Community Connectivity</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>3: Brownfield Redevelopment</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4.1: Alternative Transportation: Public Transportation Access</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>4.2: Alternative Transportation: Bicycle Storage &amp; Changing Rooms</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4.3: Alternative Transportation: Low Emitting &amp; Fuel Efficient Vehicles</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>4.4: Alternative Transportation: Parking Capacity</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
### Credits

**Sustainable Sites (SS)**

| 5.1: Site Development: Protect or Restore Habitat | 1 | 1 |
| 5.2: Site Development: Maximize Open Space | 1 | 1 |
| 6.1: Stormwater Design: Quantity Control | 1 | 1 |
| 6.2: Stormwater Design: Quality Control | 1 | 1 |

| 7.1: Heat Island Effect: Non-Roof | 1 | 1 |
| 7.2: Heat Island Effect: Roof | 1 | 1 |
| 8: Light Pollution Reduction | 1 | 1 |

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**Materials & Resources (MR)**

| 1.1: Building Reuse: Maintain Existing Walls, Floors & Roof | 2 | 3 |
| 1.2: Building Reuse: Maintain 50% of Interior Non-Structural Elements | 1 | 1 |

| 2.1: Construction Waste Management: Divert 50% From Disposal | 1 | 1 |
| 2.2: Construction Waste Management: Divert 75% From Disposal | 1 | 1 |

| 3.1: Materials Reuse: 5% | 1 | 1 |
| 3.2: Materials Reuse: 10% | 1 | 1 |
Credits

- Materials & Resources (MR) 2.2 2009
  - 4.1: Recycled Content: 10% (post-consumer + ½ pre-consumer) 1 1
  - 4.2: Recycled Content: 20% (post-consumer + ½ pre-consumer) 1 1
  - 5.1: Regional Materials: 10% Extracted, Processed & Manufactured Regionally 1 1
  - 5.2: Regional Materials: 20% Extracted, Processed & Manufactured Regionally 1 1
  - 6: Rapidly Renewable Materials 1 1
  - 7: Certified Wood 1 1

LEED 2009 Modeling and Energy Savings

ASHRAE Standard 90.1-2007
Major Addenda
ASHRAE Standard 90.1-2007 change

Envelope Addenda

- as: Modifies opaque envelope requirements
- at: Modifies fenestration (glass) requirements

section 6: HVAC

Equipment Efficiencies raised

- an: Boiler efficiencies
  18 trillion Btu of gas or oil annually as stock turns
- F: Three-phase air-cooled AC and heat pumps
  2.3 quads by 2035
- g: Air-cooled AC and heat pumps
  1.05 quads by 2035
ASHRAE Standard 90.1-2007 change

ASHRAE 62.1 Reference

- Changed from 62.1-1999 to 62.1-2004
  - Ventilation rates changed
  - Now based on summation of rates per person and per area

ASHRAE Standard 90.1-2007 change

mandatory HVAC provisions

Ventilation: High Occupancy

Demand Control Ventilation (DCV) required for Spaces
> 500 ft² and design occupancy
> 40 people/1000 ft²:

(was 3000 cfm and 100 people/1000 ft²)
ASHRAE Standard 90.1-2007 change

Off-hour Controls

- Exception was deleted for HVAC systems serving hotel/motel guest rooms

Fan system power limitation:
- Applies to systems > 5 hp

<table>
<thead>
<tr>
<th>Option</th>
<th>Constant volume</th>
<th>Variable volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Nameplate hp</td>
<td>$hp \leq CFMs \times 0.0011$</td>
<td>$hp \leq CFMs \times 0.0015$</td>
</tr>
<tr>
<td>2) System bhp</td>
<td>$bhp \leq CFMs \times 0.00094 + A$</td>
<td>$bhp \leq CFMs \times 0.0013 + A$</td>
</tr>
</tbody>
</table>
ASHRAE Standard 90.1-2007 change
Fan Power Limitation Pressure Drop Adjustment

- \[ A = \sum (PD \times \frac{\text{CFM}_{\text{design}}}{4131}) \]
- PD specified for
  - Ducts
  - Filters
  - Gas-phase air cleaners
  - Heat recovery devices
  - Sound attenuation sections
  - Other devices

ASHRAE Standard 90.1-2007 change
Prescriptive HVAC requirements
Air System Design & Control

VAV fan control
- Motors \( \geq 10 \) hp require one of the following: (was 15 hp)
  - Variable-speed drive
  - Vaneaxial fan with variable-pitch blades
  - Design wattage \( \leq 30\% \) at 50\% air volume
- DDC systems must include setpoint reset (fan-pressure optimization)
ASHRAE Standard 90.1-2007 change
Lighting Addenda

- ai: retail display lighting.
  Gives lighting designers flexibility

| EA Credit Redistribution |
|---------------------------|------------------|
| Credit | Description | LEED NC | LEED 2009 |
|        |              | Maximum points | Max % | Maximum points | Max % |
| 1      | Optimize Energy Performance | 10 | 14.5% | 19 | 19.0% |
| 2      | On-site renewable energy | 3 | 4.3% | 7 | 7.0% |
| 3      | Enhanced Commissioning | 1 | 1.4% | 2 | 2.0% |
| 4      | Enhanced Refrigerant Management | 1 | 1.4% | 2 | 2.0% |
| 5      | Measurement and verification | 1 | 1.4% | 3 | 3.0% |
| 6      | Green Power | 1 | 1.4% | 2 | 2.0% |
|        | EA Section | 17 | 24.6% | 35 | 35.0% |
|        | Rating system total | 69 | 100 |
Minor Changes, EAc3, 4, 6
(with the exception of credit points available)

- Enhanced Commissioning: No changes
- Enhanced Refrigerant Management: No changes
- Green Power: All purchases of green power shall be based on the quantity of energy consumed, not the cost

Significant EA Changes

- EAc1 – Optimize Energy Performance
- EAc2 – On-Site Renewable Energy
- EAc5 – Measurement and Verification
EAc1 – Prescriptive option 1
ASHRAE
Advanced Energy Design Guides

(1 point)
- Offices < 20,000 ft²
- Retail < 20,000 ft²
- Small Warehouses < 50,000 ft²
- K-12 Schools < 200,000 ft²

Available at no charge

www.ashrae.org/technology/page/938#completed

EAc1 – Prescriptive option 1
ASHRAE
Advanced Energy Design Guides

- Recommendations by Climate Zone
  (Must follow all for LEED EAc1)
  - Envelope
  - Lighting
  - HVAC
  - Service Water Heating
Another option
ASHRAE
Advanced Energy Design Guides

- K-12 AEDG: Savings compared to 90.1-2004
  - At least 30%
  - Daylighting, but not high efficiency lighting, 30-45%
  - High efficiency lighting but not daylighting, 24-41%
- Follow the recommendations, but model the project
- May achieve significantly more than 1 credit point

EAc1 – Prescriptive option 2
Core Performance Guide

- Offices, school, public assembly, retail under 100,000 ft²
  - NOT health care, warehouses or laboratory projects

www.advancedbuildings.net/publications.htm
EAc1 – Prescriptive option 2
Core Performance Guide

- Section 1
  - Design Intent
  - Communicating Design Intent
  - Building Configuration
  - Mechanical System Design
  - Acceptance Testing
  - Operating Training and Documentation
  - Performance Data Review

- Section 2
  - IAQ
  - Below Grade Insulation
  - Envelope
  - Lighting
  - Mechanical System Design, Control, and Mechanical Performance
  - Domestic Hot Water

Operator Training and Documentation

- Documentation – Similar to 90.1-2007 Completion Requirement
- Operator Training
Core Performance Guide
Lighting

- Whole building lighting power densities the same as 90.1-2007…but
  - “The lighting power densities contained in this table include allowances for video-display terminals, decorative lighting, and display lighting. Additional lighting power is not allowed for these uses. Task lighting is not included in these connected LPD limits.”

Lighting Power Density Comparison

<table>
<thead>
<tr>
<th>Building Type</th>
<th>90.1-2007 (W/ft²)</th>
<th>Core Performance Guide (W/ft²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family Dining</td>
<td>1.6</td>
<td>1.6 Including decorative lighting</td>
</tr>
<tr>
<td></td>
<td>Up to 1.0 additional decorative</td>
<td></td>
</tr>
<tr>
<td>Retail</td>
<td>1.5</td>
<td>1.3 Including display lighting</td>
</tr>
<tr>
<td></td>
<td>Plus display lighting</td>
<td></td>
</tr>
</tbody>
</table>
examples
Core Performance Guide Mechanical Efficiency

<table>
<thead>
<tr>
<th>Category</th>
<th>Size</th>
<th>90.1-2007</th>
<th>CPG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof top</td>
<td>20 ton</td>
<td>10.0 EER 9.7 IPLV</td>
<td>10.5 EER 10.9 IPLV</td>
</tr>
<tr>
<td>Air-cooled chiller</td>
<td>All</td>
<td>1.26 kW/ton 1.15 IPLV</td>
<td>1.2 kW/ton 1.0 IPLV</td>
</tr>
<tr>
<td>Constant Speed</td>
<td>&gt;600 tons</td>
<td>0.576 kW/ton 0.549 IPLV (as of 1/1/2010)</td>
<td>0.550 kW/ton 0.510 IPLV</td>
</tr>
<tr>
<td>centrifugal chiller</td>
<td></td>
<td>0.570 kW/ton 0.539 IPLV</td>
<td></td>
</tr>
<tr>
<td>Variable Speed</td>
<td>&gt;600 tons</td>
<td>0.576 kW/ton 0.549 IPLV (as of 1/1/2010)</td>
<td>0.55 kW/ton 0.400 IPLV</td>
</tr>
<tr>
<td>centrifugal chiller</td>
<td></td>
<td>0.590 kW/ton 0.400 IPLV</td>
<td></td>
</tr>
</tbody>
</table>

Core Performance Guide
EAC1 – Prescriptive

- One point for each three additional strategies (maximum of 2 additional pts)
  - Except: Cool roofs, Night Venting, Additional Commissioning

- Enhanced Performance Strategies
  - Daylighting and control
  - Additional lighting power reduction
  - Plug loads/appliance efficiency
  - 14 available

www.advancedbuildings.net/publications.htm
### EAC1 – Modeling

**Up to 19 points**

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

### EAC2 – On-Site Renewable Energy

*% Renewable Energy*

<table>
<thead>
<tr>
<th>% Renewable Energy</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1%</td>
<td>1</td>
</tr>
<tr>
<td>3%</td>
<td>2</td>
</tr>
<tr>
<td>5%</td>
<td>3</td>
</tr>
<tr>
<td>7%</td>
<td>4</td>
</tr>
<tr>
<td>9%</td>
<td>5</td>
</tr>
<tr>
<td>11%</td>
<td>6</td>
</tr>
<tr>
<td>13%</td>
<td>7</td>
</tr>
</tbody>
</table>

- Reduce building energy use first
- Same size renewable system becomes more cost effective
EAc5 – Measurement and Verification

- Same requirements as NC v2.2 with one addition…
- “Provide a process for corrective action to ensure energy savings are realized if the results of the M&V plan indicate that energy savings are not being achieved.”

EA Section Summary

- 35% of possible 100 points
- Increased focus on energy
  - Project
  - Renewables
  - Measurement and verification
- Significant rewards for exemplary buildings
LEED 2009 Modeling and Energy Savings

ASHRAE Standard 62.1-2007
Major Addenda

ASHRAE Standard 62.1-2007

Incorporates addenda a, b, c, d, e, f, g, and h to 62.1-2004
ASHRAE 62.1 -2007 change
Addendum b:
Airstream & Space Type revisions

- Employee Locker Rooms, Kitchenettes, and Private toilet/bath now have minimum exhaust rates (Table 6-4)
- New occupancy categories with minimum exhaust rates (Table 6-4)
- Science Laboratories – new class. for min breathing zone rate (Table 6-1)
- “Other Space Types” now have min breathing zone rates (Table 6-1)

ASHRAE 62.1 -2007 change
Addendum g:
ETS Areas & ETS-free Areas

- Separation of ETS and ETS-free areas
- Separation via pressurization and air-tightness
- Limiting air transfer and recirculation of ETS areas
- ETS are signage requirements
ASHRAE 62.1 -2007 change
Addendum h:
Residential Space Requirements

- Deleted tables E-2 & E-3 from Normative Appendix E
- Residential spaces added to Table 6-1
- ASHRAE Standard 62.2-2004 residential ventilation rates differ from those in addendum h

### Significant EQ Changes

<table>
<thead>
<tr>
<th>Credit</th>
<th>Description</th>
<th>LEED NC 2.2</th>
<th>LEED 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Maximum</td>
<td>Max %</td>
</tr>
<tr>
<td></td>
<td></td>
<td>credits</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Outdoor Air Delivery Monitor.</td>
<td>1</td>
<td>1.45%</td>
</tr>
<tr>
<td>2</td>
<td>Increased Ventilation</td>
<td>1</td>
<td>1.45%</td>
</tr>
<tr>
<td>3.1–3.2</td>
<td>Construction IAQ Manage. Plan</td>
<td>2</td>
<td>2.9%</td>
</tr>
<tr>
<td>4.1-4.4</td>
<td>Low-Emitting Materials</td>
<td>4</td>
<td>5.8%</td>
</tr>
<tr>
<td>5</td>
<td>Indoor Chemical &amp; Pollutant Source Control</td>
<td>1</td>
<td>1.45%</td>
</tr>
<tr>
<td>6.1-6.2</td>
<td>Controllability of Systems</td>
<td>2</td>
<td>2.9%</td>
</tr>
<tr>
<td>7.1-7.2</td>
<td>Thermal Comfort</td>
<td>2</td>
<td>2.9%</td>
</tr>
<tr>
<td>8.1-8.2</td>
<td>Daylight &amp; Views</td>
<td>2</td>
<td>2.9%</td>
</tr>
<tr>
<td></td>
<td>EQ Section</td>
<td>15</td>
<td>21.7%</td>
</tr>
<tr>
<td>Rating System Total</td>
<td>69</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>
EQ Changes – Credits 1 & 2

- No changes to credit points
  - Credit 1 – Outdoor Air Delivery Monitoring
  - Credit 2 – Increased Ventilation

Significant WE Changes

<table>
<thead>
<tr>
<th>Credit</th>
<th>Description</th>
<th>LEED NC 2.2</th>
<th>LEED 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum credits Max %</td>
<td>Maximum</td>
<td>Max %</td>
</tr>
<tr>
<td>1.1</td>
<td>Water Efficient Landscaping, Reduce by 50%</td>
<td>1</td>
<td>1.45%</td>
</tr>
<tr>
<td>1.2</td>
<td>Water Efficient Landscaping, No Potable Use or No Irrigation</td>
<td>1</td>
<td>1.45%</td>
</tr>
<tr>
<td>2</td>
<td>Innovative Wastewater Technologies</td>
<td>1</td>
<td>1.45%</td>
</tr>
<tr>
<td>3</td>
<td>Water Use Reduction</td>
<td>1 to 2</td>
<td>2 to 4</td>
</tr>
<tr>
<td>3.1</td>
<td>20% now 30% Reduction</td>
<td>1</td>
<td>1.45%</td>
</tr>
<tr>
<td>3.2</td>
<td>30% now 35% Reduction</td>
<td>2</td>
<td>2.9%</td>
</tr>
<tr>
<td>3.3</td>
<td>40% Reduction</td>
<td>N/A</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>WE Section</td>
<td>5</td>
<td>7.2%</td>
</tr>
<tr>
<td></td>
<td>Rating System Total</td>
<td>69</td>
<td>100</td>
</tr>
</tbody>
</table>
Possible Responses to LEED 2009 Changes

- Energy has become more important
  - Focus on efficient system design, control and operation
- Condensate reclamation
- Your LEED tools may need to change

LEED 2009 Modeling and Energy Savings

EAc1 Modeling: Option 1 – Whole Building Energy Simulation
Whole Building Simulation

- Section G2.2.1 of Standard 90.1-2007 lists eight (8) criteria as requirements for an acceptable modeling tool
- Section G2.2.4 of Standard 90.1-2007 states that a simulation program shall be tested per ASHRAE Standard 140

LEED
Sections and Points (NC 2009)

<table>
<thead>
<tr>
<th>Design Category</th>
<th>Possible Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustainable Sites</td>
<td>26</td>
</tr>
<tr>
<td>Water Efficiency</td>
<td>10 8</td>
</tr>
<tr>
<td>Energy and Atmosphere</td>
<td>35 31</td>
</tr>
<tr>
<td>Materials and Resources</td>
<td>14</td>
</tr>
<tr>
<td>Indoor Environ. Quality</td>
<td>15 1</td>
</tr>
<tr>
<td>Innovation &amp; Design</td>
<td>6</td>
</tr>
<tr>
<td>Regional Priority</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total Available Points</strong></td>
<td><strong>110 40</strong></td>
</tr>
</tbody>
</table>

Blue indicates categories TRACE can be used with and the total possible points that can be obtained
Full Year 8,760 Hour Analysis

DOE2.com your home for DOE-2 based software

Weather Data

&

Weather Data Processing Utility Programs

The download area also provides access to a wide variety of weather data that is compatible with DOE-2. DOE-2 Software and Component Data, DOE2DCP will automatically download data from this area, except for international data. The following datasets are available:

CMAQ (Canadian Meteorological Atmospheric Quality model) is available in 26 locations, derived from Canadian Government data.

CRWRF (CMAQ, updated 40 locations version, derived from Canadian Government data)

CLM (California Climate Model, version 4, 49 sites, supplied by the California Energy Commission)

TMY2 (Typical Meteorological Year version 2, 150 locations, derived from USDOE EERE datasets)

TMY3 (Typical Meteorological Year version 3, 1389 locations, derived from USDOE EERE datasets. Thanks to the funding at office of Technology for these files processed for use with DOE-2)

TMY2 (TMY Reference Year, 43 locations, derived from US National Mapping data)

WEC2 (Yearly Energy Calculations, 54 international locations, derived from US National Mapping data)

WEC3 (WECX version 3, 63 international locations, derived from US National Mapping datasets)

Note on TMY3 and TMY2: These are not the latest files. Visit the DOE-2 website for links to download the latest versions.

Full Year, 8,760 Hour Analysis
90.1 Minimally Compliant Equipment Library

- Over 160 library members including fans, heating equipment, cooling equipment, and heat rejection equipment

Automatic Features for LEED

- G3.1.2.9 - System Fan Power Calculation
- Baseline Building Rotation
Daylighting

### Daylighting Parameters

<table>
<thead>
<tr>
<th>General</th>
<th>Daylighting Controls</th>
<th>Room Parameters</th>
<th>Glass Parameters</th>
<th>Construction Parameters</th>
<th>Internal Shade Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Template Name</td>
<td>Std Continuous Daylight</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Controls
- Percent of Space Aligned
- Lighting Setpoint
- Lighting Control Type
- Miterless Power Percent
- Minimum Light Percent
- Light Control Steps
- Light Control Probability

#### Geometry
- Reference Height (R)
- Distance from Glass (D)
- Window Glass Height (W)
- Glass Length / Distance from (D) / (B)
- Glass Height / Distance (B) / (D)
- Horizontal Offset
- Skylight Length / Distance
- Skylight Width / Distance

---

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Daylighting, cont.

EQc 8.1 - Daylight 75% of Spaces
Option 2 – Daylight Simulation Model

- Minimum of 25 footcandles achieved in at least 75% of occupied spaces
- Under clear sky, at noon on the equinox and at 30° above the floor

<table>
<thead>
<tr>
<th>System Desc.</th>
<th>Room Desc.</th>
<th>Daylight Sched</th>
<th>Glass Area</th>
<th>Floor Area</th>
<th>Month</th>
<th>Day</th>
<th>Hour</th>
<th>Glass/Solar</th>
<th>Ext/Zone</th>
<th>Ext/Zone</th>
<th>Ext/Zone</th>
<th>Ext/Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHU 1-2</td>
<td>(5x3.10) A_Src_Available (10C) 94.6</td>
<td>130%</td>
<td>25</td>
<td>12</td>
<td>594</td>
<td>7</td>
<td>0</td>
<td>70</td>
<td>25.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AHU 1-2</td>
<td>(5x3.10) A_Src_Available (10C) 81.4</td>
<td>25</td>
<td>12</td>
<td>50</td>
<td>0</td>
<td>70</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AHU 1-2</td>
<td>(5x3.10) A_Src_Available (10C) 68.8</td>
<td>80</td>
<td>12</td>
<td>43</td>
<td>0</td>
<td>70</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Thermal Storage

- Cooling plant: Water-Cooled Chiller Plant
- Equipment type: Water-cooled chiller
- Space: Commercial
- Thermal storage:
  - Type: Liquid
  - Capacity: 2000
  - Schedule: Discharge Tonnage

<table>
<thead>
<tr>
<th>Operating mode</th>
<th>Capacity</th>
<th>Cooling load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chiller</td>
<td>700</td>
<td>150</td>
</tr>
<tr>
<td>Hot water</td>
<td>250</td>
<td>0.70</td>
</tr>
</tbody>
</table>

- Pumps:
  - Primary chilled water: 150
  - Secondary chilled water: 120
  - Hot water: 0
Thermal Storage, cont.

Engineers Newsletter:
Ice storage as part of a LEED® building design, volume 36-3, 2007.

Segue
Water Consumption

- Cooling Tower water usage and Cooling Coil Condensate recovery

Marley cooling tower make-up usage calculation

<table>
<thead>
<tr>
<th>Number of concentrations</th>
<th>Blowdown (% of cooling tower gpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0.4</td>
</tr>
<tr>
<td>4</td>
<td>0.25</td>
</tr>
<tr>
<td>5</td>
<td>0.18</td>
</tr>
<tr>
<td>6</td>
<td>0.13</td>
</tr>
<tr>
<td>8</td>
<td>0.08</td>
</tr>
<tr>
<td>10</td>
<td>0.06</td>
</tr>
<tr>
<td>12</td>
<td>0.04</td>
</tr>
</tbody>
</table>
Enhanced Capabilities

- Hot-Water Supply Temperature Reset
Enhanced Capabilities, cont.

- Supply Air Temperature Reset

- Hot gas reheat for dehumidification
Enhanced Capabilities, cont.

- ASHRAE Standard 62.1 report

### System Ventilation Requirements

<table>
<thead>
<tr>
<th>Airflow Locations</th>
<th>Description</th>
<th>Cooling</th>
<th>Heating</th>
</tr>
</thead>
<tbody>
<tr>
<td>System 1</td>
<td>Low &amp; Cool</td>
<td>17,224</td>
<td>5,176</td>
</tr>
<tr>
<td>Zone Office</td>
<td>Cooling</td>
<td>4,192</td>
<td>4,192</td>
</tr>
<tr>
<td>System Warehouse</td>
<td>Heating</td>
<td>38,894</td>
<td>899</td>
</tr>
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</table>

### Ventilation Parameters

<table>
<thead>
<tr>
<th>System Zone Name</th>
<th>RG</th>
<th>PH</th>
<th>Rg</th>
<th>PH</th>
<th>AS</th>
<th>VR</th>
<th>E2</th>
<th>Vsc</th>
<th>E1</th>
<th>Vsc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office</td>
<td>0.08</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

### New System Categories & Types

- System Category
  - VAV: Variable Air Volume
  - CAV: Constant Air Volume

- System Type
  - Indirect: Indirect Ventilation
  - Direct: Direct Ventilation
  - Mixed: Mixed Ventilation

- System Style
  - Active: Active System
  - Passive: Passive System

- System Advice
  - AHU: Air Handling Unit
  - VRV: Variable Refrigerant Volume

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Humidity Control? UFAD, Chilled Beams, DV.....

Energy Saving Strategies for LEED - ENL
USGBC’s momentum continues…

“The Obama Administration’s economic recovery plan includes many important provisions for green building, green schools, and energy efficiency for existing buildings that will be of great importance to our community. This investment in our nation’s built environment will not only stimulate renewed activity, it will bear further fruit measured in energy savings, cost savings, and new green jobs.”

Michelle Moore
Senior Vice President, Policy & Public Affairs
LEED 2009

- LEED is gaining momentum
- More harmonization and easier to understand
- Higher performance buildings

references for this broadcast

Where to Learn More

Subscribe at www.trane.com/engineersnewsletter
Insightful topics on HVAC system design:
- Chilled-water plants
- Air distribution
- Refrigerant-to-air systems
- Control strategies
- Industry standards and LEED
- Energy and the environment
- Acoustics
- Ventilation
- Dehumidification

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---

2009 ENL Broadcasts

- **April 22**
  ASHRAE Clean, Lean and Green
  IAQ for Sustainable Buildings
- **May 13**
  Ice Storage System Design and Application
- **November 4**
  Air-Handling Systems, Energy, and IAQ
LEED 2009 Modeling and Energy Savings

Engineers Newsletter Live
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Solberg, P., "Ice-Storage as Part of a LEED Building Design,” Engineers Newsletter 36-3 (2007).


Trane Engineers Newsletters Live Broadcasts
available to purchase from <www.trane.com/bookstore>


Industry Trade Journal Articles

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Industry Websites
Green Building Certification Institute, Available at <www.gbci.org>
EPA’s TRACI tool. Available at <http://www.epa.gov/nrmrl/std/sab/traci/>
EIA’s CBECs website. Available at <http://www.eia.doe.gov/emeu/cbecs/>
EPA’s Energy Star website. Available at <http://www.energystar.gov/>
EPA eGRID website. Available at <http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html>
ASHRAE Advanced Energy Design Guides. Available at <www.ashrae.org/aedg>
Advanced Buildings™ Core Performance™ Guide. Available at <http://www.advancedbuildings.net/corePerf.htm>