Agenda and Objectives

Trane Engineers Newsletter Live Series

LEED 2009 Modeling and Energy Savings

Trane applications engineering discuss the major changes in LEED 2009 and how they impact the HVAC practitioner. The LEED 2009 green building certification program was introduced in March of 2009 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.

By attending this event you will learn:

1. Understand LEED 2009 as it pertains to HVAC Systems
2. Identify system options for meeting WE, EA and IEQ prerequisites and achieving credits in these sections
3. Understand the importance of integrated building design
4. Compare modeling and energy savings comparisons in various location

Agenda:

1) Overview
   - b) Recent activity
   - i) Rising energy costs
   - ii) Change to LEED (mandatory two Optimize Energy Performance points)
   - iii) Energy Policy Act
2) Energy-saving strategies to achieve two points (ECM discussion)
   - a) Rooftop VAV systems
   - b) Self-contained VAV systems
   - c) Chilled-water VAV systems
   - d) Chilled-water fan-coil systems
   - e) Water-source heat pump systems
3) The "big picture" of building energy use
   - a) Examples from Neil's team
4) Top ten energy modeling mistakes
   - a) Share experience
6) Summary

Presenters

Trane Engineers Newsletter Live Series

LEED 2009 Modeling and Energy Savings

(2009)

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 joined Trane in 1982 With expertise in system optimization and control, and in chilled-water system design, Mick's primary responsibility is to help designers properly apply Trane products and systems through one-on-one support, technical publications, and seminars. Mick is a past Chair of SSPC 90.1 and holds a B.S. and M.S. degree in mechanical engineering. Mick is a registered professional engineer in the State of Wisconsin.

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.

LEED 2009 Modeling and Energy Savings

engineers newsletter LIVE

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.

CONTINUING EDUCATION AIA

2 |

LEED 2009 Update

Agenda

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

3 |

Today's Presenters

Scott Hintz
C.D.S. marketing engineer

Mick Schwedler
manager, applications engineering

Chris Hsieh
systems engineer

4 |

LEED 2009 Update

Major Changes

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

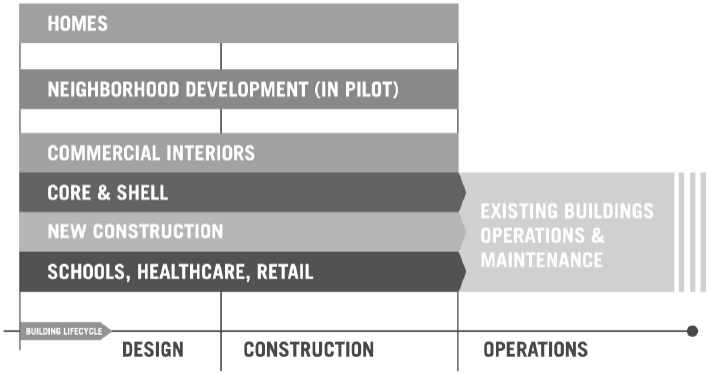
7 |

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 sites development
    Water savings
    Energy efficiency
    Materials selection
    Indoor environmental quality

8 |

LEED
Addresses entire Building Lifecycle



Source: U.S. Green Building Council

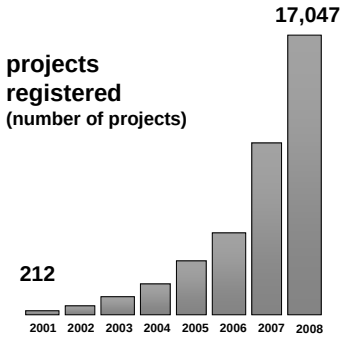
9 | © 2009 Trane

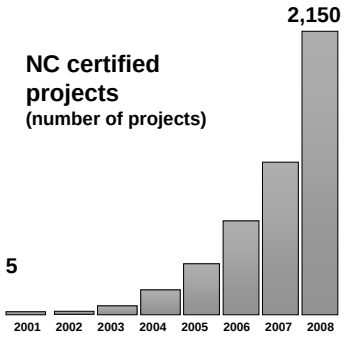
Four Levels of LEED

Source: U.S. Green Building Council

10 | © 2009 Trane

Progress of LEED

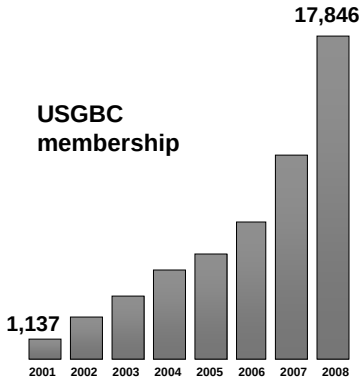




Source: U.S. Green Building Council, Dec. 2008

11 | © 2009 Trane

Progress of USGBC



Source: U.S. Green Building Council, Dec. 2008

12 | © 2009 Trane

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 Web site

13 |

LEED V3

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

14 |

Comparison

- NC 2.2
- NC 2009

15 | © 2009 Trane

For LEED NC

Prerequisites

	2.2	2009
Sustainable Sites	1	1
Water Efficiency	0	1
Energy & Atmosphere	3	3
Material & Resources	1	1
Indoor Environmental Quality	2	2
Innovation & Design Process		
Regional Bonus		

New

16 | © 2009 Trane

For LEED NC

Points distribution

	2.2	2009
▪ Sustainable Sites	14	26
▪ Water Efficiency	5	10
▪ Energy & Atmosphere	17	35
▪ Material & Resources	13	14
▪ Indoor Environmental Quality	15	15
▪ Innovation & Design Process	5	6
▪ Regional Bonus		4

25%

35%

22%

15%

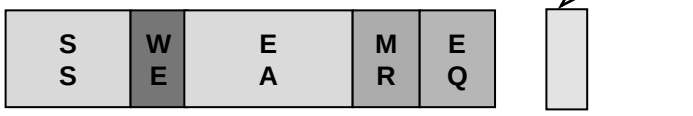
10 pt extra

Point distribution

- NC 2.2

ID and regional 10%

- NC 2009

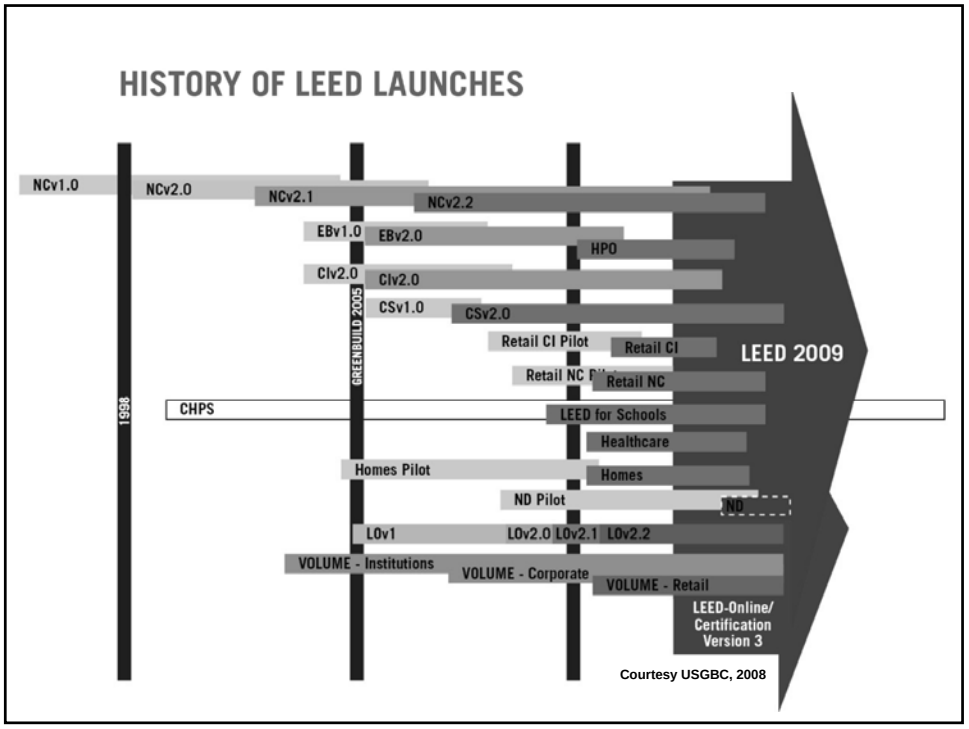


LEED 2009 Modeling and Energy Savings

Harmonization

Why Change?

- LEED use increasing
- LEED acceptance increasing
- LEED Accredited Professionals increasing in number
- High momentum



Why Change?

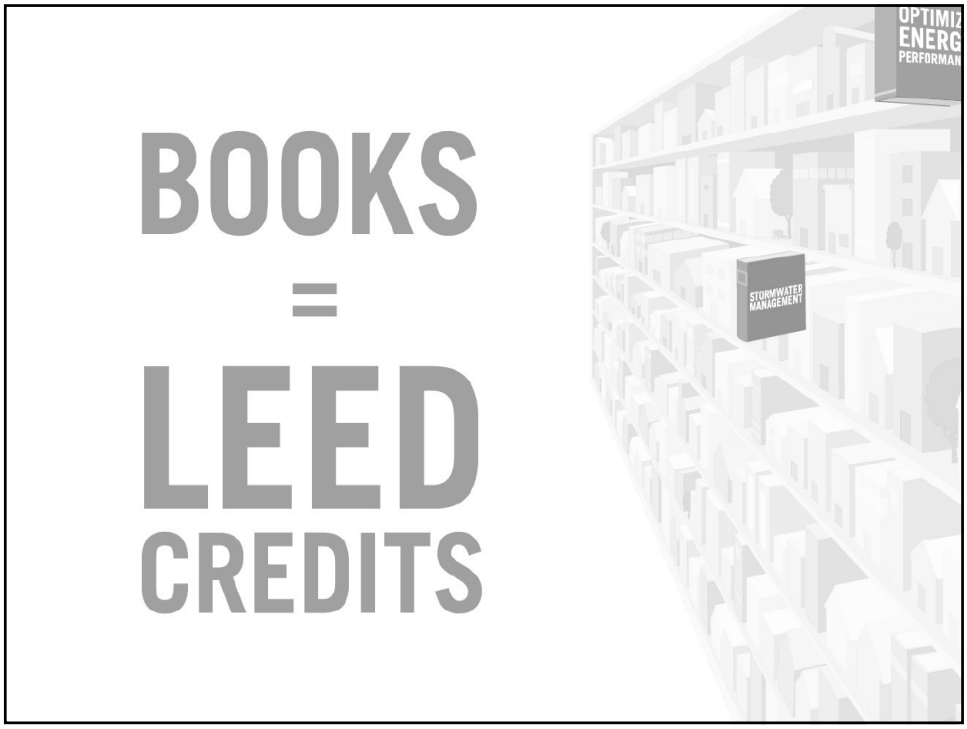
- LEED use increasing
- LEED acceptance increasing
- LEED Accredited Professionals increasing in number
- High momentum
- Products are becoming dissimilar
- LEED AP a bit nebulous
- Time for re-focus of LEED
- Need for future growth

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)



LEED 2009 Modeling and Energy Savings

engineers newsletter LIVE

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

LEED 2009 Credit Weighting

- 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

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-NC

				Existing Credit Point Allocation In LEED 2.2		Credit's Allocated Points Based on Environmental Impact	
				Points			
				LEED 2.2	LEED 2.2 (%)	LEED 3.0	LEED 3.0 (%)
0		0	Transportation	5	7%	8.3	8.3%
			Credit 2 **Development Density & Community Connectivity**	1	1.4%	1.66	1.7%
P			Credit 4.1 **Alternative Transportation,** Public Transportation Access	1	1.4%	1.66	1.7%
P			Credit 4.2 **Alternative Transportation,** Bicycle Storage & Changing Rooms	1	1.4%	1.66	1.7%
			Credit 4.3 **Alternative Transportation,** Low-Emitting and Fuel-Efficient Vehicles	1	1.4%	1.66	1.7%
P			Credit 4.4 **Alternative Transportation,** Parking Capacity	1	1.4%	1.66	1.7%
0		0	Sustainable Sites	9	13%	9.0	9.0%
Y			Prereq 1 **Construction Activity Pollution Prevention**	Required			
P			Credit 1 **Site Selection**	1	1.4%	1.74	1.7%

LEED 2009

Certification Thresholds

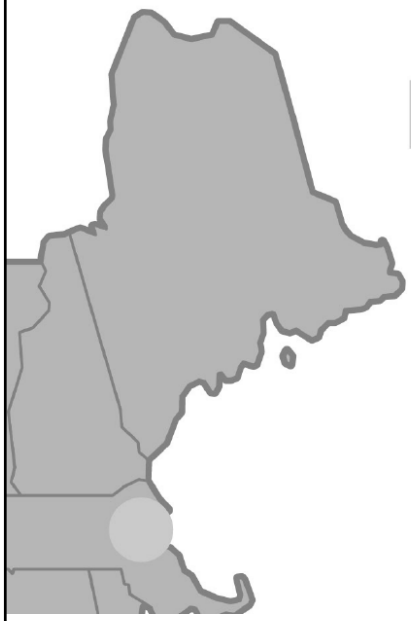
- Certified: 40–49 points
- Silver: 50–59 points
- Gold: 60–79 points
- Platinum: 80+ points

LEED 2009

NC Scorecard

	2.2	2009
Sustainable Sites	14	26
Water Efficiency	5	10
Energy & Atmosphere	17	35
Material & Resources	13	14
Indoor Environmental Quality	15	15
Innovation & Design Process	5	6
Regional Bonus		4
Total points available	69	110

33 | © 2009 Trane



BOSTON-CI

SUSTAINABLE SITES

CREDIT 3.2 ALTERNATIVE TRANSPORTATION, BICYCLE STORAGE & CHANGING ROOMS

WATER EFFICIENCY

CREDIT 1 WATER USE REDUCTION

ENERGY AND ATMOSPHERE

CREDIT 1.1 OPTIMIZE ENERGY PERFORMANCE: LIGHTING POWER

CREDIT 1.3 OPTIMIZE ENERGY PERFORMANCE: HVAC

MATERIALS AND RESOURCES

CREDIT 3.1 MATERIAL REUSE, 5%

CREDIT 5.1 REGIONAL MATERIALS, 20% MANUFACTURED REGIONALLY

34 | © 2009 Trane

LEED 2009 Modeling and Energy Savings

engineers newsletter LIVE

Certification Changes

Certification Changes

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

www.gbci.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

41 |

Tier 2:
LEED Accredited Professional

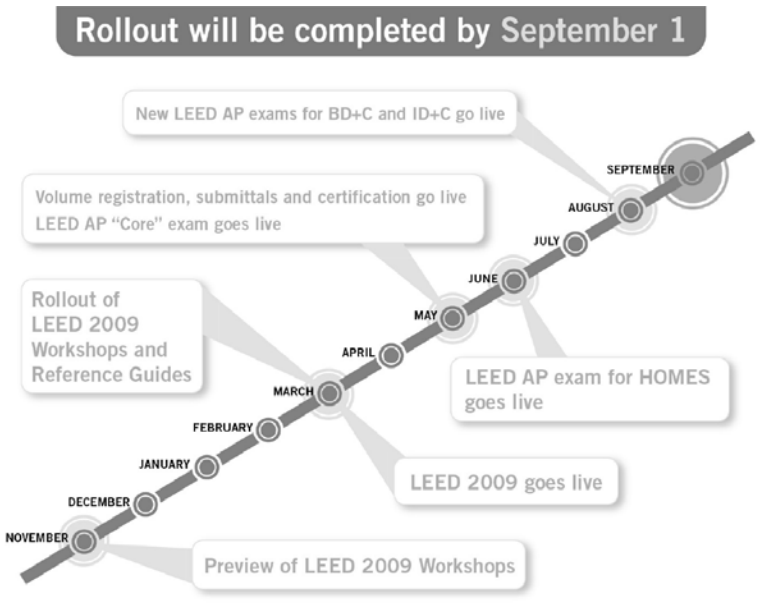
- In-depth knowledge in a particular field
- Demonstrate professional experience on at least one LEED project
- Document work on a LEED project within the last 3 years
- Examination of specific LEED product
- Biennial maintenance:
  - 30 hours
  - Minimum 6 LEED specific

42 |

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

43 | © 2009 Trane



44 | © 2009 Trane

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

engineers newsletter LIVE

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

47 |

LEED NC 2009 : EAp2
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

48 |

Major Changes : EAp2
Minimum Energy Performance

NC 2.2

Option 1: 90.1-2004

- Mandatory provision (5.4, 6.4, 7.4, 8.4, 9.4, and 10.4)
- Prescriptive requirement (5.5, 6.5, 7.5, and 9.5)
- Baseline building complies with Appendix G Building Performance Rating Method (PRM)
- 14% better than 90.1-2004 for new construction, 7% better for existing building

NC 2009

Option 1: 90.1-2007

- 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

Major Changes : EAp2
Minimum Energy Performance

NC 2.2

Option 2: prescriptive compliance path

- ASHRAE Advanced Energy Design Guide (AEDG) for small office buildings 2004

NC 2009

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

Major Changes : EAp2
Minimum Energy Performance

NC 2.2

No option 3

NC 2009

Option 3: prescriptive compliance path

- Advanced Buildings Core Performance Guide

51 | © 2009 Trane

Major Changes: EQp1
Minimum IAQ Performance

NC 2.2

62.1-2004

- 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

NC 2009

62.1-2007

- 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

52 | © 2009 Trane

Major Changes: WEp1

Water Use Reduction

NC 2.2

none

NC 2009

20% water use reduction

- Energy Policy Act 1992
- Energy Policy Act 1995
- Uniform Plumbing Code or International Plumbing Code of 2006

53 | © 2009 Trane

Credits

Sustainable Sites (SS)	2.2	2009
1: Site Selection	**1**	**1**
2: Development Density & Community Connectivity	**1**	**5**
3: Brownfield Redevelopment	**1**	**1**
4.1: Alternative Transportation: Public Transportation Access	**1**	**6**
4.2: Alternative Transportation: Bicycle Storage & Changing Rooms	**1**	**1**
4.3: Alternative Transportation: Low Emitting & Fuel Efficient Vehicles	**1**	**3**
4.4: Alternative Transportation: Parking Capacity	**1**	**2**

54 | © 2009 Trane

Credits

Sustainable Sites (SS)	2.2	2009
▪ **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**

55 | © 2009 Trane

Credits

▪ Materials & Resources (MR)	2.2	2009
• **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**

56 | © 2009 Trane

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

57 | © 2009 Trane

LEED 2009 Modeling and Energy Savings

engineers newsletter LIVE

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

ASHRAE Standard 90.1-2007 Change
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

63 | © 2009 Trane

ASHRAE Standard 90.1-2007 Change
Prescriptive HVAC Requirements

Air System Design & Control

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

Option	Constant volume	Variable volume
1) Nameplate hp	**hp ≤ CFMs x 0.0011**	**hp ≤ CFMs x 0.0015**
2) System bhp	**bhp ≤CFMs x 0.00094 + A**	**bhp ≤CFMs x 0.0013 + A**

64 | © 2009 Trane

ASHRAE Standard 90.1-2007 Change

Fan Power Limitation Pressure Drop Adjustment

- $A = \Sigma (PD \times CFM_{design} / 4131)$
- PD specified for
  - Ducts
  - Filters
  - Gas-phase air cleaners
  - Heat recovery devices
  - Sound attenuation sections
  - Other devices

65 |

ASHRAE Standard 90.1-2007 Change
Prescriptive HVAC Requirements

Air System Design & Control

- VAV fan control
  - Motors ≥ 10 hp require one of the following: ***(was 15 hp)***
    - Variable-speed drive
    - Vane axial fan with variable-pitch blades
    - Design wattage ≤ 30% at 50% air volume
  - DDC systems must include setpoint reset (fan-pressure optimization)

66 |

ASHRAE Standard 90.1-2007 change

Lighting Addenda

- ai: retail display lighting
  Gives lighting designers flexibility

67 | © 2009 Trane

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	

68 | © 2009 Trane

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**

69 |

Significant EA Changes

- EAc1 – Optimize Energy Performance
- EAc2 – On-Site Renewable Energy
- EAc5 – Measurement and Verification

70 |

EAc1 – Prescriptive Option 1
ASHRAE

Advanced Energy Design Guides

- (1 point)
  - Offices < 20,000 ft^2
  - Retail < 20,000 ft^2
  - Small Warehouses < 50,000 ft^2
  - K-12 Schools < 200,000 ft^2

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

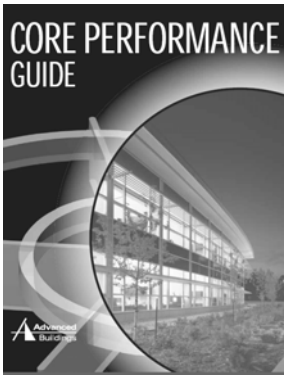
Advanced Energy Design Guides

- 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 ft^2
  - 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."*

77 | © 2009 Trane

Lighting Power Density Comparison

Building Type	90.1-2007 (W/ft^2)	Core Performance Guide (W/ft^2)
Family Dining	**1.6** **Up to 1.0 additional decorative**	**1.6** **Including decorative lighting**
Retail	**1.5** **Plus display lighting**	**1.3** **Including display lighting**

78 | © 2009 Trane

Examples

Core Performance Guide Mechanical Efficiency

Category	Size	90.1-2007	CPG
Rooftop	20 tons	10.0 EER 9.7 IPLV	10.5 EER 10.9 IPLV
Air-cooled chiller	All	1.26 kW/ton 1.15 IPLV	1.2 kW/ton 1.0 IPLV
Constant Speed centrifugal chiller	>600 tons	0.576 kW/ton 0.549 IPLV (as of 1/1/2010) 0.570 kW/ton 0.539 IPLV	0.550 kW/ton 0.510 IPLV
Variable Speed centrifugal chiller	>600 tons	0.576 kW/ton 0.549 IPLV (as of 1/1/2010) 0.590 kW/ton 0.400 IPLV	0.55 kW/ton 0.400 IPLV

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 strategies

www.advancedbuildings.net/publications.htm

EAC1 – Modeling
Up to 19 points

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

EAC2 – On-Site Renewable Energy

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

- 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

engineers newsletter LIVE

ASHRAE Standard 62.1-2007 Major Addenda

62.1 2007 Change

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)

87 |

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

88 |

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

89 | © 2009 Trane

Significant EQ Changes

Credit	Description	LEED NC 2.2		LEED 2009	
		Maximum credits	Max %	Maximum credits	Max %
1	Outdoor Air Delivery Monitor.	1	1.45%	1	1.0%
2	Increased Ventilation	1	1.45%	1	1.0%
3.1–3.2	Construction IAQ Manage. Plan	2	2.9%	2	2.0%
4.1-4.4	Low-Emitting Materials	4	5.8%	4	4.0%
5	Indoor Chemical & Pollutant Source Control	1	1.45%	1	1.0%
6.1-6.2	Controllability of Systems	2	2.9%	2	2.0%
7.1-7.2	Thermal Comfort	2	2.9%	2	2.0%
8.1-8.2	Daylight & Views	2	2.9%	2	2.0%
	EQ Section	15	21.7%	15	15.0%
	Rating System Total	69		100	

90 | © 2009 Trane

EQ Changes – Credits 1 & 2

- No changes to credit points
- Credit requirements referencing 62.1-2004 now reference 62.1-2007
  - Credit 1 – Outdoor Air Delivery Monitoring
  - Credit 2 – Increased Ventilation

91 |

Significant WE Changes

Credit	Description	LEED NC 2.2		LEED 2009	
		Maximum credits	Max %	Maximum credits	Max %
1.1	Water Efficient Landscaping, Reduce by 50%	1	1.45%	2	2.0%
1.2	Water Efficient Landscaping, No Potable Use or No Irrigation	1	1.45%	2	2.0%
2	Innovative Wastewater Technologies	1	1.45%	2	2.0%
3	Water Use Reduction	1 to 2		2 to 4	
3.1	20% now 30% Reduction	1	1.45%	2	2.0%
3.2	30% now 35% Reduction	2	2.9%	3	3.0%
3.3	40% Reduction	N/A		4	4.0%
	WE Section	5	7.2%	10	10.0%
	Rating System Total	69		100	

92 |

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

engineers newsletter LIVE

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

95 |

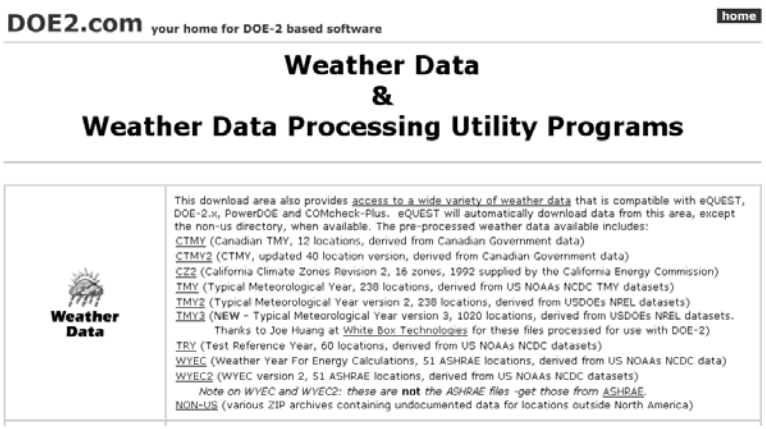
LEED
Sections and Points (NC 2009)

Design Category	Possible Points	
Sustainable Sites	26	
Water Efficiency	10	**8**
Energy and Atmosphere	35	**31**
Materials and Resources	14	
Indoor Environ. Quality	15	**1**
Innovation & Design	6	
Regional Priority	4	
Total Available Points	**110**	**40**

Blue indicates categories TRACE can be used with and the total possible points that can be obtained

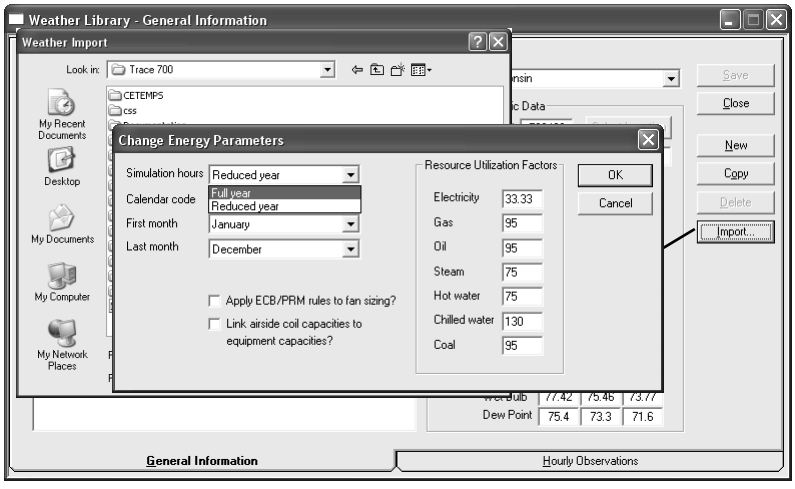
96 |

Full Year, 8,760 Hour Analysis



97 | © 2009 Trane

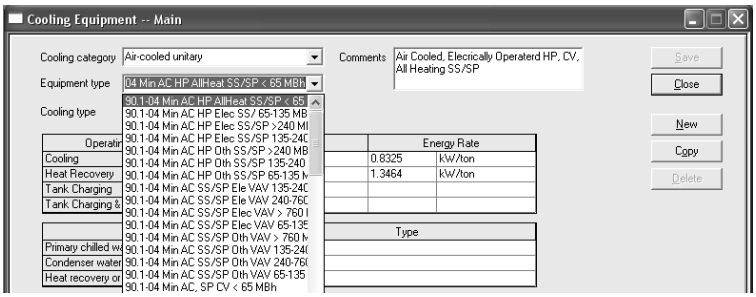
Full Year, 8,760 Hour Analysis



98 | © 2009 Trane

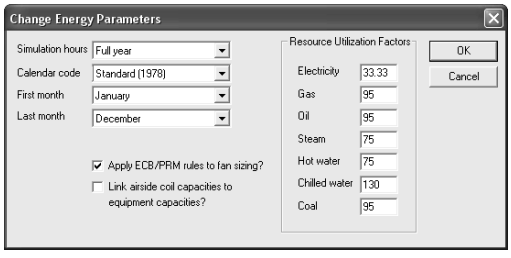
90.1 Minimally Compliant Equipment Library

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

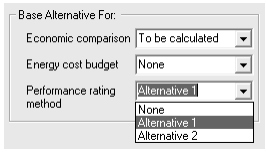


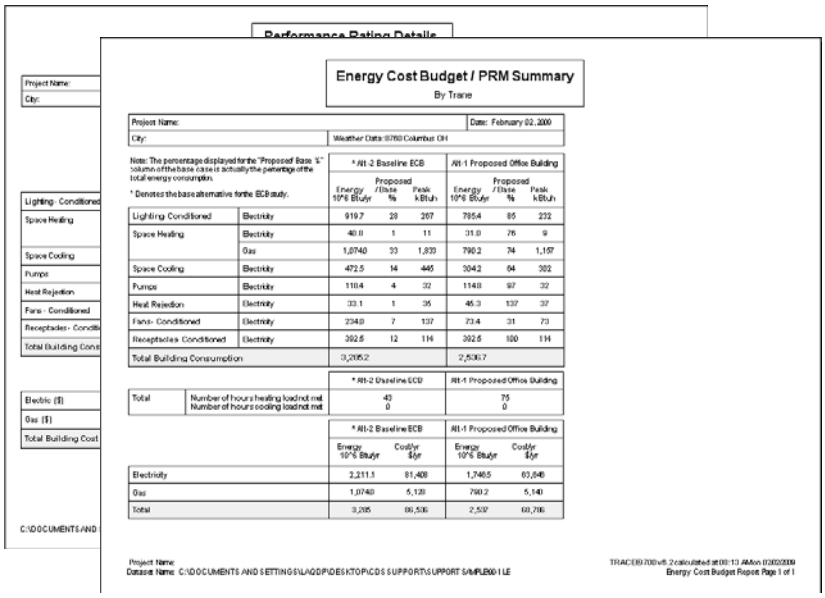
Automatic Features for LEED

- G3.1.2.9 - System Fan Power Calculation



- Baseline Building Rotation





Energy Cost Budget / PRM Summary

By Trane

Project Name:			Date: February 02, 2009		
City:		Weather Data: 93760 Columbus OH			
Note: The percentage displayed for the "Proposed / Base %" column of the base case is actually the percentage of the total energy consumption. * Denotes the base alternative for the ECB study.		* Alt-2 Baseline ECB			Alt-1 Proposed Office Building
		Energy 10^6 Btu/yr	Proposed / Base %	Peak kBtu/h	Energy 10^6 Btu/yr	Proposed / Base %	Peak kBtu/h
Lighting: Conditioned	Electricity	919.7	28	267	785.4	85	232
Space Heating:	Electricity	40.8	1	11	31.8	78	9
	Gas	1,074.0	33	1,833	790.2	74	1,197
Space Cooling:	Electricity	472.5	14	445	304.2	64	302
Pumps:	Electricity	118.4	4	32	114.8	97	32
Heat Rejection:	Electricity	33.1	1	35	46.3	137	37
Fans - Conditioned:	Electricity	234.8	7	137	73.4	31	73
Receptacles: Conditioned:	Electricity	392.6	12	114	392.6	100	114
Total Building Consumption:		3,265.2			2,538.7		

		* Alt-2 Baseline ECB	Alt-1 Proposed Office Building
Total	Number of hours heating load not met:	43	75
	Number of hours cooling load not met:	0	0

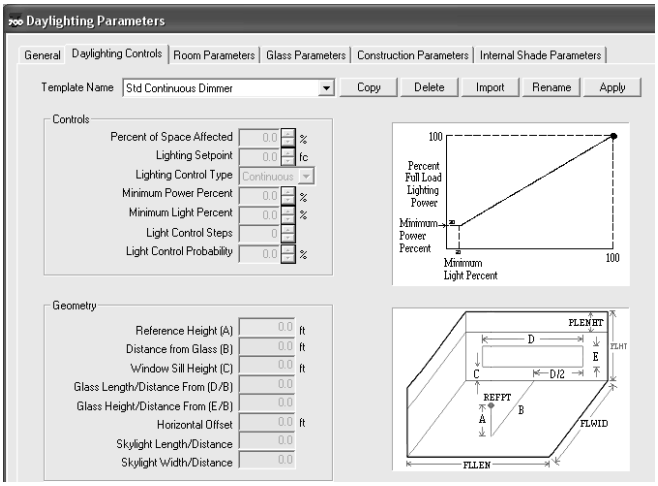
	* Alt-2 Baseline ECB		Alt-1 Proposed Office Building	
	Energy 10^6 Btu/yr	Cost/yr $/yr	Energy 10^6 Btu/yr	Cost/yr $/yr
Electricity	2,211.1	81,408	1,746.5	63,848
Gas	1,074.0	5,128	790.2	5,140
Total	3,285	86,536	2,537	68,706

Project Name:
Dataset Name: C:\DOCUMENTS AND SETTINGS\LAQDIP\DESKTOP\CDS SUPPORT\SUPPORT SAMPLE001.LE

TRACE® 700 v6.2 calculated at 08:13 AM on 02/02/2009
Energy Cost Budget Report: Page 1 of 1

101 | © 2009 Trane

Daylighting



102 | © 2009 Trane

Daylighting, cont.

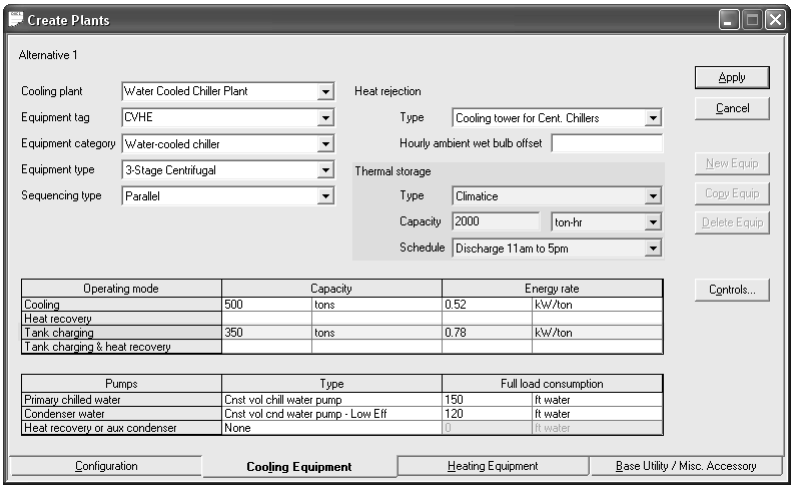
EQc 8.1 - Daylight 75% of Spaces

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

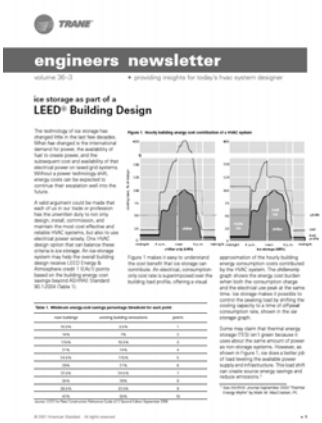
System Desc	Room Desc	Dayl Sched	Glass Area ft2	Floor Area ft2	Month	Day	Hour	GlassSolar ToSpace Btuh	Pct Ext Shad %	PctLites MetByDayl%	Refl#1 Dayl Illum ft-cand
2- AHU 1-2 (bld	3-110_A Sci	Available (100	99.6	1376	Mar	21	12	5396.7	0	70	25.3
					Sep	21	12	5294.2	0	70	25
2- AHU 1-2 (bld	3-107 Readin	Available (100	111	821	Mar	21	12	5533	0	70	37.6
					Sep	21	12	5231.8	0	70	36.5
2- AHU 1-2 (bld	3-106 Lang A	Available (100	66.6	820	Mar	21	12	4058	0	70	29.9
					Sep	21	12	3994.4	0	70	29.6

Thermal Storage



Thermal Storage, cont.

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


TRANE

engineers newsletter

volume 36-3 • providing insights for today's hvac system designer

ice storage as part of a LEED® Building Design

105 | © 2009 Trane

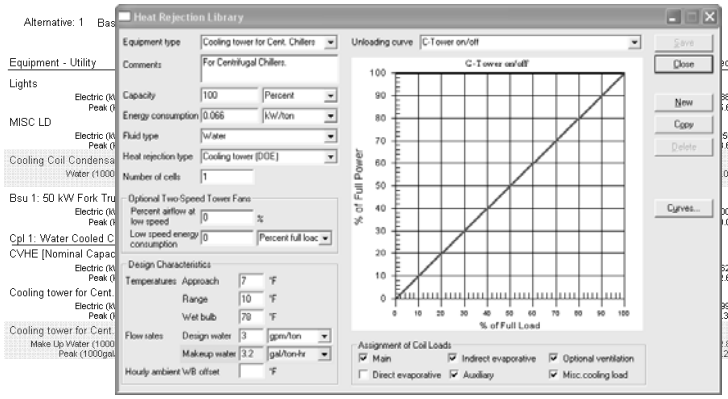
LEED 2009 Modeling and Energy Savings

engineers newsletter LIVE

Segue

Water Consumption

- Cooling Tower water usage and Cooling Coil Condensate recovery



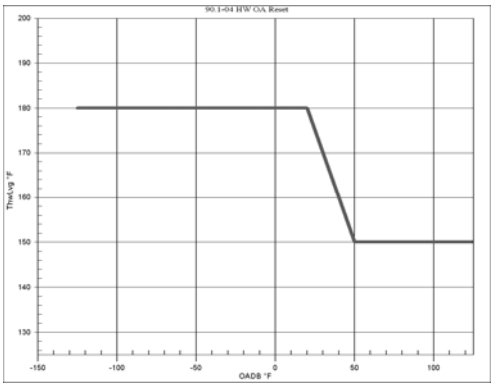
Water Consumption

- Marley cooling tower make-up usage calculation

Number of concentrations	Blowdown (% of cooling tower gpm)
3	0.4
4	0.25
5	0.18
6	0.13
8	0.08
10	0.06
12	0.04

Enhanced Capabilities

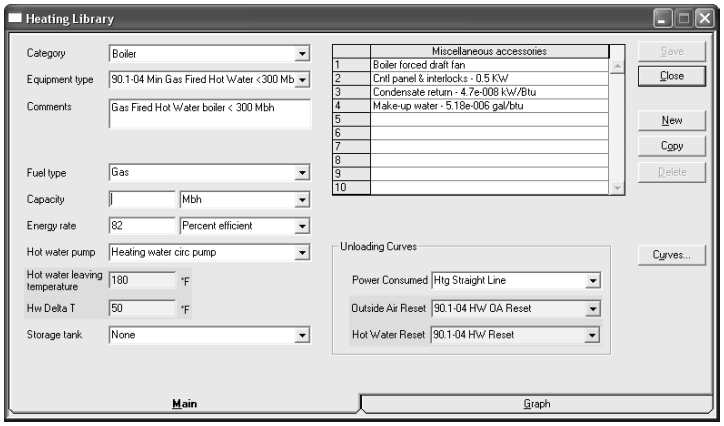
- Hot-Water Supply Temperature Reset



109 | © 2009 Trane

Enhanced Capabilities

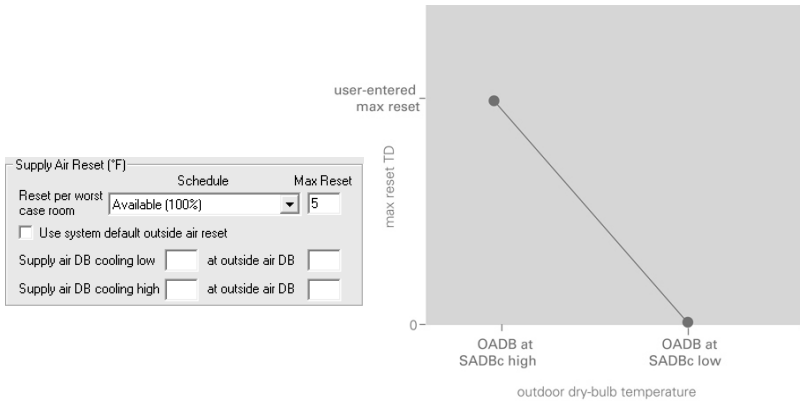
- Hot-Water Supply Temperature Reset



110 | © 2009 Trane

Enhanced Capabilities, cont.

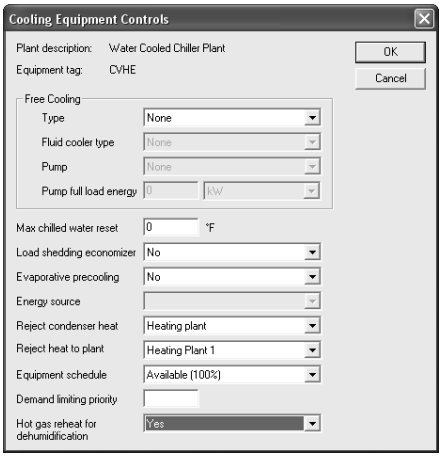
- Supply Air Temperature Reset



111 | © 2009 Trane

Enhanced Capabilities, cont.

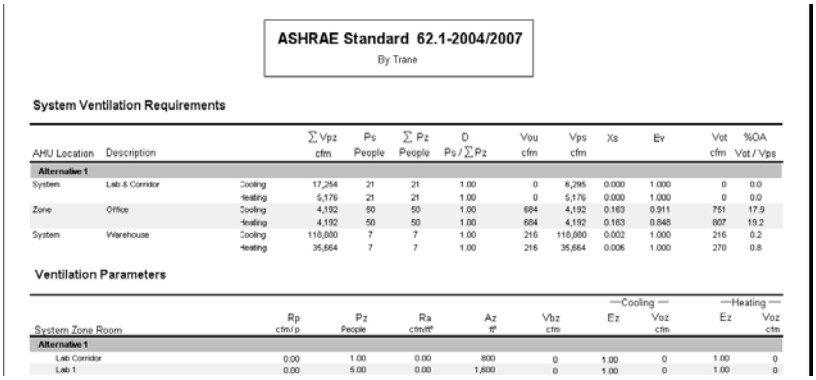
- Hot gas reheat for dehumidification



112 | © 2009 Trane

Enhanced Capabilities, cont.

- ASHRAE Standard 62.1 report



ASHRAE Standard 62.1-2004/2007

By Trane

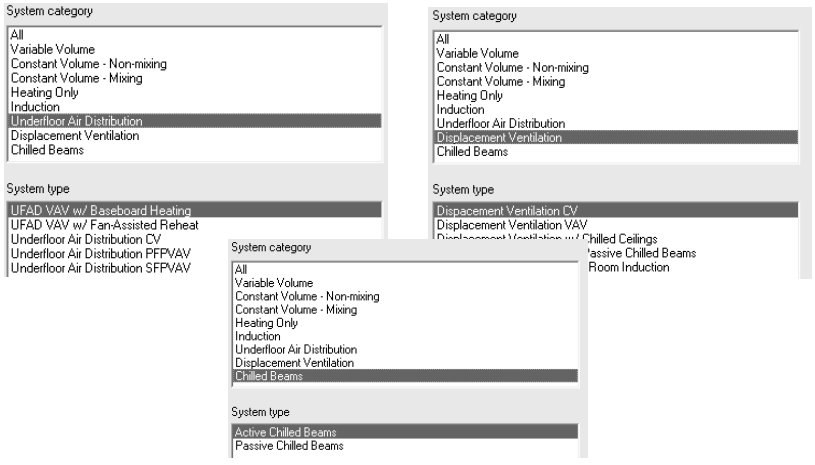
System Ventilation Requirements

AHU Location	Description		∑Vpz cfm	Ps People	∑ Pz People	D Ps / ∑Pz	Vou cfm	Vps cfm	Xs	Ev	Vot cfm	%OA Vot / Vps
Alternative 1												
System	Lab & Corridor	Cooling	17,254	21	21	1.00	0	6,295	0.000	1.000	0	0.0
		Heating	5,176	21	21	1.00	0	5,176	0.000	1.000	0	0.0
Zone	Office	Cooling	4,192	50	50	1.00	684	4,192	0.163	0.911	751	17.9
		Heating	4,192	50	50	1.00	684	4,192	0.163	0.848	807	19.2
System	Warehouse	Cooling	110,880	7	7	1.00	216	110,880	0.002	1.000	216	0.2
		Heating	35,664	7	7	1.00	216	35,664	0.006	1.000	270	0.8

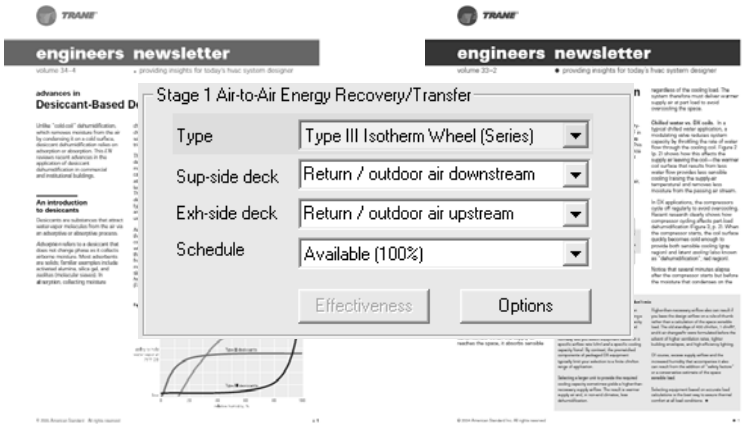
Ventilation Parameters

System Zone Room	Rp cfm / p	Pz People	Ra cfm/ft²	Az ft²	Vbz cfm	Cooling Ez	Cooling Voz cfm	Heating Ez	Heating Voz cfm
Alternative 1									
Lab Corridor	0.00	1.00	0.00	800	0	1.00	0	1.00	0
Lab 1	0.00	5.00	0.00	1,600	0	1.00	0	1.00	0

New System Categories & Types



Humidity Control?
UFAD, Chilled Beams, DV…



115 | © 2009 Trane

Energy Saving Strategies for LEED - ENL

116 | © 2009 Trane

Canada Green Building Council Ballots Passed Late 2008 or Early 2009

- LEED Canada for Homes
  http://www.cagbc.org/uploads/Homes_ENG.pdf
  March release of the Reference Guide
- LEED Canada for Existing Buildings
  http://www.cagbc.org/uploads/EBOM_formatted_ENG.pdf
- LEED Canada for New Construction v 2.0
  http://www.cagbc.org/uploads/LEED_NC_English_FINAL.pdf

117 |

LEED Canada Updates
Enhanced Refrigerant Management

- Now use the same method as USGBC
  - Homes – EA 11
  - EBOM – EA Credit 5
  - NC Version 2.0 – EA Credit 4

118 |

LEED Canada Updates

Enhanced Refrigerant Management

- Summary
  - Credit is achieved if no refrigerant is used
  - If refrigerant is used the method:
    - Balances refrigerant global warming and ozone depletion potentials
    - Requires calculation for all refrigerants (R-22, R134a, R-123, R-410a, R407c)
    - If project calculation is ≤ 100 the credit is earned
    - *"Select HVAC&R equipment with reduced refrigerant charge and increased equipment life."*

http://www.trane.com/Commercial/Uploads/XLS/891/EAc4Calculator_LEEDV2-2.xls

LEED 2009 Modeling and Energy Savings

engineers newsletter LIVE

Summary

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

Watch Past Broadcasts

ENL Archives

www.trane.com/bookstore

- 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

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

