Michigan Energy Code Training and Implementation Program

3.0 Hour Commercial Program Course Number 16141

2009 Michigan Uniform Energy Code

School of Planning, Design & Construction

Michigan State University

East Lansing, Michigan

Presenters

MICHIGAN STATE UNIVERSITY

Michigan Commercial Energy Code Training and Implementation Program:

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Course Number: 16141

3 Hours Technical:

BI, MI, or registrants with only BO/PR but no inspector registration

Project Support

Prepared by the **School of Planning, Design and Construction at Michigan State University**. Oversight provided by MSU faculty and the **Center for Construction Project Performance Assessment and Improvement (C2P2ai)**.

Funding provided by Michigan Department of Energy, Labor & Economic Growth, U.S. Department of Energy and the American Recovery and Reinvestment Act of 2009 with assistance from the Michigan Bureau of Energy Systems (BES) and Bureau of Construction Codes (BCC)

Project Objectives

To train building officials, inspectors, builders, subcontractors, suppliers, engineers and architects in the revised Michigan energy code for the purpose of:

1. Increasing understanding
2. Improving compliance
3. Reducing administrative time
4. Improving customer relationships

MICHIGAN STATE UNIVERSITY

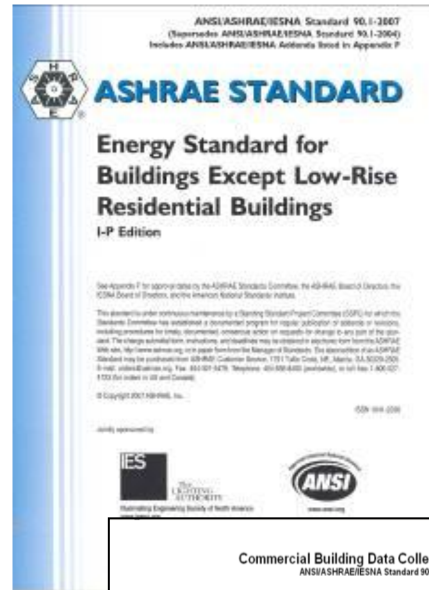
Presentation Overview

MICHIGAN STATE UNIVERSITY

- Need For Energy Codes
- Michigan Code Status
- 2009 MUEC[1] and ASHRAE 90.1
- Compliance Tools[1]
- COM*check* Software[2]
- Additional Resources

[1]As adapted from U.S. DOE provided instructional resources on ASHRAE 90.1—2007 with MI amendments

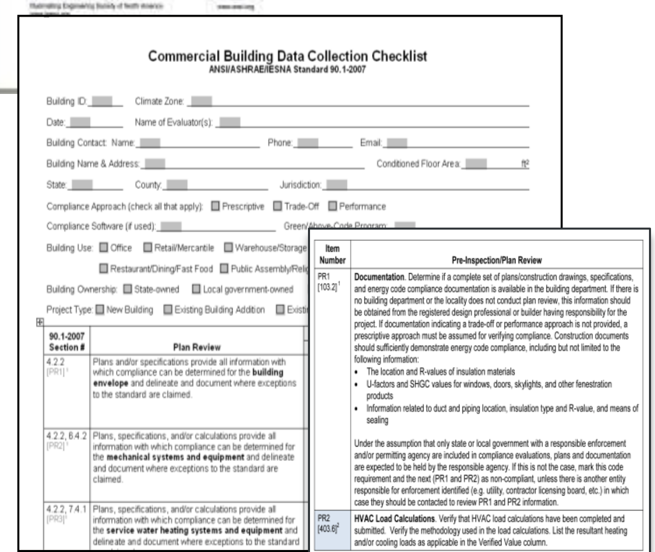
[2]Based on U.S. DOE COM*check* training case study


ANSI/ASHRAE/IESNA Standard 90.1-2007
(Supersedes ANSI/ASHRAE/IESNA Standard 90.1-2004)
Includes ANSI/ASHRAE/IESNA Addenda listed in Appendix F

ASHRAE STANDARD

Energy Standard for Buildings Except Low-Rise Residential Buildings

I-P Edition


Commercial Building Data Collection Checklist
ANSI/ASHRAE/IESNA Standard 90.1-2007

Building ID: Climate Zone:
Date: Name of Evaluator(s):
Building Contact Name: Phone: Email:
Building Name & Address: Conditioned Floor Area: ft²
State: County: Jurisdiction:
Compliance Approach (check all that apply): Prescriptive Trade-Off Performance
Compliance Software (if used): Green/Above-Code Program:
Building Use: Office Retail/Mercantile Warehouse/Storage Restaurant/Dining/Fast Food Public Assembly/Reli
Building Ownership: State-owned Local government-owned
Project Type: New Building Existing Building Addition Existi

90.1-2007 Section #	Plan Review
4.2.2 [PR1]	Plans and/or specifications provide all information with which compliance can be determined for the **building envelope** and delineate and document where exceptions to the standard are claimed.
4.2.2, 6.4.2 [PR2]	Plans, specifications, and/or calculations provide all information with which compliance can be determined for the **mechanical systems and equipment** and delineate and document where exceptions to the standard are claimed.
4.2.2, 7.4.1 [PR3]	Plans, specifications, and/or calculations provide all information with which compliance can be determined for the **service water heating systems and equipment** and delineate and document where exceptions to the standard

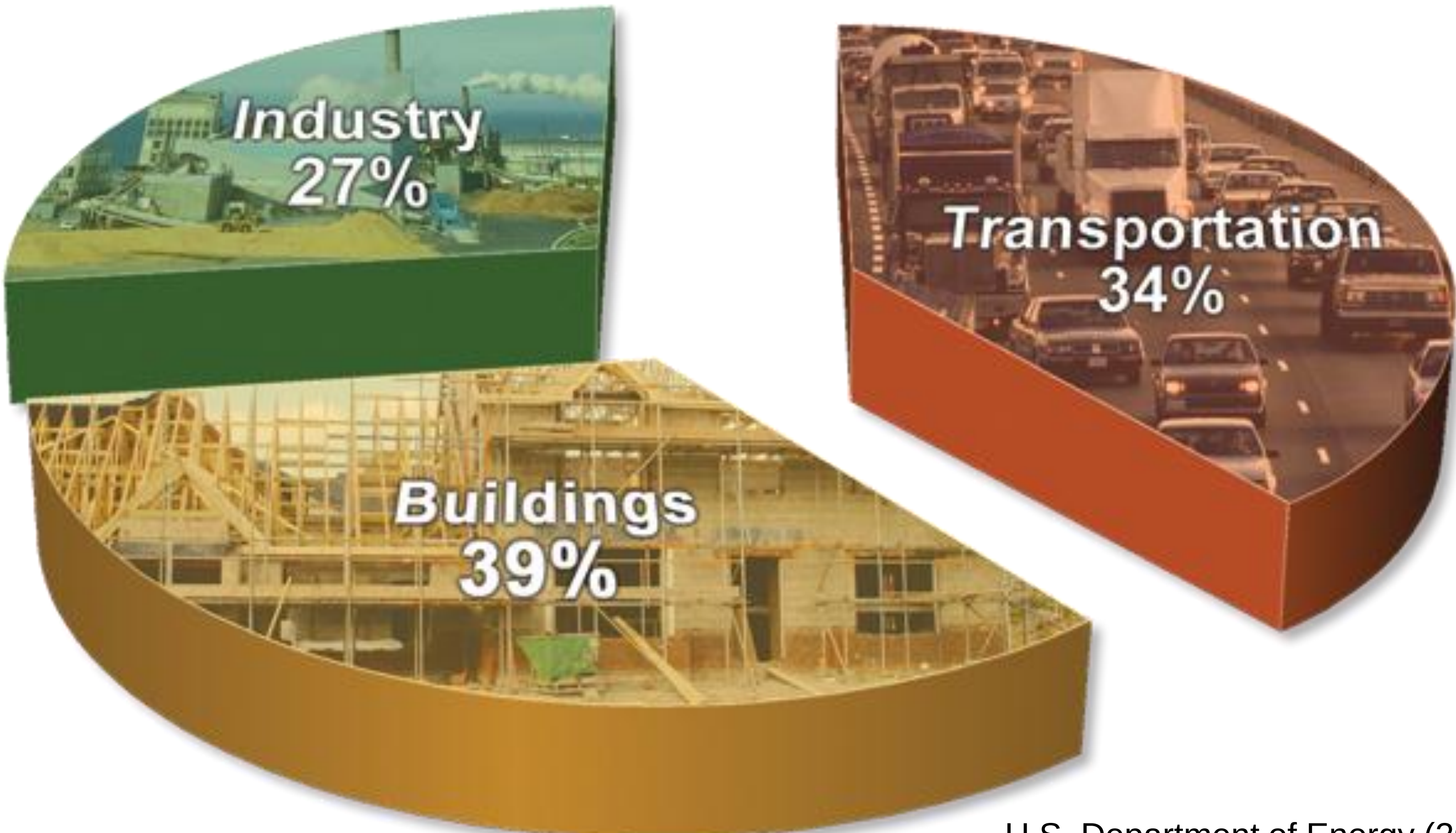
Item Number	Pre-Inspection/Plan Review
PR1 [103.2]	**Documentation.** Determine if a complete set of plans/construction drawings, specifications, and energy code compliance documentation is available in the building department. If there is no building department or the locality does not conduct plan review, this information should be obtained from the registered design professional or builder having responsibility for the project. If documentation indicating a trade-off or performance approach is not provided, a prescriptive approach must be assumed for verifying compliance. Construction documents should sufficiently demonstrate energy code compliance, including but not limited to the following information: • The location and R-values of insulation materials • U-factors and SHGC values for windows, doors, skylights, and other fenestration products • Information related to duct and piping location, insulation type and R-value, and means of sealing. Under the assumption that only state or local government with a responsible enforcement and/or permitting agency are included in compliance evaluations, plans and documentation are expected to be held by the responsible agency. If this is not the case, mark this code requirement and the next (PR1 and PR2) as non-compliant, unless there is another entity responsible for enforcement identified (e.g. utility, contractor licensing board, etc.) in which case they should be contacted to review PR1 and PR2 information.
PR2 [403.6]	**HVAC Load Calculations.** Verify that HVAC load calculations have been completed and submitted. Verify the methodology used in the load calculations. List the resultant heating and/or cooling loads as applicable in the Verified Value column.

http://www.energycodes.gov/arra/compliance_checklists.stm

Date visited: 2/11/2011

The Need For Energy Codes

U.S. Energy Use



U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

What Do Building Energy Codes and Standards Cover?

For both residential and commercial:

- **Building Envelope**
- **Mechanical**
- **Service Water Heating**
- **Lighting**
- **Electrical Power**

U.S. DOE: Code Official's Resource Guide (2010)

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Go To: www.energycodes.gov

Building Energy Codes Program

Date visited: 3/14/2011

ABOUT BECP | WHY BUILDING ENERGY CODES | RELATED LINKS

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- Builders/Contractors
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- State & Local Code Adopters
- Codes Advocates
- Students

FOLLOW US!

DOWNLOAD THE CODE:

Digital copies of the *ASHRAE Standard 90.1-2007 (I-P Edition)* and the *2009 International Energy Conservation Code®* are now available!

Get Your Copy Now!

» Learn More

1 2 3 4 5

To learn more about a featured item, click on the corresponding image.

Status of Energy Codes

Solutions & Help Center

Software & Tools

Building Energy Codes University

POWER TOOLS

Status | Helpline

Desktop Tools

REScheck | COMcheck

Online Tools

REScheck | COMcheck

RECENT UPDATES

2010 Building Energy Codes Annual Report Released
posted 03.04.2011

Store + Score Application Released
posted 03.04.2011

DOE proposed changes to IgCC PV 2.0
revised 03.10.2011

CODES IN THE NEWS

Notice of Public Meeting: Presenting and Receiving Comments to DOE Proposed Changes to the IgCC
posted 03.10.2011

A Chance Encounter with the Massachusetts Stretch Energy Code
Source: New Buildings Institute, 03.02.2011

Energy Efficiency key to Zero Energy Commercial Buildings
Source: Energy Saving Association, 02.21.2011

Michigan Code Status

Michigan Code Status

LEARN MORE....

- Status of State Energy Codes
- State-Level Technical Assistance
- Status of State-Level Technical Assistance Requests
- State-Level Technical Assistance Sample
- State-Level Technical Assistance Reports
- Energy Efficiency Partnerships
- DOE Building Technologies Application Centers

ALSO ON THIS WEBSITE...

- Status of Codes
- Solutions & Help Center
- Software & Tools
- Building Energy Codes University
- Publications
- Events Calendar

Status of State Energy Codes

Michigan

as of 2011-03-09

Do you know of updates to the information on this page?
If so, please *let us know!*

CURRENT NEWS

The energy code in Michigan has been finalized. The new code will be the 2009 International Energy Conservation Code for residential dwellings and ASHRAE 90.1-2007 for commercial buildings. The code will go into effect in March 2011.

RESIDENTIAL

Residential Code	2009 IECC
MI Amendments	
Approved Compliance Tools	Can use REScheck
MI-Specific Research	Impacts of the 2009 IECC for Residential Buildings in the State of Michigan (BECP Report, Sept. 2009)
Approximate Stringency	As stringent as the 2009 IECC
Effective Date	March 1, 2011
DOE Determination/State Certification	

COMMERCIAL

Commercial Code	ASHRAE 90.1-2007
MI Amendments	
MI-Specific Research	Impacts of Standard 90.1-2007 for Commercial Buildings in the State of Michigan (BECP Report, Sept. 2009)
Approved Compliance Tools	Can use COMcheck
Approximate Stringency	As stringent as ASHRAE 90.1-07
Effective Date	March 1, 2011
DOE Determination/State Certification	

POWER TOOLS

Status Helpline

Desktop Tools

REScheck COMcheck

Online Tools

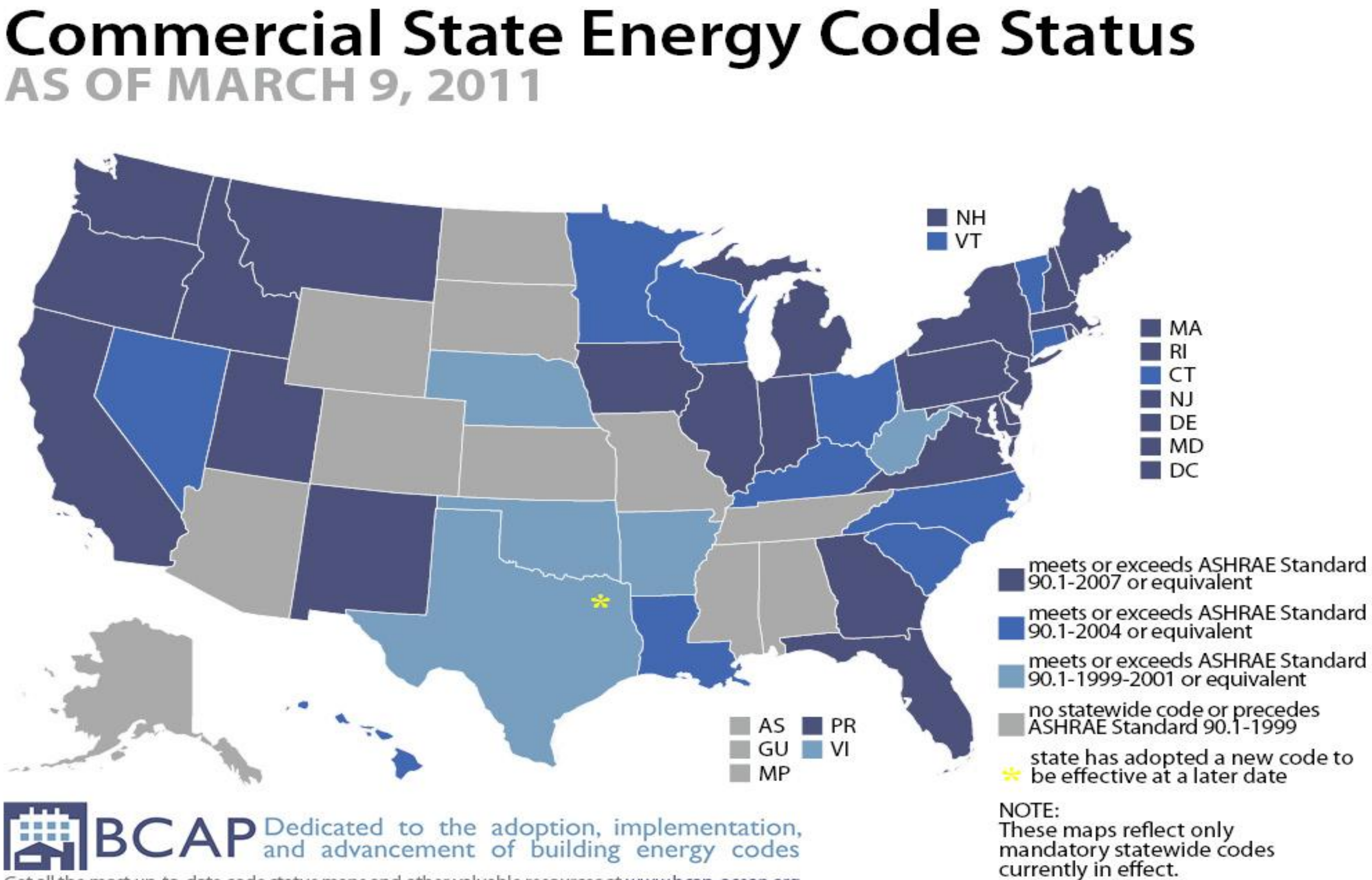
REScheck COMcheck

CUSTOMIZED MAPS

- Commercial Status at-a-glance
- Residential Status at-a-glance
- State Compliance Activities
- States that can use REScheck
- States that can use COMcheck
- Commercial Energy Code Adoption Activity
- Residential Energy Code Adoption Activity
- Download all maps!

http://www.energycodes.gov/states/state_info.php?stateAB=MI *Date visited: 3/15/2011*

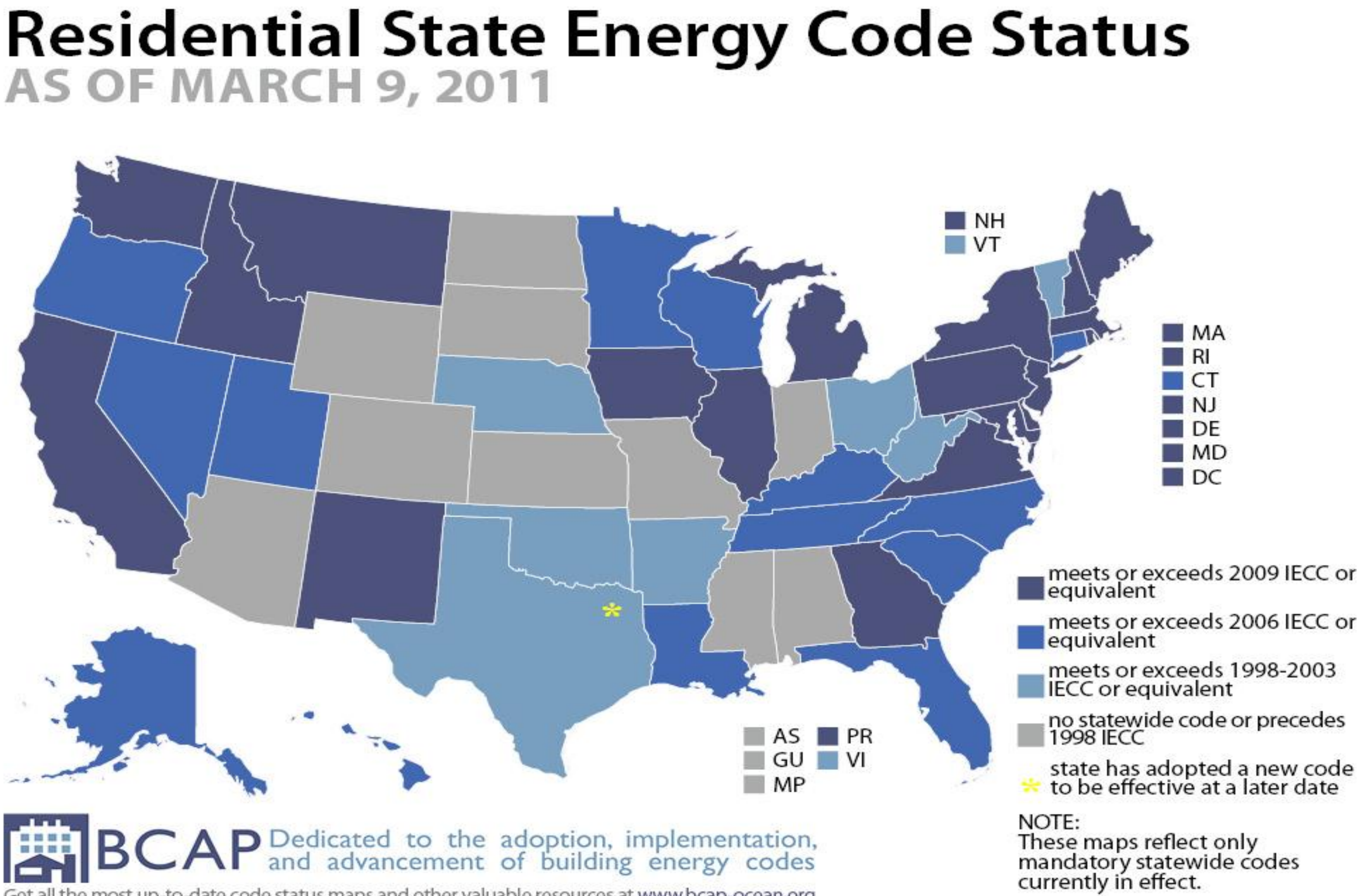
Code Status: Commercial



http://bcap-ocean.org/code-status-commercial

Date visited: 2/11/2011

Code Status: Residential



http://bcap-ocean.org/code-status-residential

Date visited: 2/11/2011

Michigan Code Status

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Online Code Environment & Advocacy Network
OCEAN

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LIBRARY | TOPICS | CODE STATUS | COMMUNITY | TOOLS | BLOG | Search GO

User Login

Username: *

Password: *

LOGIN

Create new account
Request new password

Home › 2009 Michigan Uniform Energy Code Effective March 9, 2011

2009 Michigan Uniform Energy Code Effective March 9, 2011

Posted in Adoption, Commercial, Implementation, Michigan, Michigan Uniform Energy Code, MUEC, Residential on November 15, 2010 by Paul Karrer

Rules to update the 2009 Michigan Uniform Energy Code (MUEC), Part 10 (Residential) and Part 10a (Commercial) were filed with the Secretary of State on November 8 and will be **effective March 9, 2011**. The rules will adopt the 2009 IECC with Michigan amendments and ASHRAE Standard 90.1-2007 (the MUEC is currently based on the 2003 IRC and ASHRAE 90.1-1999). The new codes were originally approved on July 20 by the Department of Energy, Labor & Economic Growth (DELEG) Bureau of Construction Codes.

A web link will be added to the Bureau's web site at www.michigan.gov/bcc, via the Codes and Standards Order Form to allow customers to purchase the code book directly from the International Code Council (ICC) for $38.00. Books are now available.

More Information: MUEC: Residential & Commercial | Bureau of Construction Codes

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BCAP Michigan Code Status

http://bcap-ocean.org/news/2010/november/15/2009-michigan-uniform-energy-code-effective-march-9-2011
Date visited: 3/15/2011

2009 Michigan Uniform Energy Code (MUEC)

http://bcap-energy.org/files/2003_MUEC.pdf **Date Visited: 09/15/2010**

2009 Michigan Uniform Energy Code (MUEC)

DEPARTMENT OF ENERGY, LABOR, AND ECONOMIC GROWTH

DIRECTOR'S OFFICE

CONSTRUCTION CODE

Filed with the Secretary of State on November 8, 2010
These rules take effect March 9, 2011

(By authority conferred on the director of the department of energy, labor, and economic growth by section 4 of 1972 PA 230, MCL 125.1504, and Executive Reorganization Order Nos. 2003-1 and 2008-20, MCL 445.2011 and MCL 445.2025)

R 408.31087, R 408.31088, R 408.31089, and R 408.31090 of the Michigan Administrative Code are amended and R 408.31087a is added to the code as follows:

PART 10a
MICHIGAN UNIFORM ENERGY CODE

R 408.31087 Applicable code.
Rule 1087. Rules governing the energy efficiency for the design and construction of buildings and structures, not including residential buildings, shall be those contained in the international energy conservation code, 2009 edition, section 501.1 and the ASHRAE energy standard for buildings except low-rise residential buildings, ANSI/ASHRAE/IESNA standard 90.1-2007 (hereafter the standard), including appendices A, B, C, and D. With the amendments noted, Section 501.1 of the international energy conservation code and the standard are adopted in these rules by reference. The Michigan uniform energy code is available for inspection or purchase at the Okemos office of the Michigan Department of Energy, Labor and Economic Growth, Bureau of Construction Codes, 2501 Woodlake Circle, Okemos, Michigan 48864, at a cost as of the time of adoption of these rules of $38.00 or may be purchased from the International Code Council, 500 New Jersey Avenue, N.W., 6th Floor, Washington, D.C. 20001. The ASHRAE 90.1-2007 standard is available for inspection at the Okemos office of the Michigan Department of Energy, Labor and Economic Growth, Bureau of Construction Codes. The standard may be purchased from the American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc., 1791 Tullie Circle, NE, Atlanta, Georgia 30329, at a cost as of the time of adoption of these rules of $119.95 each. Copies may be obtained from the Michigan Department of Energy, Labor and Economic Growth, Bureau of Construction Codes, 2501 Woodlake Circle, Okemos, Michigan 48864, at a cost as of the time of adoption of these rules of $119.95 each plus the department's cost for shipping and handling.

Presenters Note: Part 10a dependent on Part 10

http://www.michigan.gov/documents/dleg/dleg_bcc_2007_053lg_muec_commercial_337937_7.pdf

Date Visited: 2/11/2011

2009 MUEC Prescriptive Approach

Training Module

School of Planning, Design & Construction

Michigan State University
East Lansing, Michigan

MICHIGAN STATE UNIVERSITY

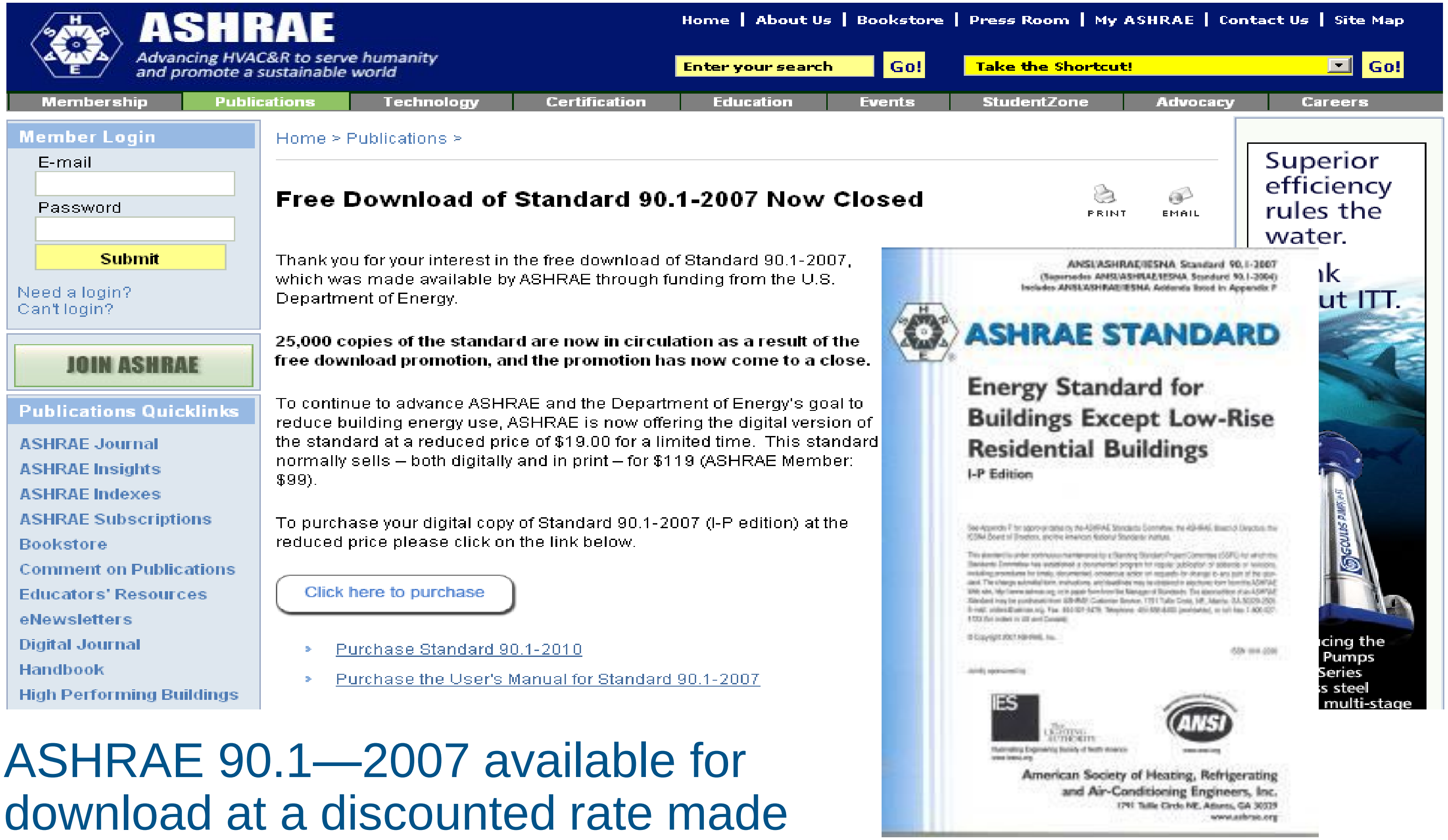
MEEA
Midwest Energy Efficiency Alliance

Department of Energy, Labor & Economic Growth
DeLEG
Working to Create Michigan's Future Today

Department of Energy United States of America

RECOVERY.GOV

ASHRAE 90.1—2007 Download



ASHRAE 90.1—2007 available for download at a discounted rate made possible by the U.S. Dept. of Energy:

http://www.ashrae.org/publications/page/2728

Date visited: 3/23/2011

Code Compliance Software Tools

Prescriptive

None Needed

Total Building "UA" Trade Off

COM*check* Software

(Web-based & Desktop)

Energy Analysis

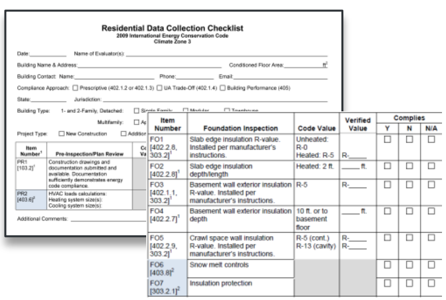
Software

For example:

DOE-2 Software

Carrier H.A.P.

eQuest



Residential Data Collection Checklist
2009 International Energy Conservation Code
Climate Zone 3

Item Number	Foundation Inspection	Code Value	Verified Value	Complies Y	Complies N	Complies N/A
FO1 [402.2.8, 303.2][1]	Slab edge insulation R-value. Installed per manufacturer's instructions.	Unheated: R-0 Heated: R-5	R-_____	☐	☐	☐
FO2 [402.2.8][1]	Slab edge insulation depth/length	Heated: 2 ft.	_____ ft.	☐	☐	☐
FO3 [402.1.1, 303.2][1]	Basement wall exterior insulation R-value. Installed per manufacturer's instructions.	R-5	R-_____	☐	☐	☐
FO4 [402.2.7][1]	Basement wall exterior insulation depth	10 ft. or to basement floor	_____ ft.	☐	☐	☐
FO5 [402.2.9, 303.2][1]	Crawl space wall insulation R-value. Installed per manufacturer's instructions.	R-5 (cont.) R-13 (cavity)	R-_____ R-_____	☐	☐	☐
FO6 [403.8][2]	Snow melt controls			☐	☐	☐
FO7 [303.2.1][2]	Insulation protection			☐	☐	☐

Why is Standard 90.1-2007 Important?

- It replaces ANSI/ASHRAE/IESNA Standard 90.1-1999, used in Michigan until 9 March 2011
- It is the professional "standard of care" set by ASHRAE consensus

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Standard 90.1-2007

- Section 1 - Purpose
- Section 2 - Scope
- Section 3 - Definitions, Abbreviations, and Acronyms
- Section 4 - Administration and Enforcement
- Section 5 - Building Envelope
- Section 6 - Heating, Ventilating, and Air Conditioning
- Section 7 - Service Water Heating
- Section 8 - Power
- Section 9 - Lighting
- Section 10 - Other Equipment
- Section 11 - Energy Cost Budget Method
- Section 12 - Normative References

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Standard 90.1-2007 Appendices

- ***A*** Rated R-Value of Insulation and Assembly U-Factor, C-Factor, and F-Factor Determinations
- ***B*** Building Envelope Climate Criteria
- ***C*** Methodology for Building Envelope Trade-Off Option in Subsection 5.6
- ***D*** Climatic Data
- ***E*** Informative References
- ***F*** Addenda Description Information (Informative)
- ***G*** Performance Rating Method (Informative, LEED®)

Presenters Note:

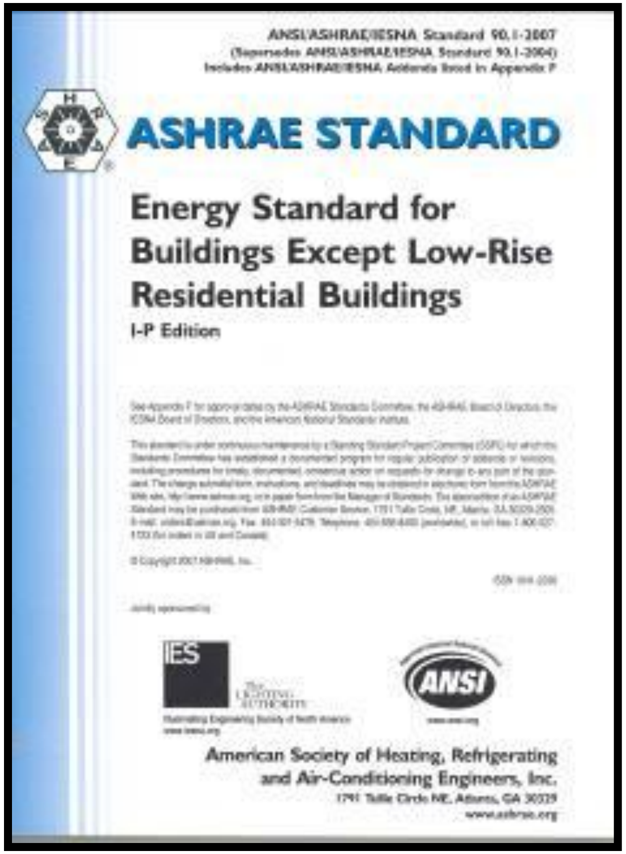
Appendices E,F, and G have not been adopted by Michigan

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Purpose *(Section 1)*

- To provide minimum requirements for the energy-efficient design of buildings except low-rise residential buildings
- MUEC residential provisions cover all low-rise (1-3 stories) houses, condos, townhouses, and apartments [R-2, R-3, R-4], but not hotels/motels [R-1]



http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Scope *(Section 2)*

(Section 2.1.a)

- New buildings and their systems
- New *portions* of buildings and their systems (additions)
- New systems and equipment in *existing* buildings (alterations)

U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Scope *(Section 2)*

- Envelope *(Section 2.2.a)*
  - if heated by a heating system with an output capacity
    $\geq$ 3.4 Btu/h-ft^2 (1 watt/ft^2) OR
  - if cooled by a cooling system with a sensible output capacity $\geq$ 5 Btu/h-ft^2
- Virtually all mechanical, power, and lighting systems are covered *(Section 2.2.b)*

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Scope Exceptions *(Section 2.3)*

- Too little heating or cooling
- Single-family, multifamily of three stories or less, manufactured or modular homes
- Buildings that don't use electricity or fossil fuel
- Equipment and portions of building systems that use energy primarily for industrial, manufacturing, or commercial processes

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Definitions, Abbreviations, and Acronyms *(Section 3)*

- 10 pages of definitions
  - some added, some deleted, some revised from 90.1-1999
- 1 page of abbreviations and acronyms
- Defined terms are italicized in text of standard

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Administration and Enforcement *(Section 4)*

- New buildings *(Section 4.1.1.1)*, additions to existing buildings *(Section 4.1.1.2),* and alterations to existing buildings *(Section 4.1.1.3)*
- Replacement of portions of existing buildings *(Section 4.1.1.4)*
- Changes in space conditioning *(Section 4.1.1.5)*

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Administration and Enforcement *(Section 4)*

- Compliance documentation *(Section 4.2.2.1)*
  - all the pertinent data of the building, systems, and equipment
- Labeling of materials and equipment *(Section 4.2.3)*
  - Fenestration, doors, insulation, mechanical equipment, and packaged terminal air conditioners
- Alternative materials and methods of construction *(Section 4.1.3)*
- Inspections *(Section 4.2.4)*

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Administration and Enforcement *(Section 4)*

- Section 4 merely provides the overall statement that new buildings, additions, alterations, replacements, and changes in space conditioning fall under the requirements of the Standard
- Details of which requirements the building must actually meet in various situations are discussed in the technical sections 5, 6, 7, 8, 9, 10, and 11 in the X.1 section named "General"

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

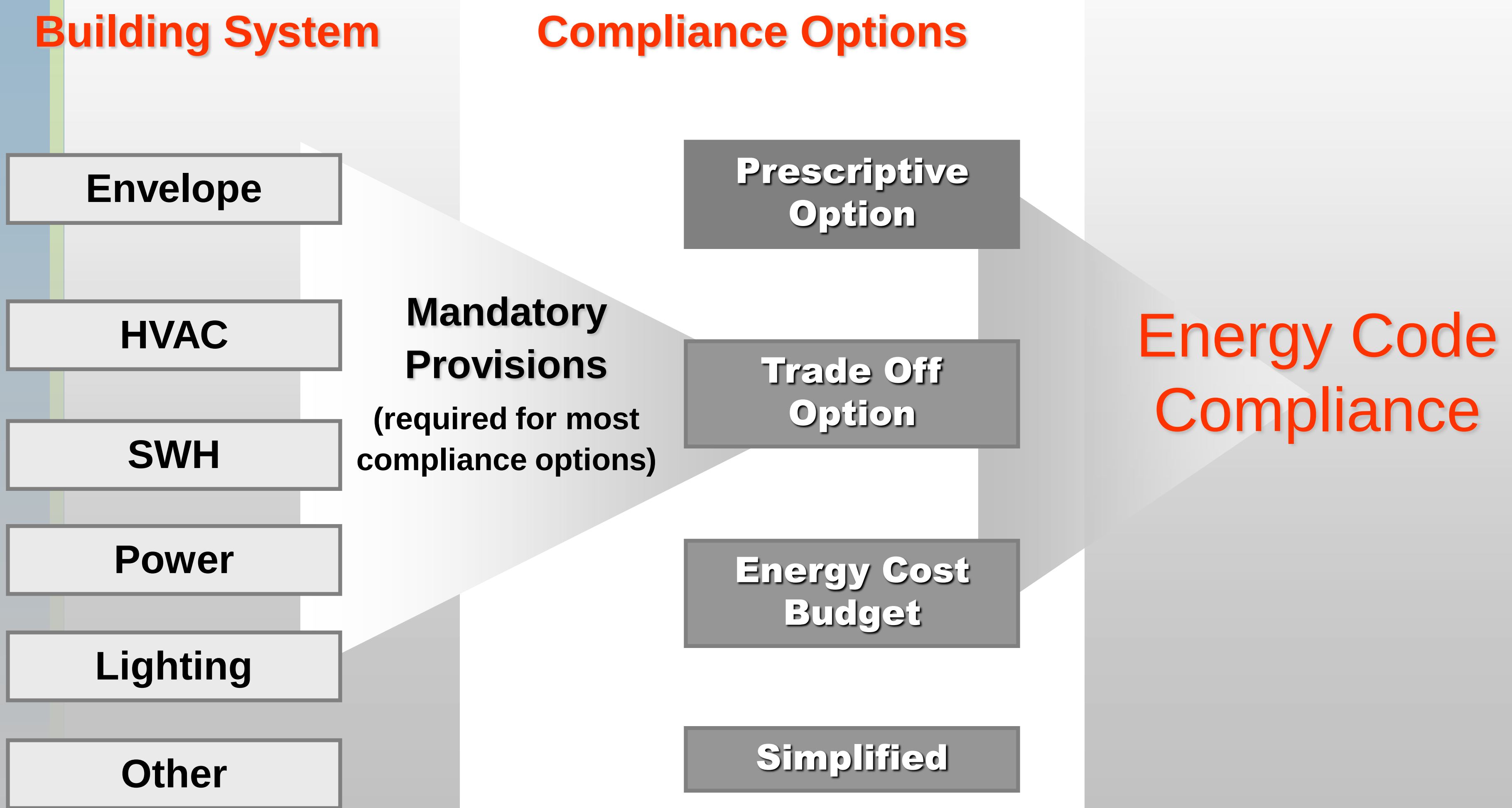
Exceptions for Alterations

- **Buildings that are specifically designated as historic *(Section 4.2.1.3.a)***
  - **by the adopting authority or**
  - **on the National Register of Historic Places or**
  - **eligible for listing by the U.S. Secretary of Interior**
- **If the building's annual energy consumption is the same as a building that meets the requirements of Sections 5-10 *(Section 4.2.1.3.b)***
  - **verified by a design professional using methods acceptable to the authority having jurisdiction**

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Compliance Approaches



http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Envelope Compliance

Building System

- Envelope
- HVAC
- SWH
- Power
- Lighting
- Other

Mandatory Provisions

(required for most compliance options)

Compliance Options

- Prescriptive Option
- Trade Off Option
- Energy Cost Budget
- Simplified

Energy Code Compliance

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Building Envelope *(Section 5)*

- General *(Section 5.1)*
  - Scope
  - Space-Conditioning Categories
  - Envelope Alterations
  - Climate
- Compliance Methods *(Section 5.2)*
- Simplified Building *(Section 5.3)* Not Used
- Mandatory Provisions *(Section 5.4)*
  - Insulation
  - Fenestration and Doors
  - Air Leakage

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Building Envelope *(Section 5)*

- Prescriptive Building Envelope Option *(Section 5.5)*
  - Opaque Areas
  - Fenestration
- Building Envelope Trade-Off Option *(Section 5.6)*
- Submittals *(Section 5.7)*
- Product Information and Installation Requirements *(Section 5.8)*

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

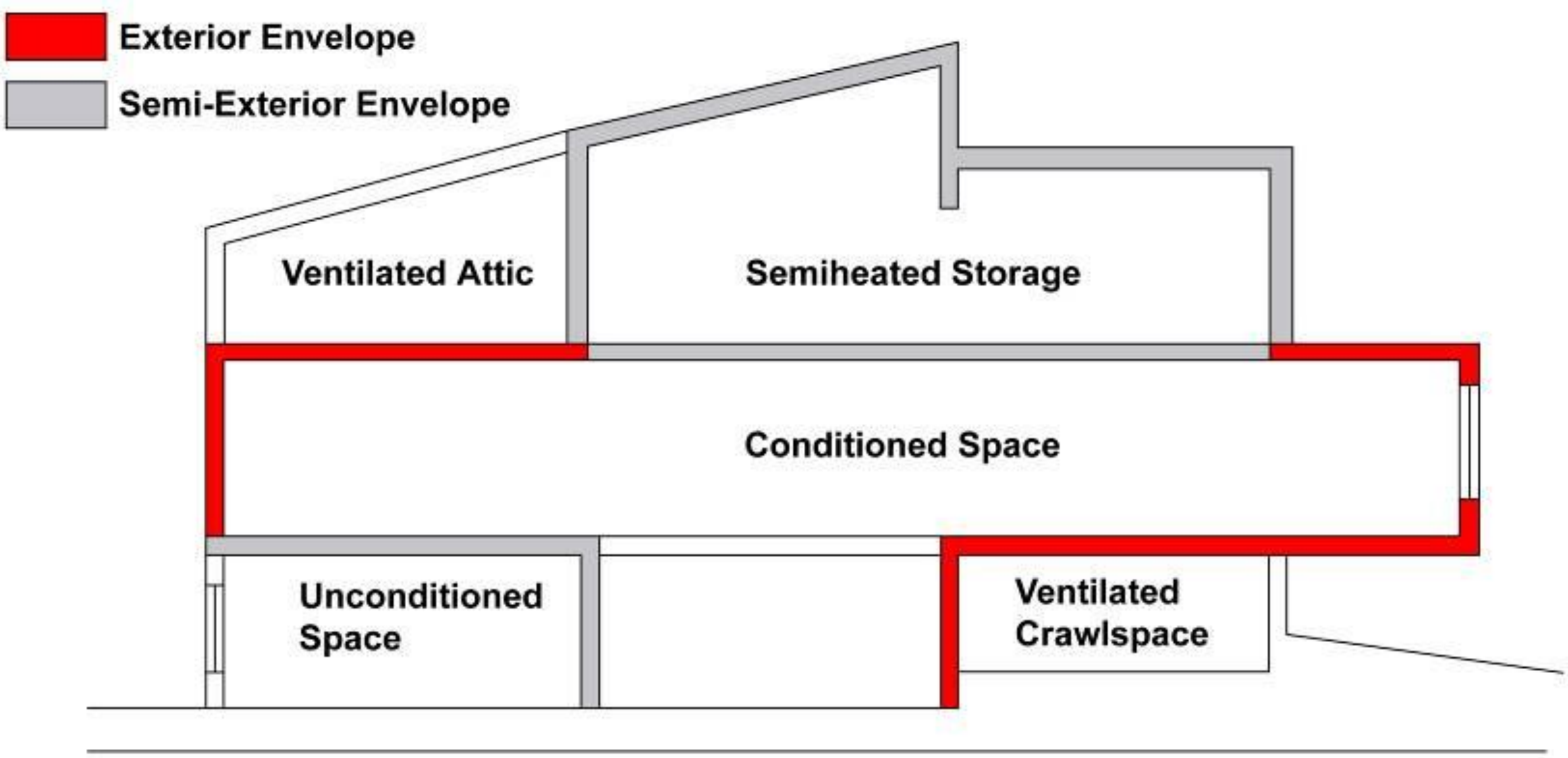
Scope

- Envelope components that enclose *(Section 5.1.2.1)*
  - Conditioned space
  - Semi-heated space
    - Has a heating system with a capacity > 3.4 Btu/h·ft^2 of floor area but is not conditioned space
- Requirements apply to three types of spaces *(Section 5.1.2.1)*
  - Nonresidential
  - Residential
  - Semi-heated
- *Exceptions*

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Building Envelope



(Figure 5.5)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Space-Conditioning Categories and Basis

Envelope Requirements Are Specified by Space-Conditioning Categories

- Each space to be included in a category *(Section 5.1.2.1)*
  - Nonresidential conditioned space
  - Residential conditioned space
  - Semi-heated space
- Spaces in climate zones 3-8 assumed to be conditioned space unless *(Section 5.1.2.3)*
  - Space will only be semi-heated or unconditioned and
  - Approved as such by the building official

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Semi-heated Space

- Has a heating system with a capacity > 3.4 Btu/h.ft^2 (1 W/ft^2) of floor area but is not conditioned space *(Section 3.2 Definition)*
- *Space is not cooled at all*

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Envelope Alterations

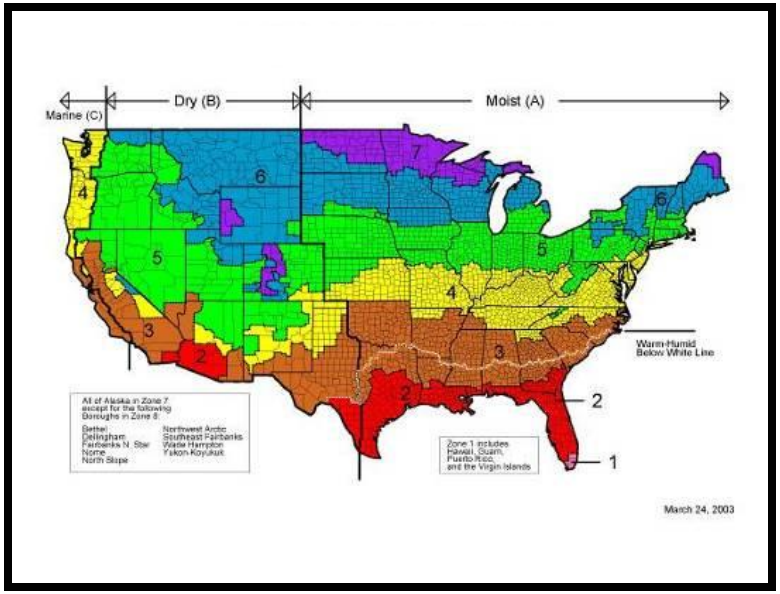
- Alterations to the building envelope shall comply with the requirements of Section 5 *(Section 5.1.3)*
  - *Exceptions* are allowed if they don't increase energy usage of building
    - Installation of storm windows
    - Replacement of glazing in existing sash and frame
    - Alterations to envelope cavities provided they are insulated to full depth with a nominal R-3.0 per in.
    - Roof and floor alterations where no new cavities are created
    - Replacement of roof membranes
    - Replacement of existing doors
    - Replacement of existing fenestration, provided area of replacement is no more than 25% of total fenestration area

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Climate Zones *(Section 5.1.4)*

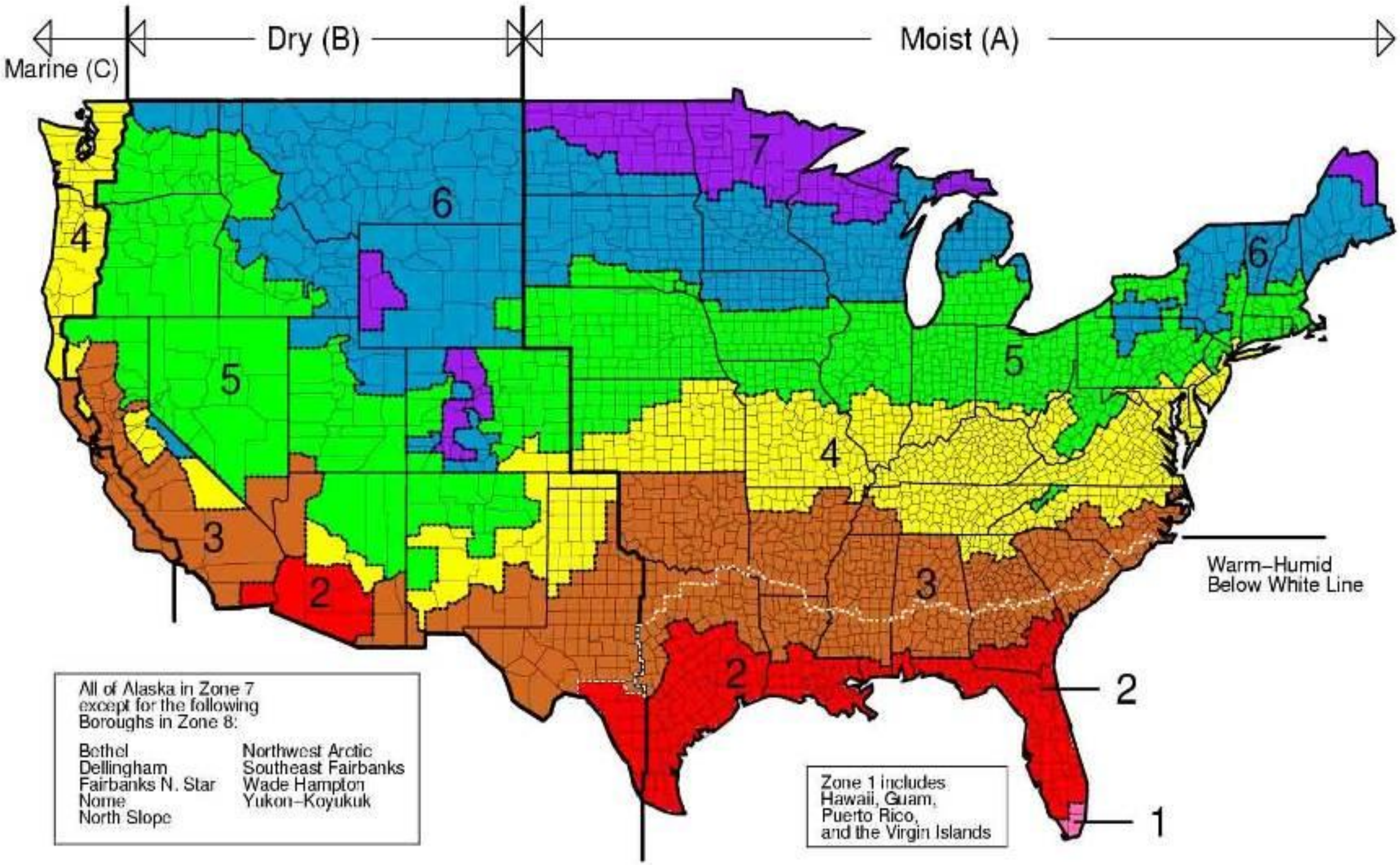
- Zones based on several climatic parameters
  - Locations listed in Appendix B on county-by-county basis for United States



http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Climate Zones—ASHRAE 90.1—2007



http://www.energycodes.gov/becu/trainers.stm

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2009 MUEC Climate Zones

The State of Michigan is divided into 3 climate zones:

Table 301.3(2)

Climate Zone Definitions

Zone Number	Thermal Criteria	
	IP Units	SI Units
5A	5400 < HDD65°F≤7200	3000 < HDD18°C≤4000
6A	7200 < HDD65°F≤9000	4000 < HDD18°C≤5000
7	9000 < HDD65°F≤12600	5000 < HDD18°C≤7000

For SI: °C = [(°F)-32]/1.8

http://www.michigan.gov/documents/dleg/dleg_bcc_2007_052lg_muec_residential_337936_7.pdf

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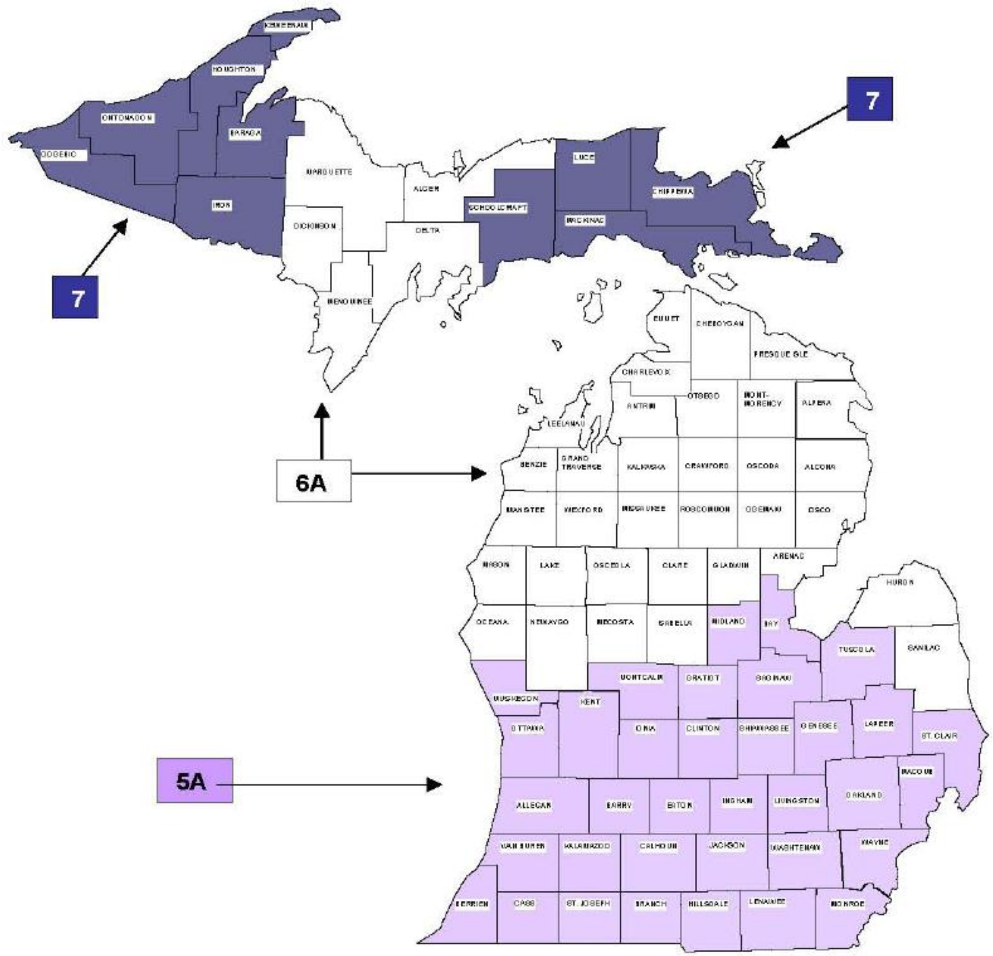
Figure 301.1A: Climate Zones



2009 Michigan Uniform Energy Code
Figure 301.1a

http://www.michigan.gov/documents/dleg/dleg_bcc_2007_052lg_muec_residential_337936_7.pdf

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Table 301.1: Climate Zones by County

Table 301.1
Climate Zones by County

Zones		
5A	6A	7
Allegan	Alcona	Baraga
Barry	Alger	Chippewa
Bay	Alpena	Gogebic
Berrien	Antrim	Houghton
Branch	Arenac	Iron
Calhoun	Benzie	Keweenaw
Cass	Charlevoix	Luce
Clinton	Cheboygan	Mackinac
Eaton	Clare	Ontonagon
Genesee	Crawford	Schoolcraft
Gratiot	Delta	
Hillsdale	Dickinson	
Ingham	Emmet	
Ionia	Gladwin	
Jackson	Grand Traverse	
Kalamazoo	Huron	
Kent	Iosco	
Lapeer	Isabella	
Lenawee	Kalkaska	
Livingston	Lake	
Macomb	Leelanau	
Midland	Manistee	
Monroe	Marquette	
Montcalm	Mason	
Muskegon	Mecosta	
Oakland	Menominee	
Ottawa	Missaukee	
Saginaw	Montmorency	
Shiawassee	Newaygo	
St. Clair	Oceana	
St. Joseph	Ogemaw	
Tuscola	Osceola	
Van Buren	Oscoda	
Washtenaw	Otsego	
Wayne	Presque Isle	
	Roscommon	
	Sanilac	
	Wexford	

Key: A – Moist. Absence of moisture designation indicates moisture regime is irrelevant.

http://www.michigan.gov/documents/dleg/dleg_bcc_2007_052lg_muec_residential_337936_7.pdf

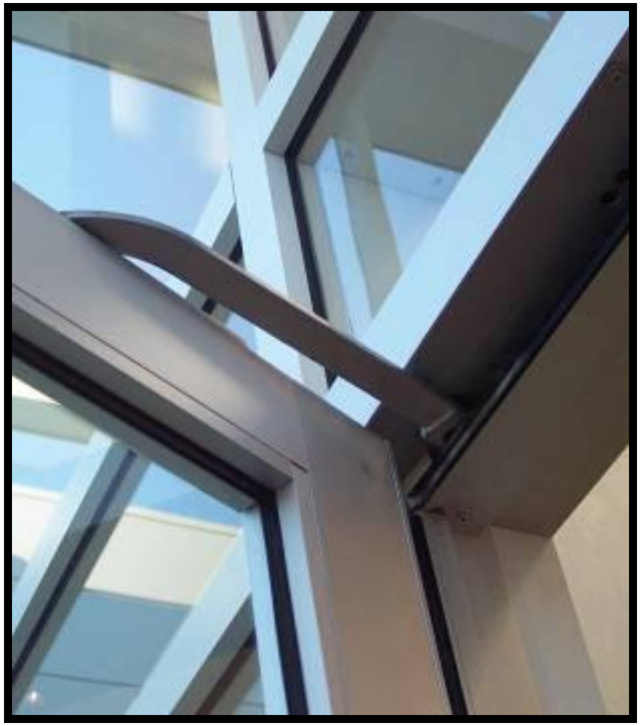
Date Visited: 2/11/2011

Envelope Compliance Paths *(Section 5.2.1)*

- You have to follow Sections
  - 5.1 (General),
  - 5.4 (Mandatory Provisions),
  - 5.7 (Submittals), and
  - 5.8 (Product Information and Installation Requirements),
- and THEN you can either follow
  - Section 5.5 (Prescriptive) or Section 5.6 (Trade-off)
- If you use the Energy Cost Budget method in Section 11, Section 5.4 is mandatory *(Section 5.2.2)*
  - However, Section 5.4 merely refers to Section 5.8

Mandatory Provisions

- Insulation *(Section 5.8.1)*
  - Labeling *(Section 5.8.1.1)*
  - Substantial Contact *(Section 5.8.1.5)*
  - Recessed Equipment *(Section 5.8.1.6)*
  - Insulation Protection *(Section 5.8.1.7)*
  - Insulation Above Suspended Ceilings *(Section 5.8.1.8)*
- Fenestration and Doors *(Section 5.8.2)*
- Air Leakage *(Section 5.4.3)*



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Air Leakage

- Seal, caulk, gasket, or weather-strip *(Section 5.4.3.1)*
  - Openings and joints in building envelope
  - Fenestration and doors per NFRC 400 *(Section 5.4.3.2)*
  - Loading docks in climate zones 4-8 *(Section 5.4.3.3)*
  - Vestibules and doors separating conditioned space from exterior *(Section 5.4.3.4)*

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Air Leakage - Building Envelope Sealing *(Section 5.4.3.1)*

- Joints around fenestration and door frames *(a)*
- Junctions between walls *(b)*
  - and foundations
  - at building corners
  - and structural floors or roofs
  - and roof or wall panels
- Openings for utility services through roofs, walls, and floors *(c)*
- Site-built fenestration and doors *(d)*
- Building assemblies used as ducts or plenums *(e)*
- Joints, seams, and penetrations of vapor retarders *(f)*
- All other openings in the building envelope *(g)*

http://www.energycodes.gov/becu/trainers.stm

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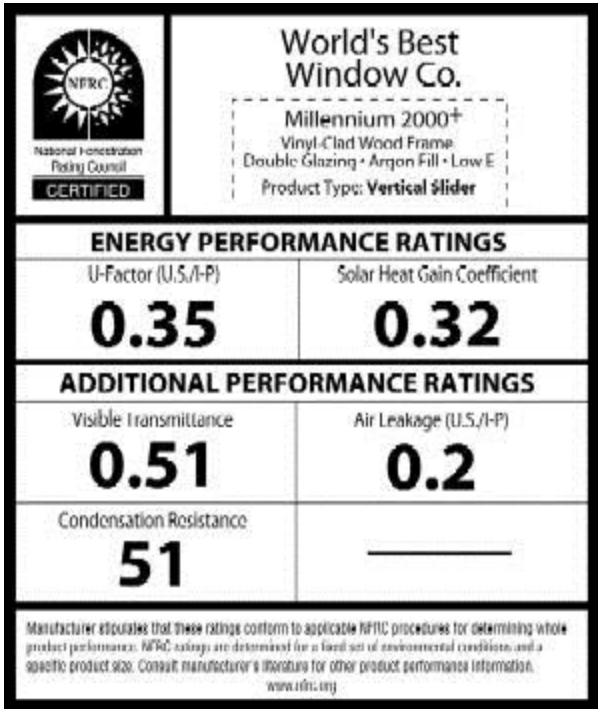
Air Leakage - Fenestration and Doors *(Section 5.4.3.2)*

- NFRC 400
- Labeled and certified by manufacturer
- Glazed swinging entrance doors and revolving doors – not to exceed 1.0 cfm/ft^2
- All other products – not to exceed 0.4 cfm/ft^2
- Exceptions
  - Field-fabricated fenestration and doors
  - Garage doors – ANSI/DASMA 105



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Air Leakage - Loading Dock Weather Seals *(Section 5.4.3.3)*

In climate zones 4-8:

- Cargo doors and loading dock doors equipped with weather seals
  - To restrict infiltration when vehicles are parked in the doorway

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http://www.energycodes.gov/becu/trainers.stm

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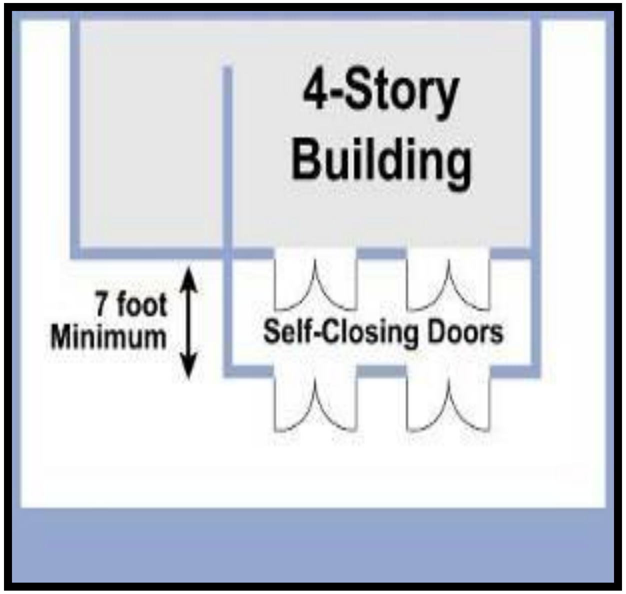
Air Leakage – Vestibules (Section 5.4.3.4)

- Required in

    Climate Zones 5-8 for entrances in buildings > 1000 ft^2

- Vestibules must have:
    - Self-closing doors
    - Interior and exterior doors not open at the same time
    - Distance between interior and exterior doors not < 7 ft when in closed position (remember ADA!) (>10 ft for LEED IEQ 5.3 entrance mat)



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Air Leakage - Vestibule Exceptions *(Section 5.4.3.4)*

- Non-entrance doors
- Building entrances with revolving doors
- Buildings < 1000 ft^2 in **climate zones 5-8**
- All doors that open from spaces < 3000 ft^2 (separate from building entrance) **OR** from dwelling units

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Prescriptive Building Envelope Option *(Section 5.5)*

WWR ≤ 40% of gross wall area
Skylight-roof ratio ≤ 5% of roof area
Each envelope component must separately meet requirements

8 criteria sets for different climate types

- Set = single page that summarizes all prescriptive requirements
  - Insulation levels for roofs, walls, floors
  - Fenestration criteria

http://www.energycodes.gov/becu/trainers.stm

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Building Envelope Requirements
(Tables 5.5-1 through 5.5-8)

Requirements for Nonresidential, Residential, and Semiheated spaces

- Opaque Elements
  - Roofs, Walls, Floors, and Doors
  - Assembly maximum values or insulation minimum R-values
- Fenestration
  - Vertical Glazing and Skylights
  - Assembly maximum U-values or assembly maximum SHGC

Building Envelope Requirements *(Table 5.5-5)*

Climate Zone 5

- Nonresidential Examples
  - Roofs: insulation entirely above deck = R-20.0 c.i. (R-15.0 c.i.)
  - Roofs: Attic and other = R-38.0 (R-30.0)
  - Above-Grade Walls: mass = R-11.4 c.i. (R-7.6 c.i.)
  - Above-Grade Walls: steel-framed = R-13.0 + R-7.5 c.i. (R-13.0 + R-3.8 c.i.)
  - Above-Grade Walls: wood-framed = R-13.0 + R-3.8 c.i. (R-13.0)
  - Below-Grade Walls: below-grade wall = R-7.5 c.i. (No Requirement)
  - Floors: mass = R-10.4 c.i. (R-8.3 c.i.)
  - Floors: steel joist = R-30.0 (R-19.0)
  - Slab-On-Grade Floors: heated = R-15 for 24 in. (R-10 for 36 in.)
  - Doors: nonswinging = U-0.500 (U-1.450)

Presenter's note: ( ) = 1999 ASHRAE 90.1 values

Designers

- Specify:
  - R-values for walls, floors, and roofs
  - U-factors for opaque doors
  - U-factor and SHGC for fenestration, OR
- Use:
  - Pre-calculated assemblies from Appendix A

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Opaque Areas *(Section 5.5.3)*

Compliance:

- Meet or exceed minimum R-values in table
  - Only R-value of insulation, not to include air films, etc

  OR
- Meet maximum U-factor, C-factor, or F-factor for the entire assembly

  OR
- Perform area-weighted average U-factor, C-factor, or F-factor
  - Only if there are multiple assemblies within a <u>single</u> class of construction for a <u>single</u> space-conditioning category

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Roof Insulation *(Section 5.5.3.1)*

- Meet or exceed minimum R-value in table for climate zone (Table 5.5-1 thru 8)
- Skylight curbs insulated to level of roofs with insulation entirely above deck or R-5, whichever is less
- Three types of roofs are defined:
  - Roofs with insulation entirely above deck
    - R-value is for continuous insulation
    - Interruptions for mechanical equipment ≤ 1% of surface of the total roof area

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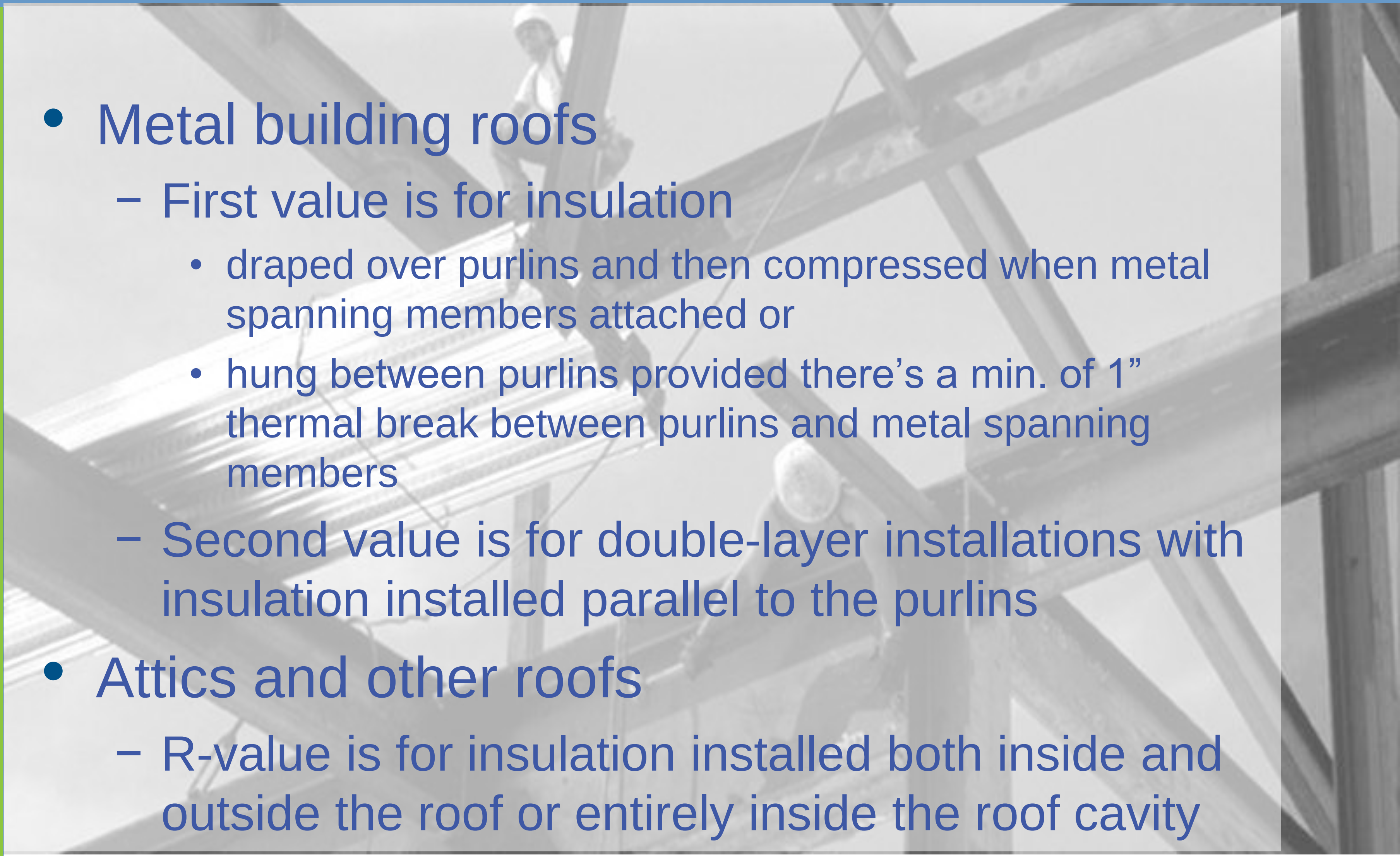
Roof Insulation *(Section 5.5.3.1)*



- Metal building roofs
  - First value is for insulation
    - draped over purlins and then compressed when metal spanning members attached or
    - hung between purlins provided there's a min. of 1" thermal break between purlins and metal spanning members
  - Second value is for double-layer installations with insulation installed parallel to the purlins
- Attics and other roofs
  - R-value is for insulation installed both inside and outside the roof or entirely inside the roof cavity

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High Albedo Roofs *(Section 5.5.3.1)*

Roofs with a minimum total solar reflectance of 0.70 and a minimum thermal emittance of 0.75 or a minimum Solar Reflective Index of 82, other than roofs with ventilated attics or roofs of semiheated spaces or roofs over conditioned spaces that are not cooled spaces shall comply with the values in Table 5.5.3.1.

Basically, "cool roofs" are allowed to have less insulation

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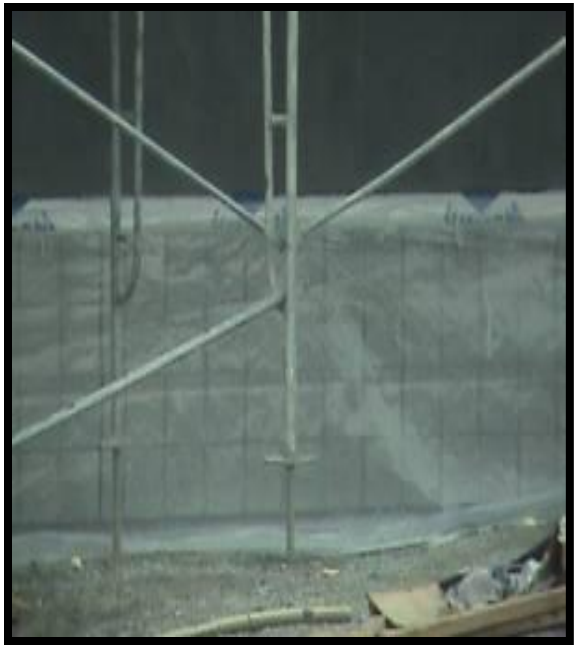
Above-Grade Wall Insulation (Section 5.5.3.2)

- Meet or exceed R-value in appropriate table for climate zone
- Four types of walls are defined:
  - Mass walls:
    - heat capacity determined from Table A3.1B or A3.1C
    - R-value is for continuous insulation or when uninterrupted by framing other than metal clips no closer than 24 in. o.c. horizontally and 16 in. o.c. vertically
  - *Exception* – requirement of U-0.151



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Above-Grade Wall Insulation (Section 5.5.3.2)

Metal building wall R-value

- for insulation compressed between metal wall panels and the steel structure

Steel-framed wall R-value

- for uncompressed insulation installed in the cavity between steel studs

Wood-framed and other R-value

- for uncompressed insulation installed in the cavity between wood studs; also acceptable to be continuous insulation uninterrupted by studs

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Below-Grade Wall Insulation *(Section 5.5.3.3)*

- Meet or exceed values in appropriate table for climate zone
- R-value is for continuous insulation
- If framing is used, compliance is based on maximum assembly C-factor

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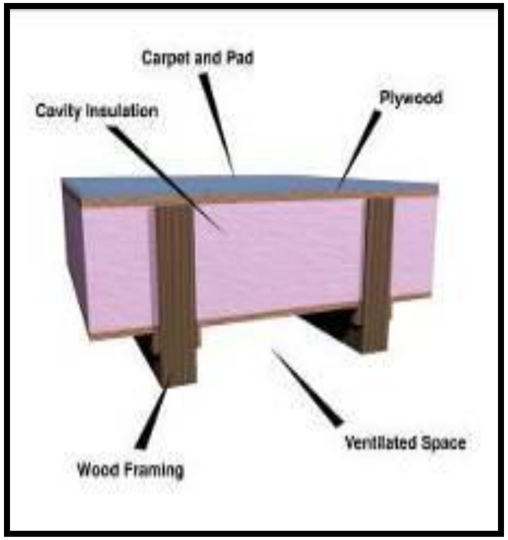
Floor Insulation *(Section 5.5.3.4)*

- Meet or exceed values in appropriate table for
  climate zone
- 3 classes of floors over unconditioned space are defined:
  - Mass floors
    - R-value is for continuous insulation
    - If framing is used, compliance is based on maximum assembly U-factor
  - Steel-joist floors
    - R-value is for uncompressed insulation or spray-on insulation, but is also acceptable for continuous insulation
  - Wood-framed and others
    - R-value is for uncompressed insulation, but is also acceptable for continuous insulation



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Slab-on-Grade Floor Insulation *(Section 5.5.3.5)*

- Meet or exceed values in appropriate table for climate zone (includes R-value and depth or width of insulation)
- Be installed around the perimeter to the distance specified
  - **Inside foundation wall** – extend downward from top of slab a minimum distance specified or to the top of the footing, whichever is less
  - **Outside foundation wall** – extend from top of the slab or downward to at least the bottom of the slab and then horizontally to a minimum distance specified

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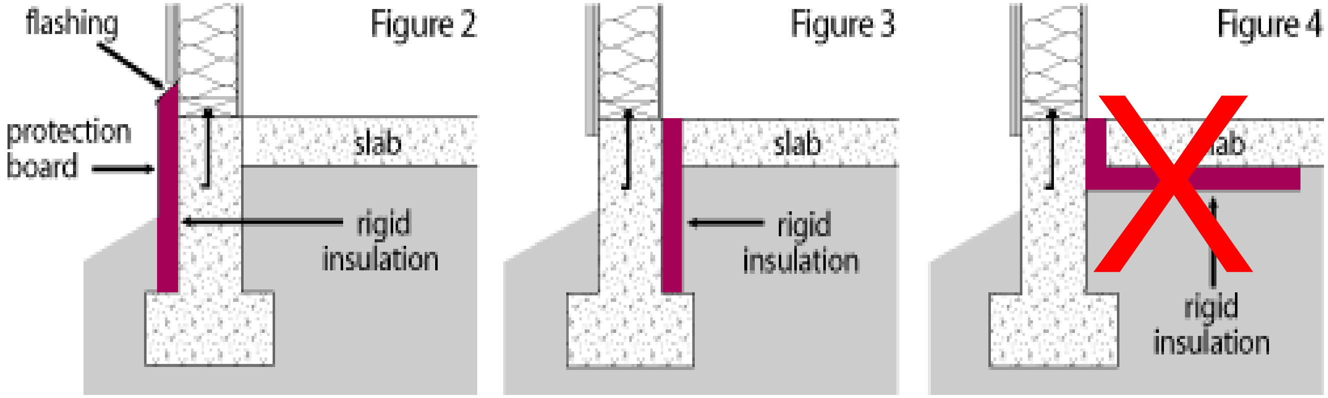
Slab Edge Insulation *(Section 5.5.3.5)*

Slab-on-Grade Floors

Can use R factor or F factor from 5.5-5 thru 7

When using the F factor must refer to Table A6.3

- Downward from top of slab a minimum of 24”
- R-10 for unheated floors, R-15 for heated floors
- No requirement for insulation in CZ5 for unheated floors
- Insulation can be vertical or extend horizontally under the slab or out from the building (must be under 10 inches of soil) But only with computer based methods and not with prescriptive



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no longer allowed

Opaque Doors *(Section 5.5.3.6)*

- Meet or exceed maximum U-factors in appropriate table for climate zone

- Example: Climate Zone 5
  - Nonresidential
    - Swinging = U-0.700 (U-0.700)
    - Non-swinging = U-0.500 (U-1.450)
  - Residential
    - Swinging = U-0.500 (U-0.700)
    - Non-swinging = U-0.500 (U-0.500)
  - Semiheated
    - Swinging = U-0.700 (U-0.700)
    - Non-swinging = U-1.450 (U-1.450)

Presenter's note:
( ) = 1999 ASHRAE 90.1 values

http://www.energycodes.gov/becu/trainers.stm

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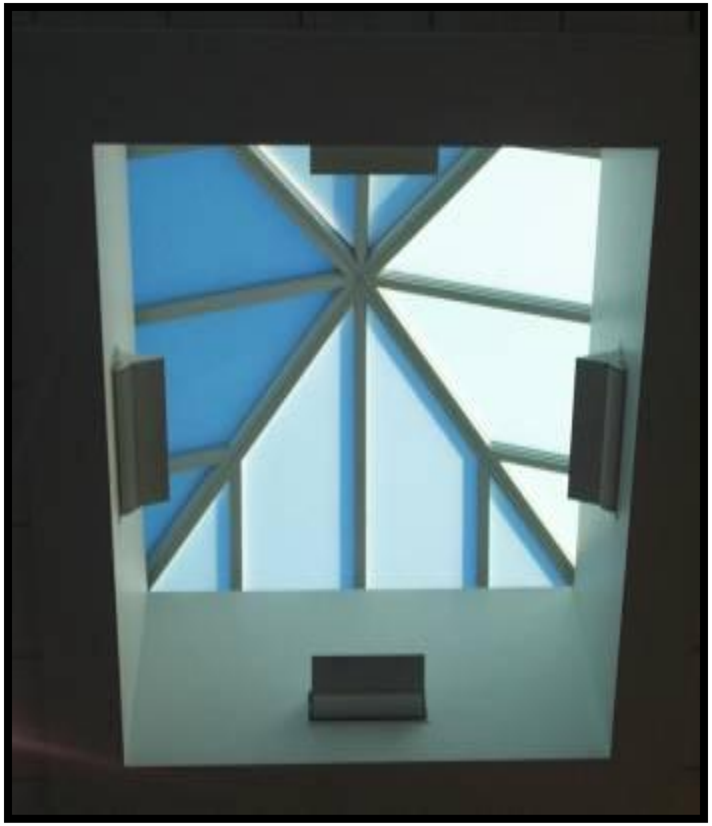
Fenestration *(Section 5.5.4)*

- Criteria apply to fenestration, including windows, glass doors, glass block, plastic panels, and skylights
- Compliance
  - Meet or exceed maximum U-factors in table
  - Meet or exceed minimum SHGC in table
  - Use NFRC ratings or default values in Appendix A



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Fenestration Area

- Total vertical fenestration area to be < 40% of gross wall area *(Section 5.5.4.2.1)*
  - Including both fixed and operable vertical fenestration
- Total skylight area to be < 5% of gross roof area *(Section 5.5.4.2.2)*
  - Including glass skylights, plastic skylights with a curb, and all skylights without a curb

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Fenestration U-Factor *(Section 5.5.4.3)*

U-factor not greater than specified in Tables 5.5-1 through 5.5-8 For example:

Zone 5 and 6 vertical glazing metal framing

U=0.45 and SHGC 0.40

Zone 7 vertical glazing metal framing

U=0.40 and SHGC 0.45

Unit U value rather than glass only (must include frame)

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Fenestration SHGC

- Vertical fenestration *(Section 5.5.4.4.1)*
  - SHGC values < Table value for appropriate total vertical fenestration area
- Skylights *(Section 5.5.4.4.2)*
  - SHGC values < Table value for appropriate total skylight area
- No SHGC requirements for semi-heated spaces
- No criteria for Visible Light Transmittance in Prescriptive Building Envelope Option, but there are minimum criteria in the Trade-Off Option (Details in Appendix C)
- Exceptions

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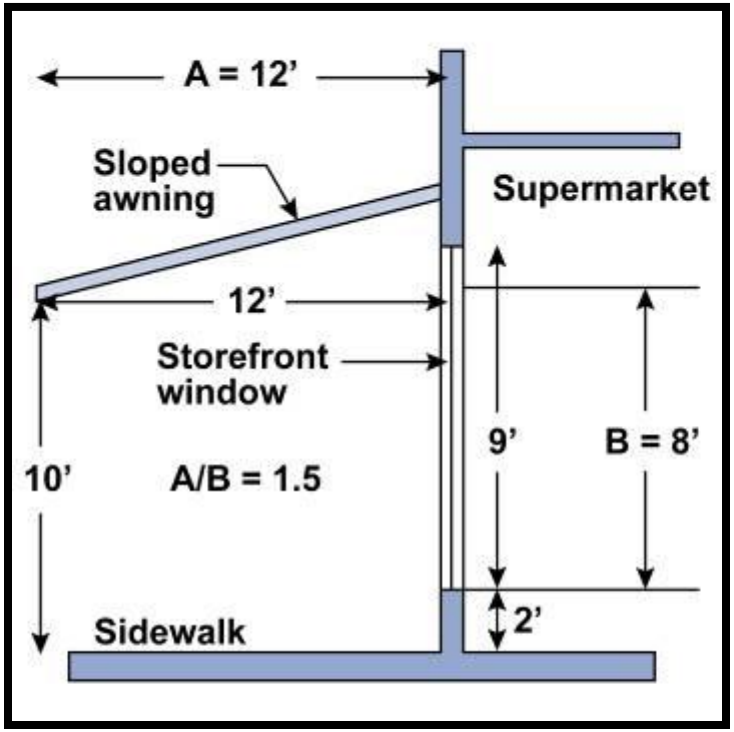
Overhangs

- Standard credits permanent overhangs by adjustment to SHGC
- Size of overhang is determined by projection factor



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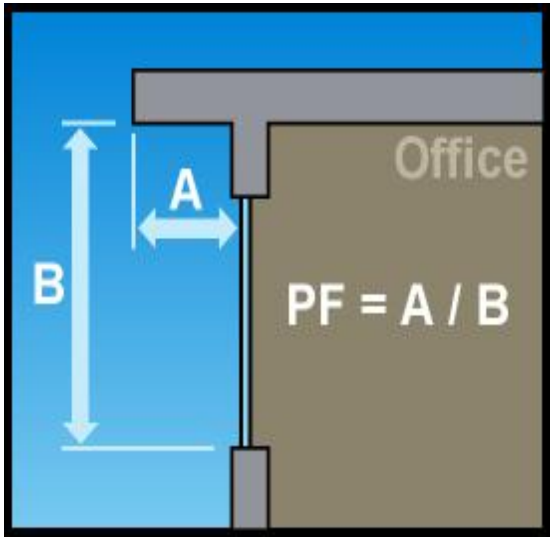

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Building Envelope Trade-Off Option

Building complies if:

- It satisfies the provisions of 5.1, 5.4, 5.7, and 5.8 *(Section 5.6.1a)*
- Envelope performance factor (EPF) of proposed building is ≤ EPF of budget building *(Section 5.6.1b)*
  - EPF considers only the building envelope components *(Section 5.6.1.1)* and is calculated using procedures in Normative Appendix C *(Section 5.6.1.3)*
  - Schedules of operation, lighting power, equipment power, occupant density, and mechanical systems to be the same for both the proposed building and the budget building *(Section 5.6.1.2)*

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Product Information and Installation Requirements

- Labeling of Building Envelope Insulation *(Section 5.8.1.1)*
- Compliance with Manufacturers' Requirements *(Section 5.8.1.2)*
- Loose-Fill Insulation Limitation *(Section 5.8.1.3)*
- Baffles *(Section 5.8.1.4)*
- Substantial Contact *(Section 5.8.1.5)*
- Recessed Equipment *(Section 5.8.1.6)*
- Insulation Protection *(Section 5.8.1.7)*
- Location of Roof Insulation *(Section 5.8.1.8)*
- Extent of Insulation *(Section 5.8.1.9)*

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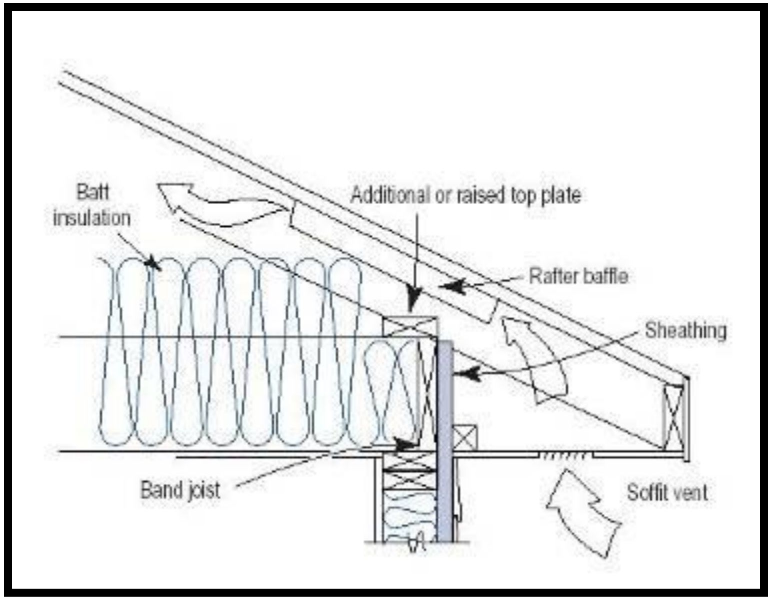
Insulation Installation

- Per manufacturer's instructions *(Section 5.8.1.2)*
- Achieve rated R-value *(Section 5.8.1.2)*
- No open-blown or poured loose-fill insulation when ceiling slope is > 3/12 *(Section 5.8.1.3)*
- If eave vents installed *(Section 5.8.1.4)*
  - Provide baffling of air vents to deflect incoming air above the surface of the insulation
- Exception *(Section 5.8.1.2)*
  - Metal buildings – if roof and wall insulation is compressed between roof or wall skin and the structure



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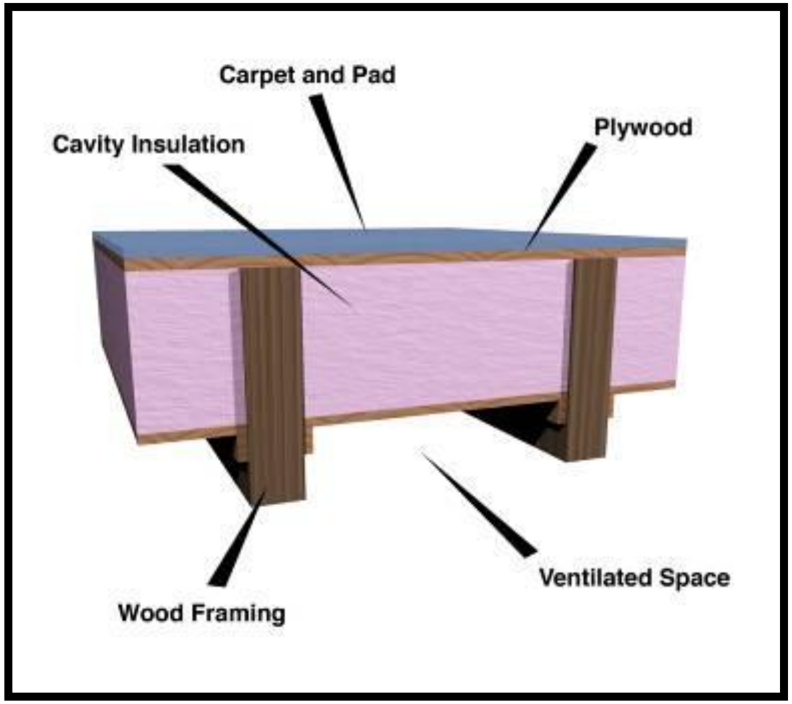
Insulation - Substantial Contact *(Section 5.8.1.5)*

- Install insulation in a permanent manner in substantial contact with inside surface
- Flexible batt insulation in floor cavities
  - Supported in a permanent manner by supports no more than 24 in. on center (o.c.)



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Recessed Equipment *(Section 5.8.1.6)*

- Do not recess equipment to affect insulation thickness
  - Lighting fixtures
  - HVAC equipment (includes wall heaters, ducts, and plenums)
  - Other
- Except when
  - Total combined area affected (include necessary clearances) is
    < 1% of opaque area of the assembly, **OR**
  - Entire roof, wall, or floor is covered with insulation to the full depth required, **OR**
  - Effects of reduced insulation are included in area-weighted calculations

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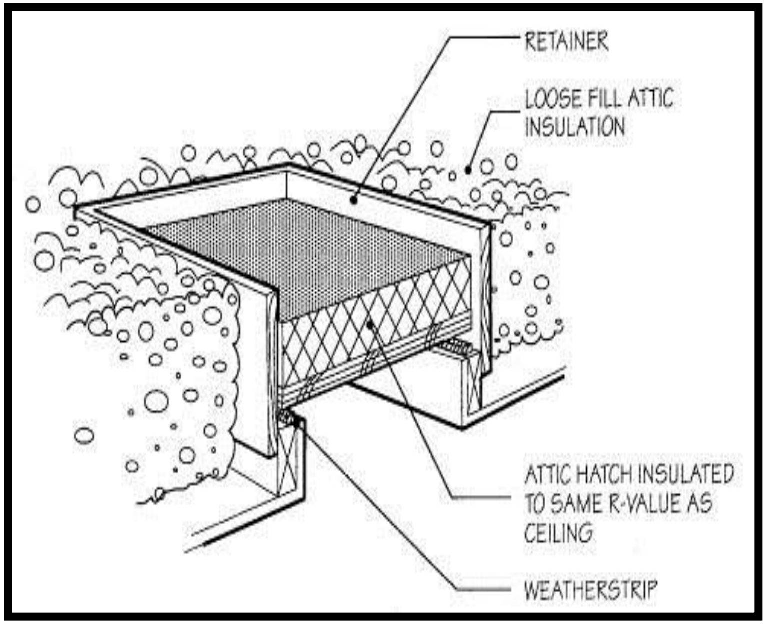
Insulation Protection

Insulation Protection:

- Cover exterior insulation with protective material (*Section 5.8.1.7)*
  - Sunlight
  - Moisture
  - Landscaping operations
  - Equipment maintenance
  - Wind



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- Access to attics and mechanical rooms without damaging or compressing insulation *(Section 5.8.1.7.1)*
- Insulation materials in ground contact to have a water absorption rate ≤ 0.3% (ASTM C272) *(Section 5.8.1.7.3)*

http://www.energycodes.gov/becu/trainers.stm

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Suspended Ceilings

Roof Insulation:

- Not installed on a suspended ceiling with removable ceiling panels *(Section 5.8.1.8)*

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Fenestration and Doors

U-factors *(Section 5.8.2.4)*

- NFRC 100 or
- Assemblies listed in Appendix A

SHGC *(Section 5.8.2.5)*

- NFRC 200 or
- Assemblies listed in Appendix A

Visible Light Transmittance *(Section 5.8.2.6)*

- NFRC 200 when building envelope trade-off option is used

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U-Factor *(Section 5.8.2.4)*

- Skylights – Manufacturer to determine at a slope of 20° above the horizontal
- Labeled and certified by manufacturer *(Sections 5.8.2.1 and 5.8.2.2)*
- Limited to max 5% of roof for prescriptive applied to each space categories *(Tables 5.5-1 through 5.5-8)*
- U Factor depends on skylight class i.e. glass with curb, plastic with curb and without curb
- Exceptions
  - Glazed wall systems in vertical fenestration and skylights – may use U-factors in A.8.1
  - A8.2 acceptable for other vertical fenestration
  - A7 acceptable for opaque doors
  - ANSI/DASMA 105 acceptable for garage doors

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Solar Heat Gain Coefficient *(Section 5.8.2.5)*

- The glazing's effectiveness in rejecting solar heat gain
- NFRC 200
- Exceptions
  - SC x 0.86 is acceptable for overall fenestration area (NFRC 300)
  - SHGC of center-of-glass is acceptable (NFRC 300) for overall fenestration area
  - SHGC from A8.1 for glazed wall systems in vertical fenestration and skylights
  - SHGC from A8.2 for other vertical fenestration

http://www.energycodes.gov/becu/trainers.stm

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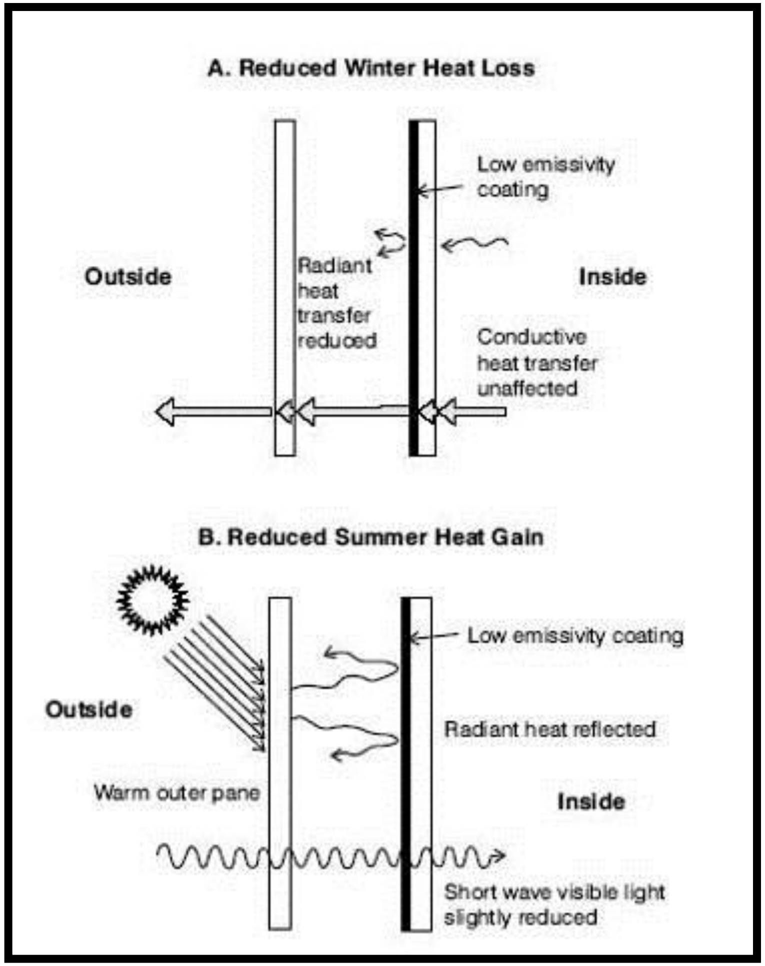
SHGC

- Part of a system for rating window performance
  - used by the National Fenestration Rating Council (NFRC)
- Gradually replacing shading coefficient (SC) in product literature and design standards
  - convert SC to SHGC by multiplying the SC value by 0.86



U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

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Visible Light Transmittance

- A measure of the amount of visible light that passes through fenestration
- Affected by:
  - composition of the glass
  - coatings
  - internal shading devices
- Relationship between VLT and SHGC
  - Day-lighting without excessive solar gain– VLT at least 1.2 x SHGC

U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

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HVAC Compliance

Building System

- Envelope
- HVAC
- SWH
- Power
- Lighting
- Other

Mandatory Provisions

(required for most compliance options)

Compliance Options

- Prescriptive Option
- Trade Off Option
- Energy Cost Budget
- Simplified

Energy Code Compliance

http://www.energycodes.gov/becu/trainers.stm

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HVAC Alterations *(Section 6.1.1.3)*

- **Equipment** - New equipment shall meet the minimum efficiency requirements *(Section 6.1.1.3.1)*
- **Cooling Systems**
  - New cooling systems installed to serve previously un-cooled spaces shall comply with this section *(Section 6.1.1.3.2)*
  - Alterations to existing cooling systems shall not decrease economizer capacity (unless economizer tradeoff is used) *(Section 6.1.1.3.3)*
- **Ductwork** - New and replacement ductwork shall comply with applicable requirements *(Section 6.1.1.3.4)*
- **Piping** - New and replacement piping shall comply with applicable requirements *(Section 6.1.1.3.5)*

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HVAC Alterations *(Section 6.1.1.3)*

Alterations to the building HVAC system shall comply with the requirements of Section 6

- *Exceptions* that are allowed:
  - Equipment being modified or repaired (not replaced)
    - Provided such modifications will not result in an increase in the annual energy consumption
  - Equipment being replaced or altered which requires extensive revisions to other systems and such replaced or altered equipment is a like-for-like replacement
  - Refrigerant change of existing equipment
  - Relocation of existing equipment
  - Ducts and pipes where there is insufficient space or access to meet these requirements

http://www.energycodes.gov/becu/trainers.stm

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HVAC Compliance Paths

(Section 6.2.1)

- You have to follow Sections
  - 6.1 General,
  - 6.7 Submittals, and
  - 6.8 Minimum Equipment Efficiency,
- And then you can follow either
  - Section 6.3 Simplified Approach OR
  - Sections 6.4 Mandatory Provisions and 6.5 Prescriptive Path

Alternatively, you can follow Section 11 (ECB), in which case Section 6.4 is mandatory *(Section 6.2.2)*

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Simplified Approach Option

(Section 6.3.1)

Limited to:

- Buildings with 1 or 2 stories
- Buildings < 25,000 ft^2

(Section 6.3.2)

- Single-zone systems (unitary or split) Can have several single-zone systems in building
- Air-cooled or evaporatively cooled
- 15 paragraphs cover Simplified Approach

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Simplified Approach Option *(Section 6.3.2)*

The system shall have an economizer, unless the economizer Trade-off Option is used *(c)*

(Table 6.3.2)

- Limited to unitary systems
- Requires higher minimum cooling efficiency (EER)
- Trade-off EER by
  - System size
  - Climate zone

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Simplified Approach Option *(Section 6.3.2)*

- Manual changeover or dual set-point thermostat *(f)*
- Heat pump supplementary control *(g)*
- No reheat or simultaneous heating and cooling for humidity control *(h)*
- "Time clocks" (except hotel/motel guest rooms and systems requiring continuous operation) *(i)*

  (In reality: programmable thermostat)
- Piping and ductwork insulated *(j and k)*

http://www.energycodes.gov/becu/trainers.stm

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Simplified Approach Option *(Section 6.3.2)*

- Balancing of ducted systems *(l)*
- Interlocked thermostats for separate heating and cooling of same zone *(m)*
- Exhaust > 300 cfm: gravity or motorized dampers unless operated continuously *(n)*
- System > 10,000 cfm: optimum start controls *(o)*

http://www.energycodes.gov/becu/trainers.stm

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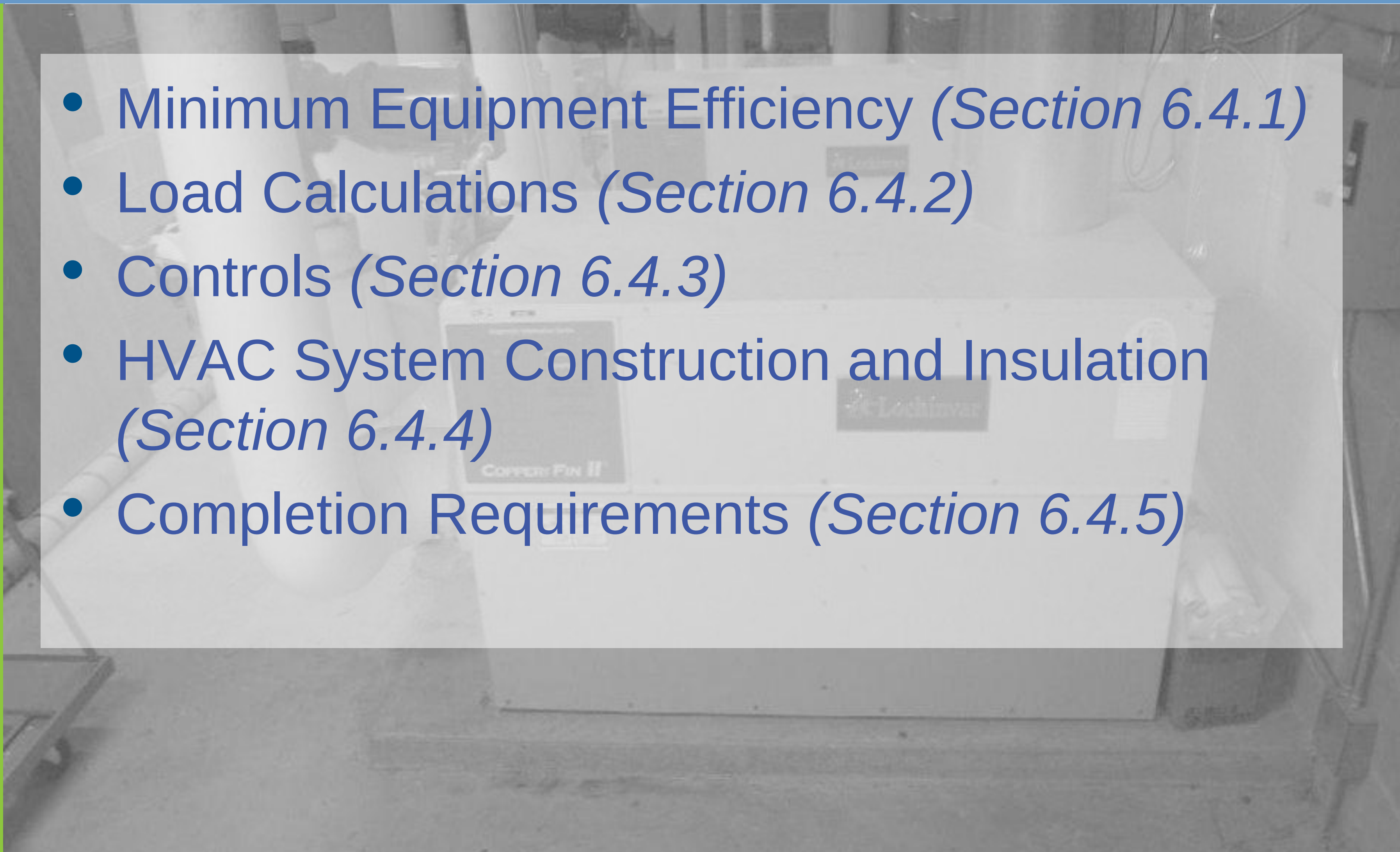
HVAC Mandatory Provisions



- Minimum Equipment Efficiency *(Section 6.4.1)*
- Load Calculations *(Section 6.4.2)*
- Controls *(Section 6.4.3)*
- HVAC System Construction and Insulation *(Section 6.4.4)*
- Completion Requirements *(Section 6.4.5)*

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Equipment Covered

- Package air conditioners and condensing units *(Table 6.8.1A)*
- Heat pumps (air, water, and ground source) *(Table 6.8.1B)*
- Packaged terminal and room air conditioners *(Table 6.8.1D)*
- Chillers including absorption chillers *(Table 6.8.1C)*
- Furnaces and unit heaters *(Table 6.8.1E)*
- Boilers *(Table 6.8.1F)*
- Heat rejection equipment *(Table 6.8.1G)*

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Mechanical Equipment Efficiency

- Tables 6.8.1A – 6.8.1G
- Tables 6.8.1H-6.8.1J used for water cooled centrifugal chillers that operate at non-standard rating conditions
- Combination HVAC and water heating systems to meet all requirements for appropriate space heating or cooling category
- Gas-fired and oil-fired forced air furnaces with input ratings ≥ 225,000 Btu/h to have intermittent or interrupted ignition device and have either power venting or a flue damper *(Table 6.8.1E footnote h)*
- All furnaces with input ratings ≥ 225,000 Btu/h, including electric furnaces, not located in conditioned space, to have jacket losses ≤ 0.75% of the input rating *(Section 6.4.1.1)*

Verification of Equipment Efficiencies *(Section 6.4.1.4)*

Equipment efficiency information from manufacturers verified as follows:

- EPACT equipment – to comply with DOE certification requirements *(a)*
- If certification program exists for covered product and includes provisions for verification and challenge of equipment efficiency ratings, product listed in program OR *(b)*
- If product not listed in program, ratings verified by an independent laboratory test report OR *(c)*
- If no certification program exists, equipment efficiency ratings supported by data furnished by manufacturer OR *(d)*
- Where components from different manufacturers are used, system designer specifies components whose combined efficiency meets Section 6.4.1 *(e)*
- Products in Table 6.8.1G shall have efficiency ratings supported by data furnished by manufacturer.

Labeling

- Mechanical equipment – equipment not covered by NAECA shall carry a permanent label stating equipment complies with 90.1 *(Section 6.4.1.5.1)*
- Packaged terminal air conditioners – packaged terminal air conditioners and heat pumps with sleeve sizes < 16 in. high and 42 in. wide shall be factory labeled as follows: *(Section 6.4.1.5.2)*
  - *Manufactured for replacement applications only: not to be installed in new construction projects*

Load Calculations *(Section 6.4.2)*

- Must calculate heating and cooling system design loads
- Must base calculations on generally accepted engineering standards and handbooks

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Controls – Zone Thermostatic and Dead Band

Required for each zone *(Section 6.4.3.1.1)*

- Perimeter can be treated differently

Dead band controls *(Section 6.4.3.1.2)*

- Thermostats must have at least a 5°F dead band
- Exceptions
  - Thermostats that require manual changeover between heating and cooling modes
  - Special occupancy or applications where wide temperature ranges aren't acceptable (e.g., retirement homes) and approved by adopting authority

U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

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Controls – Setpoint Overlap Restriction *(Section 6.4.3.2)*

If limit switches, mechanical stops, or software programming for DDC systems are used

- Means will be provided to prevent the heating set point from exceeding the cooling set point minus any applicable proportional band

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Controls – Off-Hour

- Automatic shutdown *(Section 6.4.3.3.1)*
- Setback controls *(Section 6.4.3.3.2)*
- Optimum start *(Section 6.4.3.3.3)*
- Zone isolation *(Section 6.4.3.3.4)*
- Exceptions, HVAC systems *(Section 6.4.3.3)*
  - with heating/cooling capacity < 15,000 Btu/h
  - intended to operate continuously

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Controls - Automatic Shutdown *(Section 6.4.3.3.1)*

- Automatic 7-day/week time clock with 10-hour battery backup
  - Exception: 2-day/week thermostat for residential applications
- Each control to have
  - Occupant sensor, **OR**
  - Manually-operated timer with maximum two hour duration, **OR**
  - Security system interlock
- Exception
  - Residential occupancies allowed to operate with only 2 different time schedules/wk

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Controls – Setback *(Section 6.4.3.3.2)*

Climate Zones 2-8

- Lower heating set point to 55ºF or less

Climate Zones 1b, 2b, 3b (hot/dry)

- Automatically restart, temporarily operate
  - Raise cooling set point to 90ºF or higher **OR**
  - Prevent high space humidity levels

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Controls - Optimum Start *(Section 6.4.3.3.3)*

Individual heating and cooling air distribution systems with

- Total design supply air capacity > 10,000 cfm
- Served by one or more supply fans

Control algorithm to at least be a function of

- Difference between space temperature and occupied setpoint and amount of time prior to scheduled occupancy

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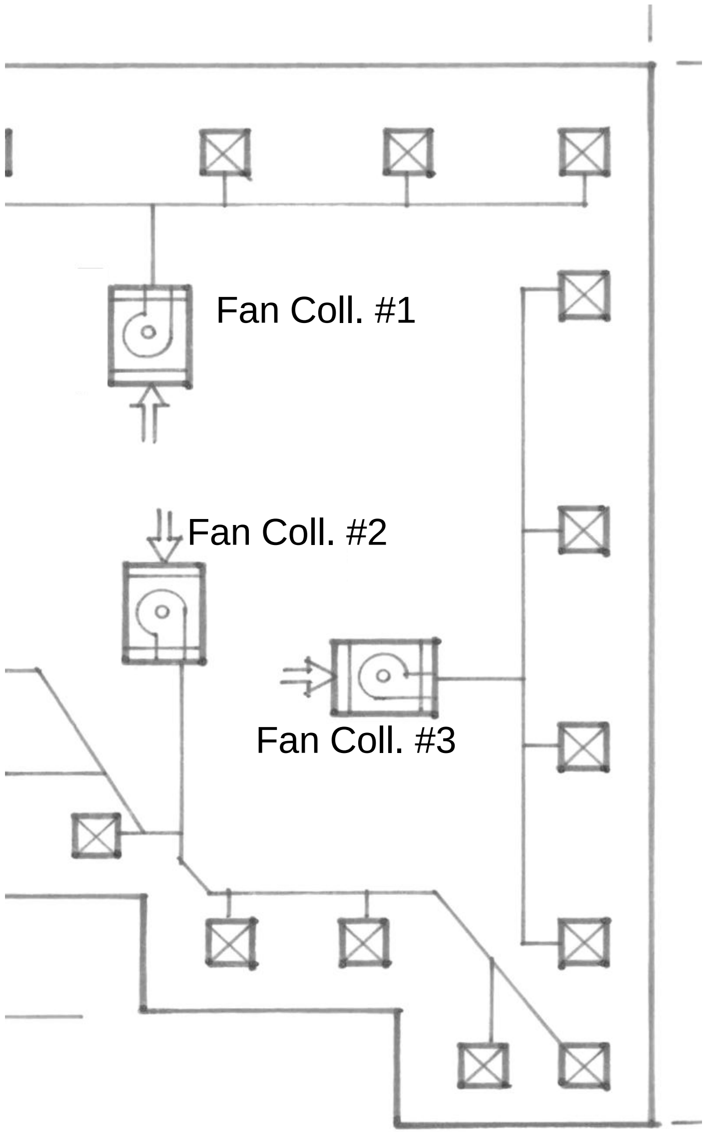
Controls - Zone Isolation *(Section 6.4.3.3.4)*

- Applies to:
  - Each floor in a multistory building
  - Maximum 25,000 ft^2 zone on one floor
- Requirements:
  - Isolation devices to shut off outdoor and exhaust airflow when > 5,000 cfm
  - Central systems shall be capable of stable operation with one isolation zone
  - Capable of separate time schedules for each isolation zone



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Controls – Ventilation System

- Motorized dampers for:

  -Stair and Shaft Vents *(Section 6.4.3.4.1)*

  -Gravity Hoods, Vents, and Ventilators *(Section 6.4.3.4.2)*

  Exceptions: - <3 stories high

  -CZ 1-3

  -unconditioned spaces

http://www.energycodes.gov/becu/trainers.stm

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Stair and Shaft Vents *(Section 6.4.3.4.1)*

Motorized dampers:

- Can be automatically closed during normal building operation
- Interlocked to open as required by fire and smoke detection systems

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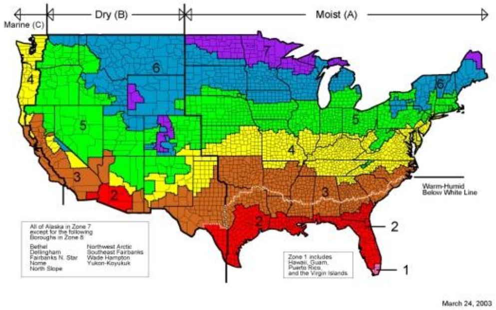
Gravity Hoods, Vents, and Ventilators *(Section 6.4.3.4.2)*

- Motorized dampers to automatically shut when spaces served are not in use
- *Exceptions:*
  - Gravity dampers okay in buildings
    - < 3 stories in height *above* grade
    - Of any height in climate zones 1 - 3
  - Ventilation systems serving unconditioned spaces



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Controls - Shutoff Damper *(Section 6.4.3.4.3)*

- Motorized dampers for outdoor air supply and exhaust systems
- Ventilation outside air dampers to be capable of automatically shutting off during
  - Preoccupancy building warm up, cool down, and setback

  (Except when ventilation reduces energy costs or when ventilation must be supplied to meet code requirements)

Controls - Shutoff Damper *(Section 6.4.3.4.3)*

- *Exceptions*:
  - Gravity dampers okay in buildings
    - < 3 stories in height
    - Of any height in climate zones 1-3
  - Outdoor-air intake or exhaust < 300 cfm
- Table 6.4.3.4.4 provides maximum leakage rates for outdoor air supply and exhaust dampers *(Section 6.4.3.4.4)*

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Dampers *(Section 6.4.3.4.4)*

Where OA supply and exhaust air dampers are required by Section 6.4.3.4

- They shall have a maximum leakage rate when tested in accordance with AMCA Standard 500 as indicated in Table 6.4.3.4.4

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Ventilation Fan Controls *(Section 6.4.3.4.5)*

- Fans with motors > 0.75 hp shall have automatic controls complying with Section 6.4.3.3.1 that are capable of shutting off fans when not required
- *Exception:*
  - HVAC systems intended to operate continuously

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Heat Pump Auxiliary Heat Control *(Section 6.4.3.5)*

- Controls to prevent supplementary heat when heat pump can handle the load
- *Exception:*
  - Heat pumps
    - With minimum efficiency regulated by NAECA
    - With HSPF rating meeting Table 6.8.1B

    (Includes all usage of internal electric resistance heating)

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Controls - Humidifier Preheat *(Section 6.4.3.6)*

Automatic valve to shut off preheat when humidification is *not* required

Controls - Humidification and Dehumidification *(Section 6.4.3.7)*

Provide means to prevent simultaneous operation of humidification and dehumidification equipment

- Limit switches, mechanical stops, or software programming (DDC systems)

Exceptions:

- Zones served by desiccant systems, used with direct evaporative cooling in series
- Systems serving zones where specific humidity levels are required and approved by jurisdiction
  - Museums and hospitals

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Controls - Freeze Protection and Snow/Ice *(Section 6.4.3.8)*

Automatic controls for:

- Freeze protection systems
  - outside air temperatures > 40°F or when conditions of protected fluid will prevent freezing
- Snow- and ice-melting systems
  - pavement temperature > 50°F and no precipitation is falling and outdoor temperature > 40°F

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Ventilation Controls for High-Occupancy Areas (Section 6.4.3.9)

DCV must be provided for each zone with a area > 500 ft² and the design occupancy > 40 people/1000 ft² where the HVAC system has:

- An air-side economizer,
- Automatic modulating control of the outdoor air damper, OR
- A design outdoor airflow > 3,000 cfm

Demand control ventilation (DCV): a ventilation system capability that provides for the automatic reduction of outdoor air intake below design rates when the actual occupancy of spaces served by the system is less than design occupancy.

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Ventilation: High Occupancy Exceptions *(Section 6.4.3.9)*

Exceptions:

- Systems with exhaust-air energy recovery complying with Section 6.5.6.1
- Multiple zone systems without DDC to the zone level
- Systems with a design OA airflow <1,200 cfm
- Spaces where supply-exhaust <1,200 cfm

HVAC System Construction and Insulation

- Insulation installed in accordance with industry-accepted standards *(Section 6.4.4.1.1)*
- Insulation protection *(Section 6.4.4.1.1)*
- Duct and plenum insulation *(Section 6.4.4.1.2)*
- Piping insulation *(Section 6.4.4.1.3)*
- Duct sealing *(Section 6.4.4.2.1)*
- Duct leakage tests *(Section 6.4.4.2.2)*

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General *(Section 6.4.4.1.1)*

- Insulation installed in accordance with industry-accepted standards
- Insulation:
  - Protected from damage due to sunlight, moisture, equipment maintenance, and wind
  - Exposed to weather to be suitable for outdoor service
  - Covering chilled water piping, refrigerant suction piping, or cooling ducts located outside the conditioned space to include a vapor retardant located outside the insulation, all penetrations and joints of which to be sealed

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Duct and Plenum Insulation *(Section 6.4.4.1.2)*

- All ***supply*** and ***return*** ducts and plenums to be insulated per Tables 6.8.2A and 6.8.2B
- *Exceptions:*
  - Factory-installed plenums, casings, or ductwork furnished as part of HVAC equipment
  - Ducts located in heated, semi-heated, or cooled spaces
  - For runouts < 10 ft in length to air terminals or air outlets, the R-value need not exceed R-3.5
  - Backs of air outlets and outlet plenums exposed to unconditioned or indirectly conditioned spaces with face areas > 5 ft^2 need not exceed R-2; those ≤ 5 ft^2 need not be insulated

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Piping Insulation *(Section 6.4.4.1.3)*

- Table 6.8.3
- *Exceptions:*
  - Factory-installed
  - Piping conveying fluids
    - design operating temperature range between 60°F-105°F, inclusive
    - that haven't been heated or cooled through the use of nonrenewable energy or where heat gain or heat loss will not increase energy usage
  - Hot water piping between shut off valve and coil, not > 4 ft in length, when located in conditioned spaces
  - Pipe unions in heating systems (steam, steam condensate, and hot water)

Duct Sealing *(Section 6.4.4.2.1)*

- Tables 6.4.4.2A and 6.4.4.2B
- Requirements of 6.4.4.2.2
- Based on standard industry practice and definitions

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Duct Leakage Tests *(Section 6.4.4.2.2)*

- Designed > 3 in. w.c.
  - Leak tested
  - Representative sections ≥ 25% of the total installed duct area shall be tested
  - Ratings > 3 in. w.c. to be identified on drawings
  - Maximum permitted duct leakage
    - $L_{max} = C_L P^{0.65}$

Where L_{max} = maximum permitted leakage in cfm/100 ft^2 duct surface area

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Completion Requirements *(Section 6.4.5)*

- Refers to Section 6.7 for Submittal and Completion Requirements including
  - Record drawings *(Section 6.7.2.1)*
  - Operating and maintenance manuals *(Section 6.7.2.2)*
  - System balancing *(Section 6.7.2.3)*
  - System commissioning *(Section 6.7.2.4)*

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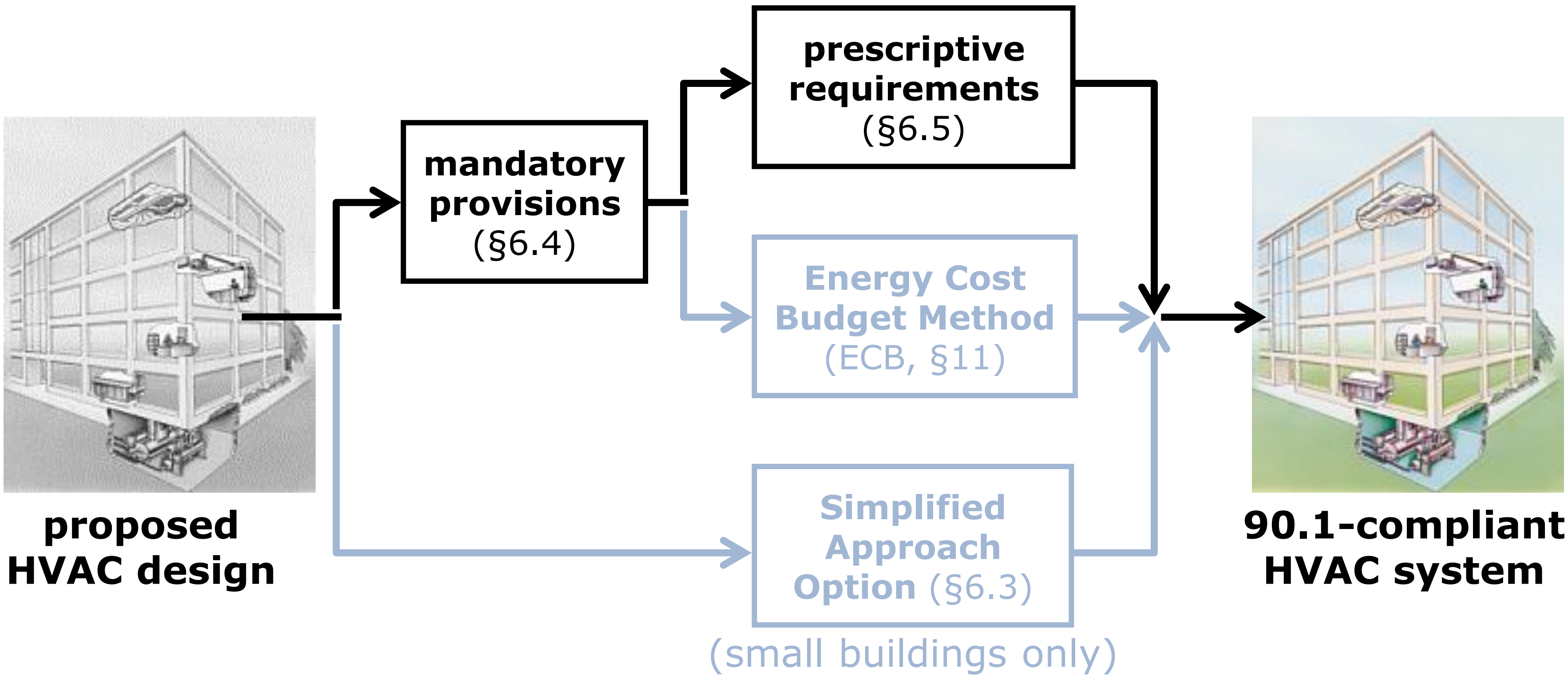
Prescriptive Requirements



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HVAC Prescriptive Path *(Section 6.5)*

- Economizers *(Section 6.5.1)*
- Simultaneous Heating and Cooling Limitation *(Section 6.5.2)*
- Air System Design and Control *(Section 6.5.3)*
- Hydronic System Design and Control (*Section 6.5.4)*
- Heat Rejection Equipment *(Section 6.5.5)*
- Energy Recovery *(Section 6.5.6)*
- Exhaust Hoods *(Section 6.5.7)*
- Radiant Heating Systems *(Section 6.5.8)*
- Hot Gas Bypass Limitation *(Section 6.5.9)*

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Economizers *(Section 6.5.1)*

- Climate and size dependent (Table 6.5.1)
- There are LOTS of exceptions
- Can use air economizers *(Section 6.5.1.1)*
  - 100% of design supply air
  - Sequenced with mechanical cooling equipment
  - High limit shutoff
  - Dampers
- Can use water economizers *(Section 6.5.1.2)*
  - 100% of expected system cooling load at 50°F DB, 45°F WB
  - Maximum pressure drop limitation

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Economizer Exceptions *(Section 6.5.1)*

Exceptions:

- Cooling capacity - Table 6.5.1
- Systems with gas phase air cleaning per Standard 62
- Where >25% of the air must be humidified >35°Fdp
- Systems with condenser heat recovery per 6.5.6.2
- Residential systems <5X limits in Table 6.5.1
- Systems with a balance point <=60°F
- Systems expected to operate < 20hrs/wk
- Systems serving zones with refrigerated casework
- Where cooling efficiency exceeds Table 6.3.2

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Economizers (Table 6.5.1)

Climate zone	Cooling capacity for which an economizer is required
1a, 1b, 2a, 3a, 4a (Miami, St. Louis, Charlotte)	Economizer unnecessary
2b, 5a, 6a, 7, 8 (Yuma, AZ, Michigan, Alaska)	≥ 135,000 Btu/h
3b, 3c, 4b, 4c, 5b, 5c, 6b (Denver, Lubbock, Vancouver)	≥ 65,000 Btu/h

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Design Capacity – Air Economizers *(Section 6.5.1.1.1)*

System capable of modulating outside air and return air dampers to provide up to 100% of the design supply air quantity as outside air for cooling

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Economizer Control Signal *(Section 6.5.1.1.2)*

- Dampers capable of being sequenced with the mechanical cooling equipment and shall not be controlled by only mixed air temperature
- *Exception:*
  - Systems controlled from space temperature (such as single-zone systems)

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High Limit Shutoff *(Section 6.5.1.1.3)*

- Automatically reduce outdoor air intake to minimum outdoor air quantity when outdoor air intake will no longer reduce cooling energy usage
- Control types for specific climates from Table 6.5.1.1.3A
- Settings from Table 6.5.1.1.3B

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Dampers *(Section 6.5.1.1.4)*

Return air and outdoor air dampers to meet the damper leakage specified in Section 6.4.3.4.4 for outdoor air supply and exhaust dampers.

Presenter's Note:

This is the second reference to the same table

http://www.energycodes.gov/becu/trainers.stm

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Relief of Excess Outside Air *(Section 6.5.1.1.5)*

- Means to relieve excess outdoor air during economizer operation to prevent over-pressurizing the building
- Outlet located to avoid recirculation into the building

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Design Capacity – Water Economizers *(Section 6.5.1.2.1)*

- System capable of cooling supply air by indirect evaporation and providing up to 100% of expected system cooling load at outside air temperatures of 50°F dry bulb/45°F wet bulb and below
- *Exception:*
  - You can also meet this requirement if your design can meet 100% of expected cooling load at 45°F dry bulb/40°F wet bulb

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Maximum Pressure Drop *(Section 6.5.1.2.2)*

- Pre-cooling coils and water-to-water heat exchangers to have either
  - Water-side pressure drop of < 15 ft of water **OR**
  - Bypassed when not in use

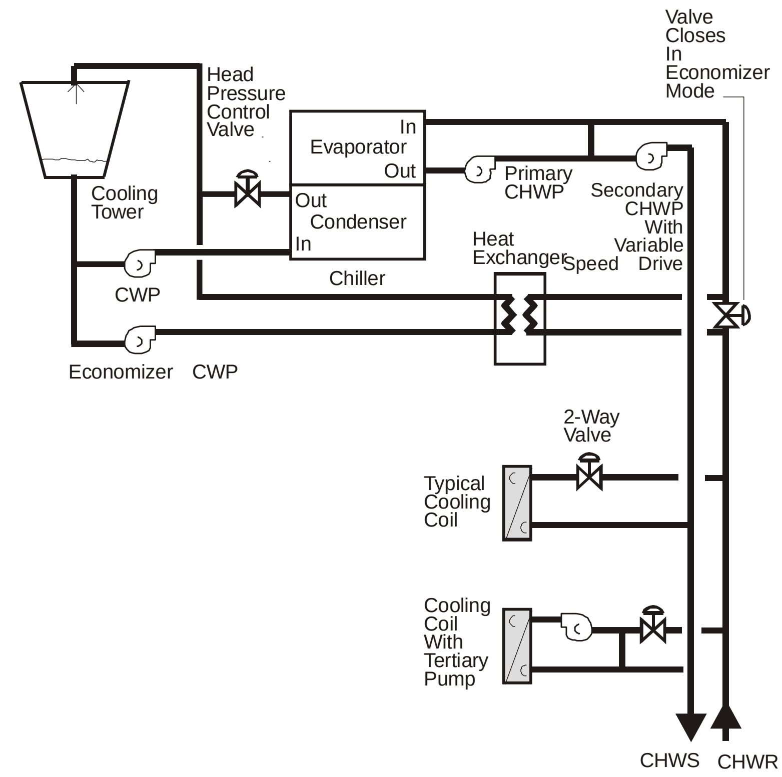

Figure 6-O from 90.1 User's Manual

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Integrated Economizer Control *(Section 6.5.1.3)*

- Economizers must be integrated with mechanical cooling systems and be capable of providing partial cooling even when additional mechanical cooling is required

  (Generally, 55 dF. O.A – 75 dF. O.A.)
- Some *exceptions* to this

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Economizer Heating System Impact *(Section 6.5.1.4)*

- Designed so economizer operation doesn’t increase the building heating energy use during normal operation (High enthalpy O.A.)
- *Exception:*
  - Economizers on VAV systems that cause zone level heating to increase due to a reduction in supply air temperature

U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Zone Controls *(Section 6.5.2.1)*

- Capable of operating in sequence the supply of heating and cooling energy to the zone
- Controls prevent
  - Reheating
  - Re-cooling
  - Mixing or simultaneously supplying air previously heated or cooled
  - Other simultaneous operation of heating and cooling systems to the same zone

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Zone Controls – Exceptions *(Section 6.5.2.1)*

- Zones for which volume of air that is reheated, recooled, or mixed is no greater than the larger of the following
  - Volume of outside air to meet 6.2 of ASHRAE 62 for the zone
  - 0.4 cfm/ft^2 of zone conditioned floor area
  - 30% of zone design peak supply
  - 300 cfm for zones whose peak flow rate totals no more than 10% of the total fan system flow rate
  - Any higher rate that can be demonstrated to jurisdiction to reduce overall system annual energy usage
- Zones where special pressurization relationships, cross-contamination requirements, or code-required minimum circulation rates are such that the variable air volume systems are impractical

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Hydronic System Controls *(Section 6.5.2.2)*

Limit heating and cooling of fluids previously heated or cooled mechanically per 6.5.2.2.1 through 6.5.2.2.3, which follows.

Three-Pipe System – NOT APPROVED *(Section 6.5.2.2.1)*

Common return system for both hot and chilled water shall not be used.

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Two-Pipe Changeover System *(Section 6.5.2.2.2)*

Common distribution system acceptable if:

- Dead-band from one mode to another is ≥ 15°F outside air temperature
- Controls to allow operation of ≥ 4 hours before changing over
- Reset controls so heating and cooling supply temperatures at changeover point no more than 30°F apart

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Hydronic (Water Loop) Heat Pump Systems *(Section 6.5.2.2.3)*

- Controls to provide heat pump water supply temperature deadband of at least 20°F between initiation of heat rejection and heat addition by central devices
- Cooling tower bypass or cooling tower isolation dampers

- *Exception:*
  - If system loop temperature optimization controller is used, deadband < 20°F is allowed

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Dehumidification *(Section 6.5.2.3)*

Humidistatic controls to prevent

- Reheating
- Mixing of hot and cold air streams
- Heating and cooling of same air stream

U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Dehumidification Exceptions *(Section 6.5.2.3)*

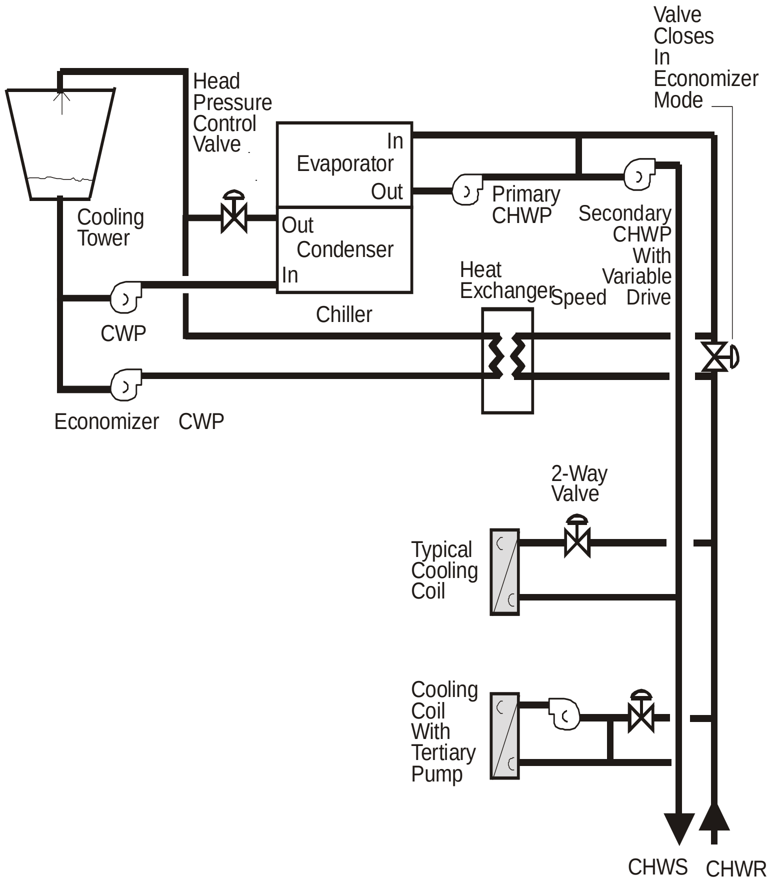
- Systems capable of reducing supply air flow to 50%, or to minimum ventilation
- Systems under 6.67 tons that can unload at least 50%
- Systems smaller than 3.3 tons
- Process applications
- 75% of reheat or recool energy is recovered or solar

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Humidification *(Section 6.5.2.4)*

Systems with hydronic cooling and humidification systems designed to maintain inside humidity at > 35°F dew point temperature shall use a ***water*** economizer if an economizer is required by 6.5.1



U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Air System Design and Control *(Section 6.5.3)*

HVAC systems with total fan system power > 5 hp to meet 6.5.3.1 through 6.5.3.2

- Fan Power Limitation *(Section 6.5.3.1)*
- VAV Fan Control
  - Part Load Fan Power Limitation *(Section 6.5.3.2.1)*
  - Static Pressure Sensor location *(Section 6.5.3.2.2)*
  - Set Point Reset *(Section 6.5.3.2.3)*

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Fan Power Limitation *(Section 6.5.3.1)*

- Not to exceed allowances in Table 6.5.3.1.1A
- Allowable fan system power may be adjusted according to specific conditions listed in Table 6.5.3.1.1B
- *Exceptions noted*

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Motor Nameplate Horsepower *(Section 6.5.3.1.2)*

- Selected fan motor to be no larger than first available motor size greater than bhp
- Fan bhp on design documents
- *Exceptions:*
  - Fans < 6 bhp, where first available motor larger than bhp has nameplate rating within 50% of bhp, next larger nameplate motor size may be selected

    (example: 4 bhp may use 7.5 hp motor)
  - Fans ≥ 6 bhp, where first available motor larger than bhp has nameplate rating within 30% of bhp, next larger nameplate motor size may be selected

    (example: 8 bhp may use 15 hp motor)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Part-Load Fan Power Limitation *(Section 6.5.3.2.1)*

Individual VAV fans with motors ≥ 10 hp

- Must have either:
  - Variable Speed Drive
  - Vane-axial fan with variable-pitch fan blades
  - Other controls and devices to result in fan motor demand ≤ 30% of design wattage at 50% of design air volume when static pressure set point = 1/3 of total design static pressure, based on manufacturer's certified fan data

U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Static Pressure Sensor Location (Section 6.5.3.2.2)

- Placed so controller set point is ≤ 1/3 the total design fan static pressure
  - *Except* for digital control systems with zone reset capabilities where it may be at the fan discharge
- Install multiple sensors in each major branch if sensor would be located downstream of a major duct split

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Set Point Reset *(Section 6.5.3.2.3)*

For systems with direct digital control of individual zone boxes reporting to the central control panel

- Static pressure set point reset based on zone requiring the most pressure

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Hydronic System Design and Control *(Section 6.5.4)*

HVAC hydronic systems with total pump system power > 10 hp shall meet Sections 6.5.4.1 – 6.5.4.4

- Hydronic Variable Flow Systems *(Section 6.5.4.1)*
- Pump Isolation *(Section 6.5.4.2)*
- Chilled- and Hot-Water Temperature Reset *(Section 6.5.4.3)*
- Hydronic (water-loop) Heat Pump Systems *(Section 6.5.4.4)*

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Hydronic Variable Flow *(Section 6.5.4.1)*

- HVAC pumping systems to include control valves
  - Designed to modulate or step open and close as a function of load
  - Designed for variable fluid flow
  - Capable of reducing flow rates to ≤ 50% of design flow rate
- Individual pumps serving variable flow systems with a pump head > 100 ft and motor > 50 hp
  - Have controls and/or devices resulting in pump motor demand ≤ 30% of design wattage at 50% of design water flow

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Hydronic Variable Flow – Exceptions *(Section 6.5.4.1)*

- Systems where:
  - Minimum flow is < minimum flow required by equipment manufacturer for proper operation of equipment served by the system
  - Total pump system power ≤ 75 hp
- Systems that include ≤ 3 control valves

http://www.energycodes.gov/becu/trainers.stm

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Pump Isolation *(Section 6.5.4.2)*

If chilled water plant has more than one chiller or boiler plant has more than one boiler

- Provide for flow reduction when chiller or boiler is shut down

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Chilled and Hot Water Temperature Reset Controls *(Section 6.5.4.3)*

- Affects systems with design capacity > 300,000 Btu/h
  - To include controls to automatically reset supply water temperatures by representative building loads (including return water temperature) or by outside air temperature
- *Exceptions*:
  - If controls would result in improper operation
  - Hydronic systems with variable flow

Presenter's note:
O.A. reset controls recommended for all boilers

Hydronic Heat Pump *(Section 6.5.4.4)*

For heat pump loops with total pump system power > 10 hp *(Section 6.5.4)*

- Two-position valves at each hydronic heat pump must be provided and interlocked to shut off water flow to the heat pump when the compressor is off
  - This basically converts the system into a variable flow system. As such, these systems must also comply with Section 6.5.4.1

http://www.energycodes.gov/becu/trainers.stm

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Heat Rejection Equipment *(Section 6.5.5.1)*

- Applies to heat rejection equipment used in comfort cooling systems such as
  - Air-cooled condensers
  - Open cooling towers
  - Closed-circuit cooling towers
  - Evaporative condensers
- *Exceptions:*
  - Heat rejection devices included as an integral part of equipment listed devices whose energy usage is included in Tables 6.8.1A-6.8.1D

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Heat Rejection Fan Speed Control *(Section 6.5.5.2)*

- Each condenser or tower fan powered by a motor ≥ 7.5 hp
  - Have capability to operate fan at ≤ 2/3 full speed
  - Have controls to automatically change the fan speed to control the leaving fluid temperature or condensing temperature/pressure of the heat rejection device
- *Exceptions:*
  - Condenser fans serving multiple refrigerant circuits or flooded condensers
  - Installations located in climates zones 1 and 2
  - 1/3 of the fans on a multiple fan application speed controlled

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Exhaust Air Energy Recovery *(Section 6.5.6.1)*

Incorporate exhaust air energy recovery in systems with

- ≥ 70% outside air and ≥ 5000 cfm total
- Minimum 50% energy recovery effectiveness

U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Exhaust Air Energy Recovery Exceptions (Section 6.5.6.1)

- Lab systems meeting Section 6.5.7.2
- Systems serving uncooled spaces that are heated to < 60°F
- Systems exhausting toxic, flammable, paint or corrosive fumes or dust
- Commercial kitchen hoods used for collecting grease or smoke
- Where > 60% of outdoor heating energy is provided from site-recovered or site solar energy
- Heating systems in climate zones 1 through 3
- Cooling systems in climate zones 3c, 4c, 5b, 5c, 6b, 7, and 8
- Where largest exhaust source is < 75% of the design outdoor airflow
- Systems requiring dehumidification that employ energy recovery in series with the cooling coil

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Heat Recovery for Service Water Heating *(Section 6.5.6.2)*

- Condenser recovery required if
  - 24 hrs per day **and**
  - Heat rejection > 6,000,000 Btu/h **and**
  - SWH load > 1,000,000 Btu/h
- *Exceptions*

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Kitchen Hoods (Exhaust) *(Section 6.5.7.1)*

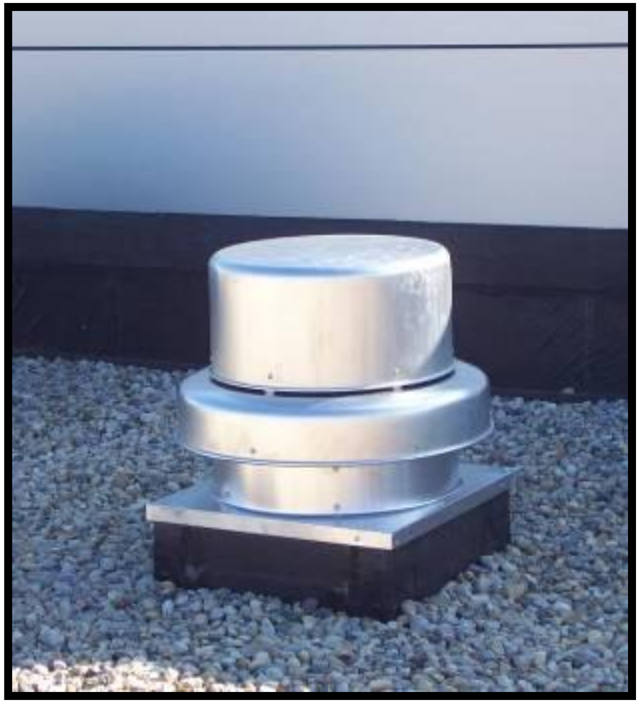
- Hoods > 5,000 cfm to be provided with makeup air sized for at least 50% of exhaust air volume that is a) unheated or heated to no more than 60°F and b) uncooled or cooled without the use of mechanical cooling
- Exceptions
  - Where hoods are used to exhaust ventilation air that would otherwise exfiltrate or be exhausted by other fan systems
  - Certified grease extractor hoods that require a face velocity no greater than 60 fpm

Presenter's note: MMC 508 requires make-up air for all commercial hoods

Fume Hoods *(Section 6.5.7.2)*

Hood systems with a total exhaust rate > 15,000 cfm to have ONE of the following features

- Operation to ≤ 50% design flow **OR**
- Direct make up at least 75% of exhaust rate at specified conditions **OR**
- Heat recovery for make-up air



U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Radiant Heating Systems *(Section 6.5.8)*

- Required for unenclosed spaces except loading docks with air curtains *(Section 6.5.8.1)*
- "Radiant heating systems that are used as primary or supplemental enclosed space heating must be in conformance with the governing provisions of the standard" *(Section 6.5.8.2)*

U.S. Department of Energy (2010)

Presenter's note:
"standard" is undefined

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Hot Gas Bypass Limitation *(Section 6.5.9)*

- Not used (including other evaporator pressure control systems) unless system is designed with multiple steps of unloading or continuous capacity modulation
- *Exception:*
  - Unitary packaged systems with cooling capacities
    ≤ 90,000 Btu/h

http://www.energycodes.gov/becu/trainers.stm

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Submittals

- Record drawings *(Section 6.7.2.1)*
- Operating and maintenance manuals *(Section 6.7.2.2)*
- System balancing *(Section 6.7.2.3)*
- System commissioning *(Section 6.7.2.4)*

http://www.energycodes.gov/becu/trainers.stm

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Drawings *(Section 6.7.2.1)*

Record drawings of actual installation to building owner within 90 days of system acceptance and include, as a minimum

- Location and performance data on each piece of equipment
- General configuration of duct and pipe distribution system including sizes
- Terminal air or water design flow rates

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Manuals *(Section 6.7.2.2)*

Operating and maintenance manuals to building owner within 90 days of system acceptance and include several items

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

System Balancing *(Section 6.7.2.3)*

(Section 6.7.2.3.1)

- Systems shall be balanced in accordance with accepted engineering standards
- Written report for conditioned spaces > 5000 ft^2

(Section 6.7.2.3.2)

- Minimize throttling losses
- For fans with system power > 1 hp
  - Adjust fan speed to meet design flow conditions

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Hydronic System Balancing *(Section 6.7.2.3.3)*

- Proportionately balanced to minimize throttling losses
- Pump impeller trimmed or pump speed adjusted to meet design flow conditions
- Each system to have either the ability to measure differential pressure increase across the pump or have test ports at each side of the pump
- *Exceptions:*
  - Pumps with pump motors ≤ 10 hp
  - When throttling results in < 5% of the nameplate hp draw, or 3 hp, whichever is greater, above that required if the impeller was trimmed

http://www.energycodes.gov/becu/trainers.stm

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System Commissioning (Section 6.7.2.4)

- Control elements shall be calibrated, adjusted, and in proper working condition

- > 50,000 ft^2 conditioned area requires commissioning instructions
  - *Except* warehouses and semi-heated spaces

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Minimum Equipment Efficiency Tables

- Equipment Efficiency Tables 6.8.1A to 6.8.1J
- Duct Insulation Tables 6.8.2A and 6.8.2B
- Pipe Insulation Table 6.8.3

http://www.energycodes.gov/becu/trainers.stm

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SWH Compliance

Building System

- Envelope
- HVAC
- SWH
- Power
- Lighting
- Other

Mandatory Provisions

(required for most compliance options)

Compliance Options

- Prescriptive Option
- Trade Off Option
- Energy Cost Budget
- Simplified

Energy Code Compliance

http://www.energycodes.gov/becu/trainers.stm

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Service Water Heating *(Section 7)*

- General *(Section 7.1)*
- Compliance Path(s) *(Section 7.2)*
- Mandatory Provisions *(Section 7.4)*
  - Load calculations
  - Equipment efficiency
  - Service hot water piping insulation
  - System controls
  - Pools
  - Heat traps
- Prescriptive Path *(Section 7.5)*
  - Space heating and water heating
  - Service water heating equipment
- Submittals *(Section 7.7)*

U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

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SWH Alterations (*Section 7.1.1.3)*

SWH equipment installed as a direct replacement shall meet these requirements unless there is not sufficient space or access to meet these requirements

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

SWH Compliance Paths *(Section 7.2)*

- You have to follow Sections
  - 7.1,
  - 7.4,
  - 7.5,
  - 7.7, and
  - 7.8
- Alternatively, you can follow Section 11 (ECB), in which case Section 7.4 is mandatory

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Load Calculations *(Section 7.4.1)*

In accordance with manufacturer's published sizing guidelines or generally accepted engineering standards and handbooks

Equipment Efficiency *(Section 7.4.2)*

- Refers to Table 7.8 for equipment efficiencies
- Equipment not listed in Table 7.8 has no minimum performance requirements
- *Exception:*
  - Water heaters and hot water supply boilers > 140 gal storage capacity don’t have to meet standby loss requirements when
    - Tank surface is thermally insulated to R-12.5, and
    - A standing pilot light isn’t installed, and
    - Gas- or oil-fired water heaters have a flue damper or fan-assisted combustion

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Service Hot Water Piping Insulation *(Section 7.4.3)*

- Table 6.8.3, Section 6
- Circulating water heater
  - Re-circulating system piping, including supply and return piping *(a)*
- Non-re-circulating storage system
  - First 8 ft of outlet piping *(b)*
  - Inlet pipe between storage tank and heat trap *(c)*
- Externally-heated pipes (heat trace or impedance heating) *(d)*

U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

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Service Water Heating System Controls *(Section 7.4.4)*

- Temperature Controls *(Section 7.4.4.1)*
- Temperature Maintenance Controls *(Section 7.4.4.2)*
- Outlet Temperature Controls *(Section 7.4.4.3)*
- Circulating Pump Controls *(Section 7.4.4.4)*

U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

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Temperature Controls *(Section 7.4.4.1)*

- To allow for storage temperature adjustment from 120°F or lower to a maximum temperature compatible with the intended use
- *Exception:*
  - If manufacturer's installation instructions specify a higher minimum thermostat setting to minimize condensation and resulting corrosion

http://www.energycodes.gov/becu/trainers.stm

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Temperature Maintenance Controls *(Section 7.4.4.2)*

Automatic time switches or other controls:

- Set to switch off usage temperature maintenance system during extended periods when hot water is not required

http://www.energycodes.gov/becu/trainers.stm

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Outlet Temperature Controls *(Section 7.4.4.3)*

Controls provided:

- To limit maximum temperature of water delivered from lavatory faucets in public facility restrooms to 110°F

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Circulating Pump Controls *(Section 7.4.4.4)*

To limit operation of a ***storage tank circulating pump*** to a period from the start of the heating cycle to a maximum of five minutes after the end of the heating cycle

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Pools *(Section 7.4.5)*

- Pool heaters to have readily accessible on-off switch *(Section 7.4.5.1)*
- Pool heaters fired by natural gas can NOT have continuously burning pilot lights *(Section 7.4.5.1)*
- Vapor retardant pool covers required (unless > 60% from site-recovered or solar heat) *(Section 7.4.5.2)* Time switches required *(Section 7.4.5.3)*

U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Heat Traps *(Section 7.4.6)*

Non-circulating systems to have heat traps on both the inlet and outlet piping as close as practical to storage tank (if no integral heat traps)

- Either a device specifically designed for this purpose or
- Arrangement of tubing that forms a loop of 360° or piping that from the point of connection to the water heater includes a length of piping directed downward before connection to the vertical piping of the supply water or hot water distribution system, as applicable

U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Space Heating + Water Heating (Section 7.5.1)

- Gas- or oil-fired space heating boiler system (complying with Section 6) is allowed to provide total space heating and water heating when ONE of the following conditions is met
  - Single boiler or component that is heating the service water has a standby loss in Btu/h not exceeding
    - (13.3 x *pmd* + 400) / *n*; where *pmd* is probable maximum demand in gal/h and *n* is the fraction of the year when outdoor daily mean temperature is > 64.9°F
  - Jurisdiction agrees use of a single heat source will consume less energy than separate units
  - Energy input of the combined boiler and water heater system is < 150,000 Btu/h
- Instructions for determining standby loss are included in this Section

Service Water Heating Equipment *(Section 7.5.2)*

Equipment used to provide the additional function of space heating as part of a combination (integrated) system shall satisfy all requirements for service water heating equipment

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Service Water Heating Submittals *(Section 7.7.1)*

Authority having jurisdiction may require submittal of compliance documentation and supplemental information in accord with Section 4.2.2 of this standard

http://www.energycodes.gov/becu/trainers.stm

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Power Compliance

Building System

Compliance Options

- Envelope
- HVAC
- SWH
- **Power**
- Lighting
- Other

Mandatory Provisions

(required for most compliance options)

- Prescriptive Option
- Trade Off Option
- **Energy Cost Budget**
- Simplified

Energy Code Compliance

http://www.energycodes.gov/becu/trainers.stm

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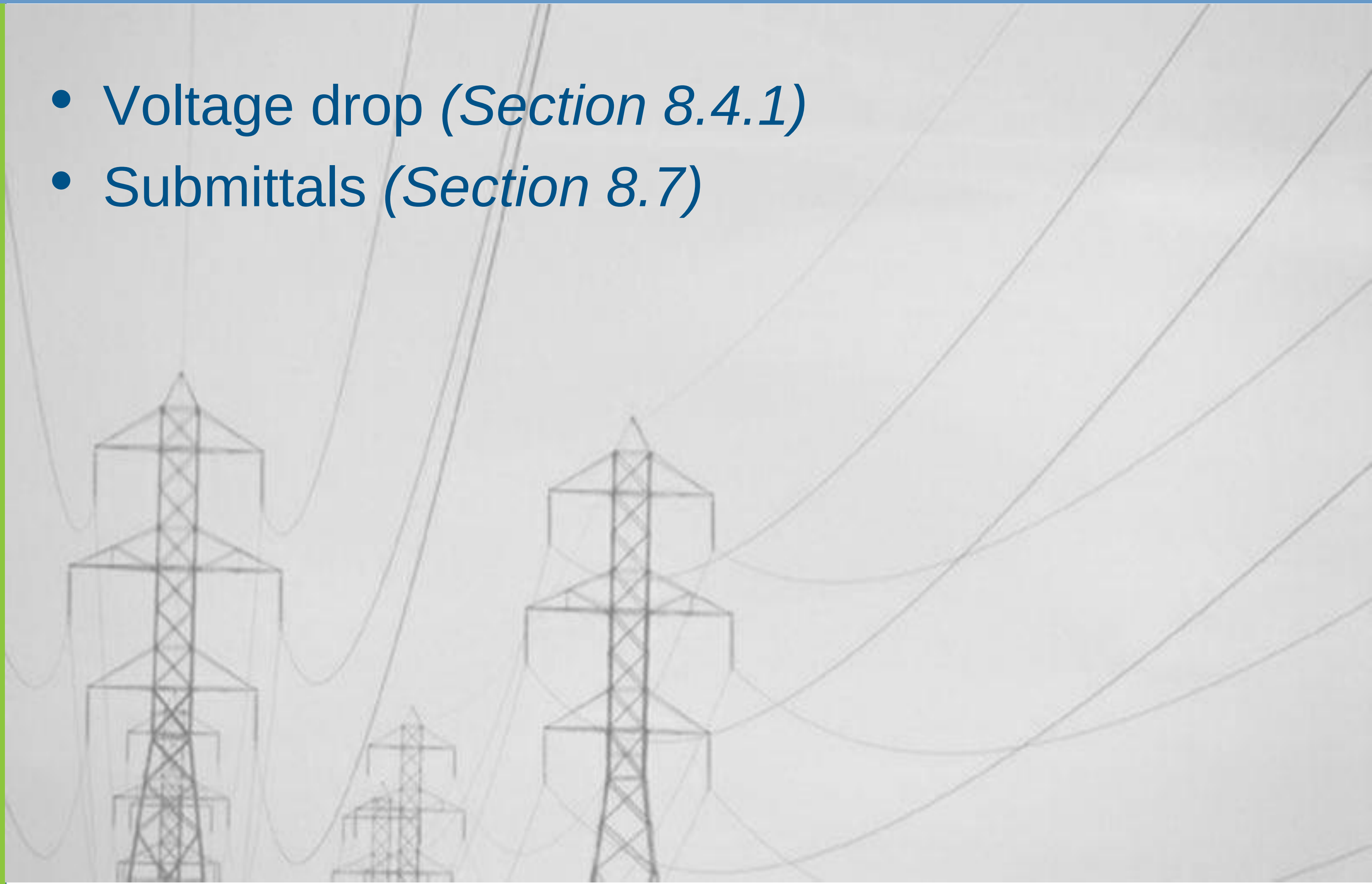
Power *(Section 8)*



- Voltage drop *(Section 8.4.1)*
- Submittals *(Section 8.7)*

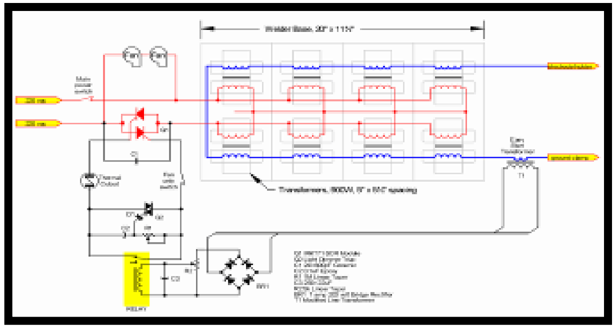
Date visited: 2/11/2011

Voltage Drop *(Section 8.4.1)*

Two types of conductors:

1. Feeder conductors *(Section 8.4.1.1)*
   - Connect service equipment to the branch circuit breaker panels
   - 2% maximum voltage drop allowed at design load
2. Branch circuit conductors *(Section 8.4.1.2)*
   - Run from the final circuit breaker to the outlet or load
   - 3% maximum voltage drop allowed at design load

– These are more stringent than non-enforceable requirements in the National Electric Code (NEC)



U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

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Power Submittals *(Section 8.7)*

Owner gets information about the building's electrical system

- Record drawings of actual installation within 30 days *(Section 8.7.1)*
  - Single-line diagram of electrical distribution system
  - Floor plans showing location and areas served for all distribution
- Manuals *(Section 8.7.2)*:
  - Submittal data stating equipment rating
  - O&M manuals for equipment
  - Qualified service agency
  - Complete narrative of system as it's normally intended to operate

U.S. Department of Energy (2010)

U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

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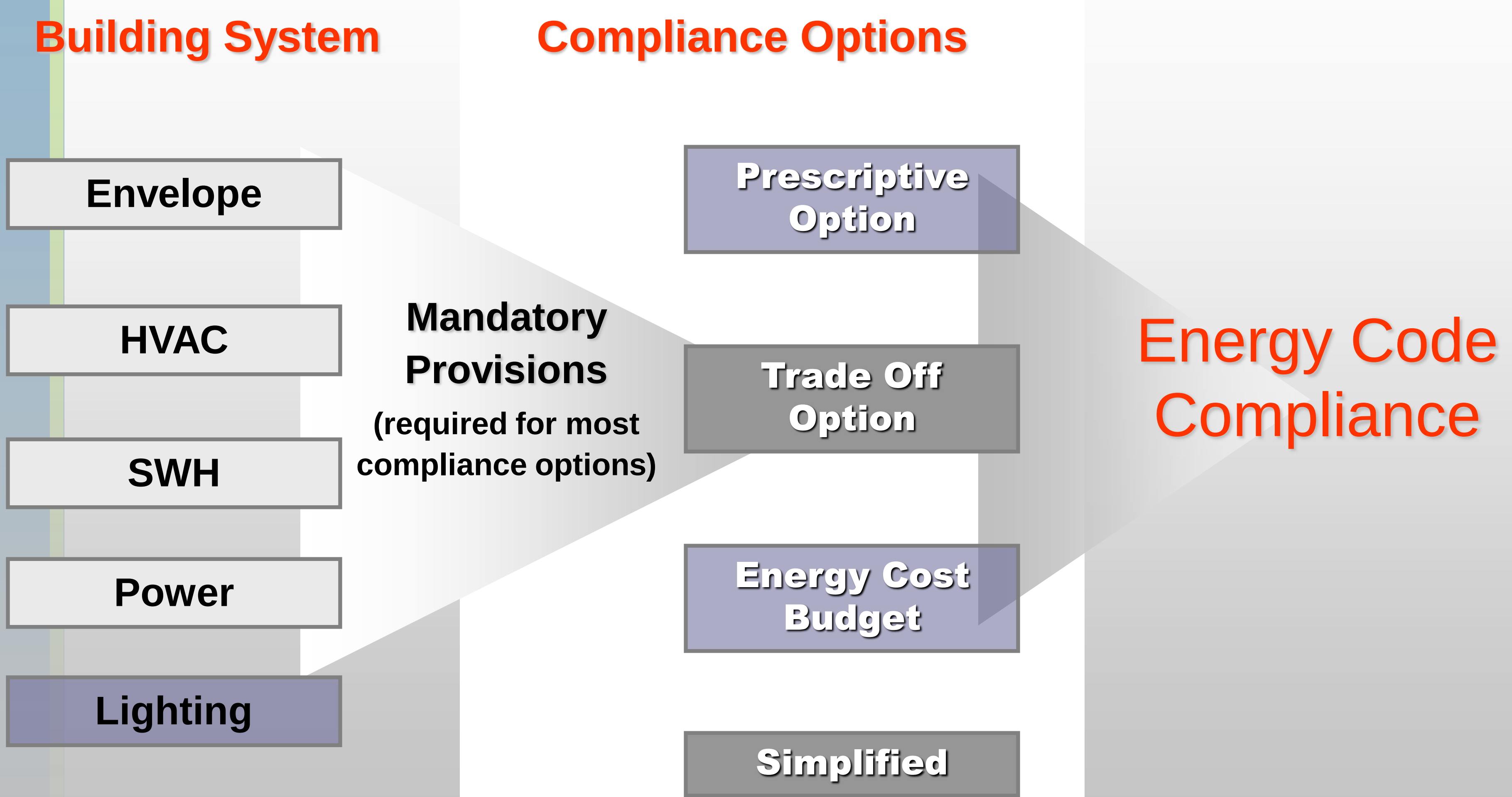
Lighting Compliance



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Lighting *(Section 9)*

- General Application *(Section 9.1)*
  - Scope
  - Lighting Alterations
  - Installed Interior Lighting Power
  - Luminaire Wattage
- Compliance Path(s) *(Section 9.2)*
- Mandatory Provisions *(Section 9.4)*
  - Lighting control
  - Tandem wiring
  - Exit signs
  - Exterior building grounds lighting
  - Exterior building lighting power
- Building Area Method Compliance Path (*Section 9.5)*
- Alternative Compliance Path: Space-by-Space Method *(Section 9.6)*

U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

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Lighting General *(Section 9.1)*

- Scope *(Section 9.1.1)*:
  - Interior spaces of buildings *(a)*
  - Exterior building features *(b)*
  - Exterior grounds lighting powered through building *(c)*
  - Exceptions
    - Emergency lighting
    - Lighting required by life safety statute
    - Lighting within dwelling units of buildings
    - Decorative gas lighting
- Lighting Alterations *(Section 9.1.2)*:
  - New lighting and lighting controls must comply with this section, unless an alteration replaces less than 50% of luminaires in a space and that alteration does not increase the installed lighting power

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Lighting General

(Section 9.1.3)

- Installed Interior Lighting Power shall include all power used by the luminaires, including lamps, ballasts, transformers, and controls
  - **Exception**: in the case where there are two independently operated lighting systems that are controlled to prevent simultaneous operation
    - Include only the higher wattage system

(Section 9.1.4)

- Luminaire Wattage for various systems shall be determined in accordance with details in this section

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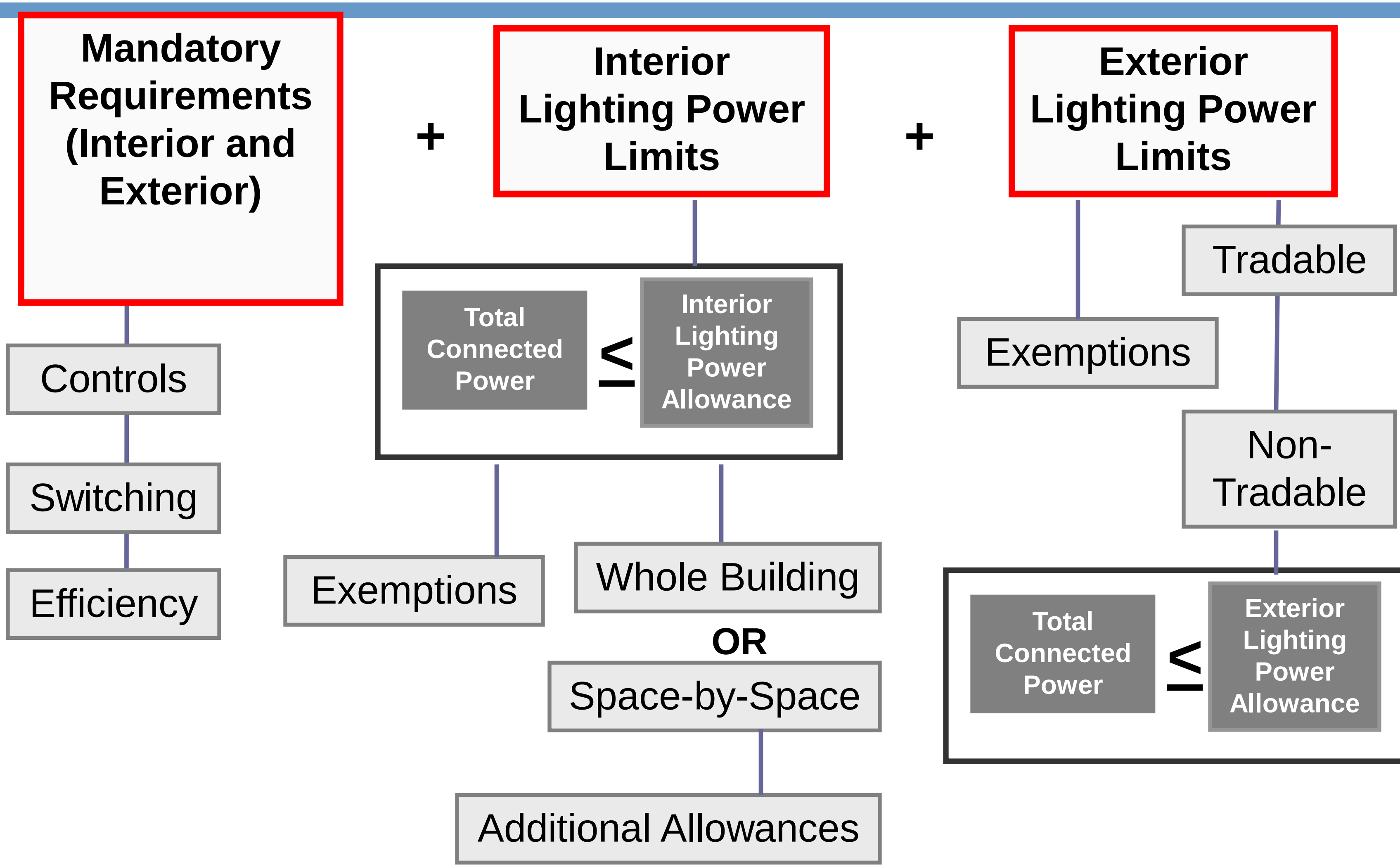
Date visited: 2/11/2011

Basic Lighting Requirements



U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Luminaire Wattage *(Section 9.1.4)*

- Standard incandescent = max. labeled wattage of the luminaire *(a)*
- Luminaires with ballasts or transformers = wattage of the maximum lamp/ballast combination OR max. labeled wattage of the luminaire *(b)*
- Line voltage track = actual wattage with a min. 30 W per foot OR wattage limit of system’s circuit breaker OR wattage limit of other permanent-current-limiting device(s) on the system *(c)*
- Low voltage track = transformer wattage *(d)*
- All others as specified on equipment *(e)*

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Mandatory: Individual Space Control *(Section 9.4.1.2)*

- At least one for each room or space enclosed by ceiling-height partitions
  - in spaces ≤ 10,000 ft^2, each control serves 2500 ft^2 maximum and in spaces > 10,000 ft^2, serves 10,000 ft^2 maximum
- Readily accessible to occupants
- Remote location is allowed to accommodate areas where safety or security is a concern

U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Mandatory: Additional Space Controls *(Section 9.4.1.4)*

Hotel/motel guest room lighting must be controlled at room entry *(c)*

U.S. Department of Energy (2010)

Occupancy sensors are required in:

- Classrooms (except shop, lab, K-12)
- Conference/meeting rooms
- Employee lunch/break rooms

U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Mandatory: Individual Space Control *(Section 9.4.1.4)*

Additional control required for:

- Display/accent lighting *(a)*
- Case lighting *(b)*
- Task lighting *(d)*
- Non-visual lighting *(e)*
- Demonstration lighting *(f)*

U.S. Department of Energy (2010) (all)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Mandatory: Automatic Shutoff *(Section 9.4.1.1)*

- Automatic lighting shutoff control device required in all buildings larger than 5,000 ft^2

- Override of automatic shutoff required for not more than 4 hours *(Section 9.4.1.2)*

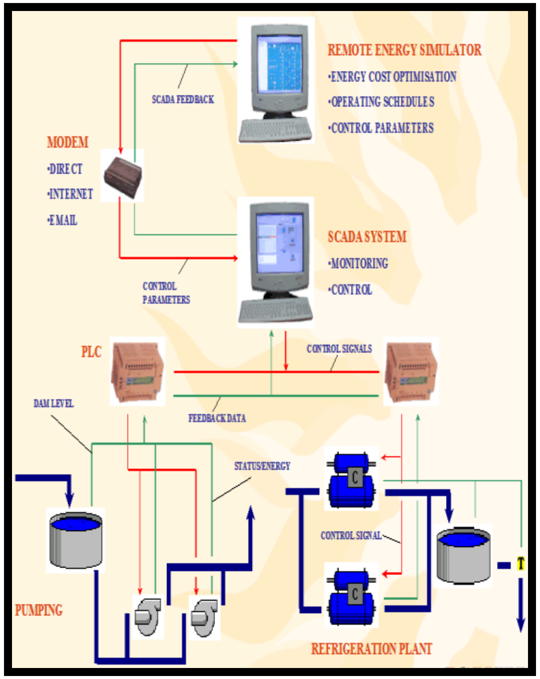
- *Exceptions* to automatic shutoff:
  - Lighting for 24-hour operation
  - Patient care spaces
  - Areas with safety or security concerns

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Automatic Shutoff *(Section 9.4.1.1)*

- Compliance options:
- Control lights on a scheduled basis (automatic time switch) *(a)*
  - Time-of-day controller
  - Controls ≤ 25,000 ft^2 and not more than one floor
- Occupant sensor *(b)*
  - Turn lights off within 30 minutes of occupant leaving the space
- Signal from another control or alarm that indicates the area is unoccupied *(c)*



U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Application of Automatic Shutoff

Intent is to apply to business entities or structures where whole building control is practical

Example application:

- Strip mall – individual business unit

U.S. Department of Energy (2010)

Exterior Lighting Control *(Section 9.4.1.3)*

- For dusk-to-dawn lighting: astronomical time switch or photosensor
- For all other: astronomical time switch **OR photosensor + time switch [REVISED!]**
- All time switches must have 10 hour battery backup
- *Exceptions*:
  - Covered vehicle entrances
  - Exits from buildings or parking structures
  - (where required for safety, security, or eye adaptation)

U.S. Department of Energy (2010) (all)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Additional Control *(Section 9.4.1.4)*

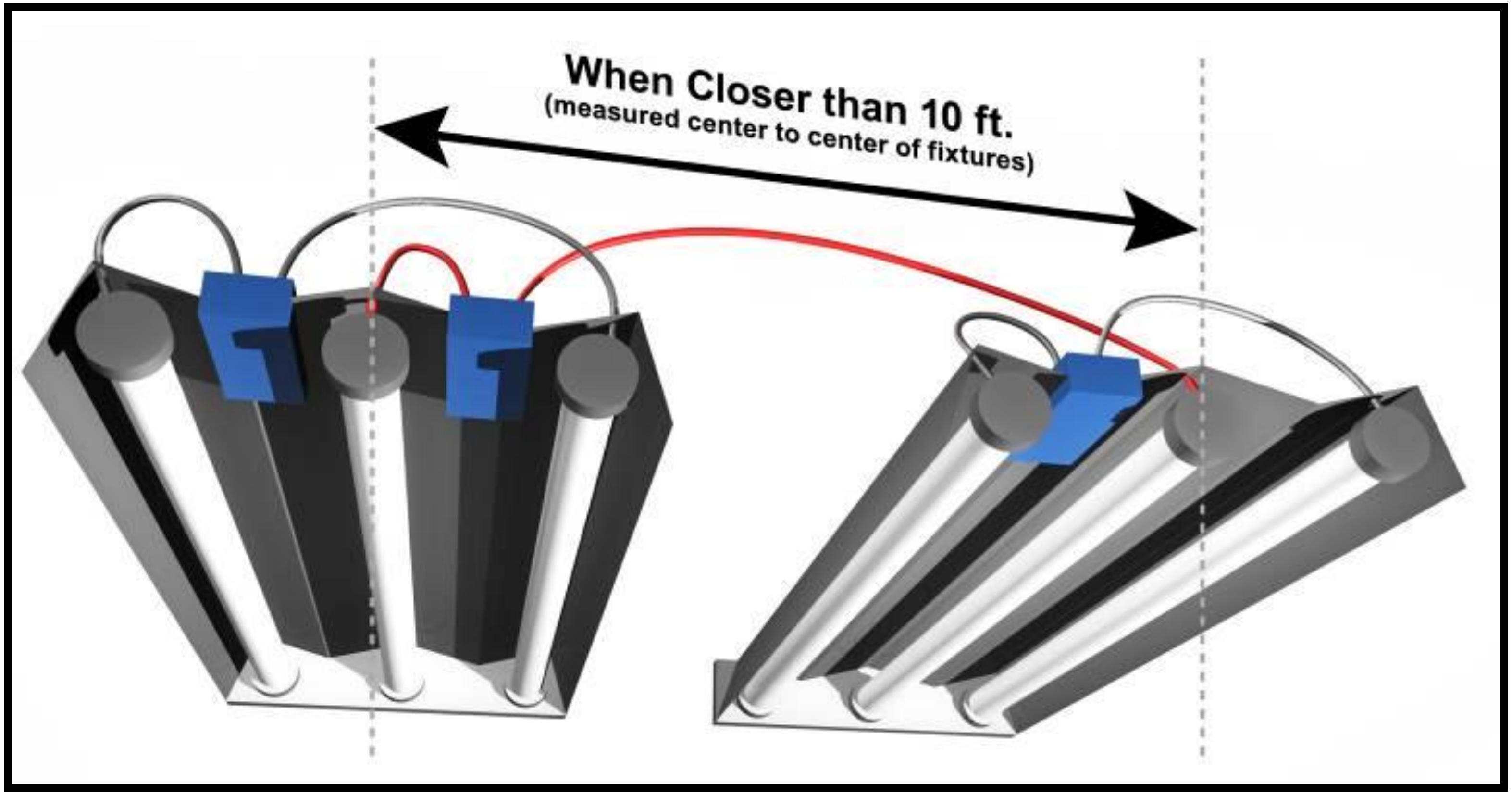
Many special lighting applications must be controlled separately

- Display/accent lighting *(a)*
- Case lighting *(b)*
- Hotel/motel guest room lighting *(c)*
- Task lighting *(d)*
- Non-visual lighting *(e)*
- Demonstration lighting *(f)*

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Tandem Wiring *(Section 9.4.2)*



U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Tandem Wiring Exceptions *(Section 9.4.2)*

- Separated surface or pendant luminaires
- Recessed luminaires more than 10 ft apart
- Other luminaires
  - With three-lamp ballasts
  - On emergency lighting circuits
  - With no available pair
  - With one lamp, high frequency, electronic ballast

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Exit Signs *(Section 9.4.3)*

Limited to 5 watts per face

U.S. Department of Energy (2010)

U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

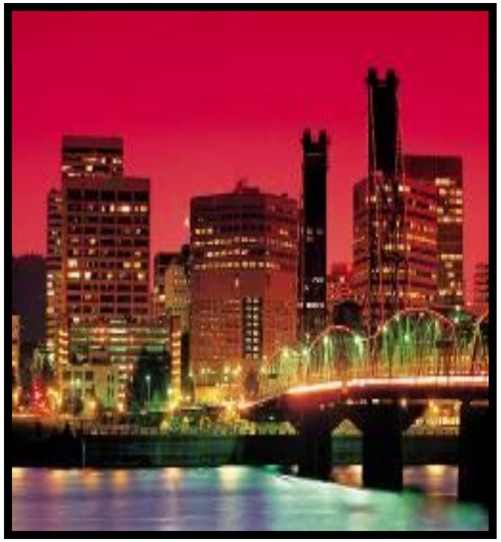
Date visited: 2/11/2011

Exterior Lighting Power

- Building grounds lighting luminaires over 100 watts must have lamp efficacy of at least 60 lumen/Watt. ***Exception***: motion sensor controls. *(Section 9.4.4)*
- Exterior Building Lighting Power must meet prescribed wattage limits. Exterior applications divided into 2 categories *(Section 9.4.5)*:

Tradable: allowed wattage may be traded among these applications

Non-Tradable: allowed wattage **cannot** be traded between surfaces or with other exterior lighting



U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

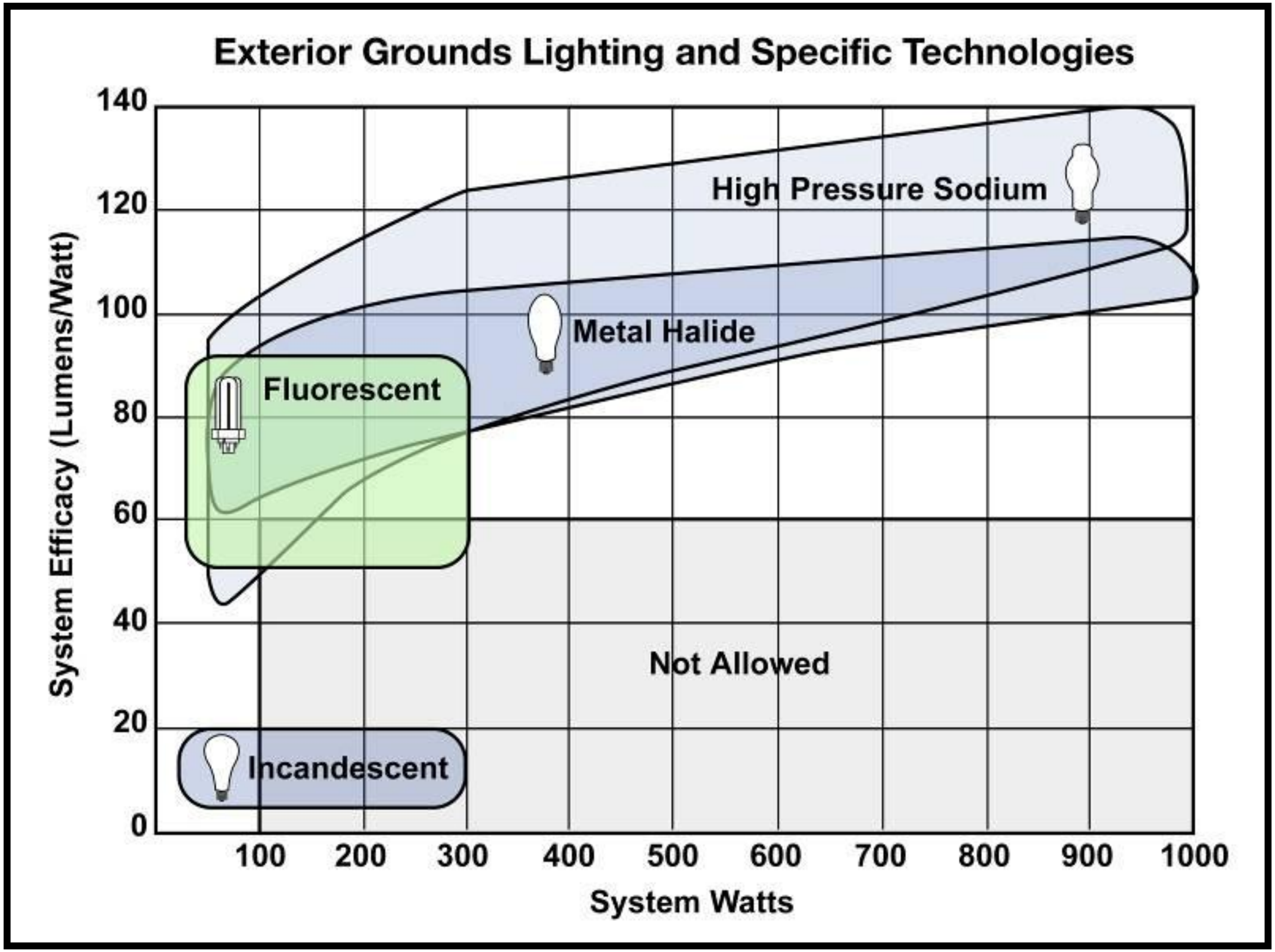
Efficacy *(Section 3 definition)*

- The ratio of light output to watts input
  - lumens per watt
- The higher the efficacy, the more efficient the light source
  - 40 watt incandescent = 480 lumens (12 L / W)
  - 40 watt fluorescent = 2640 lumens (66 L / W)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Efficacy

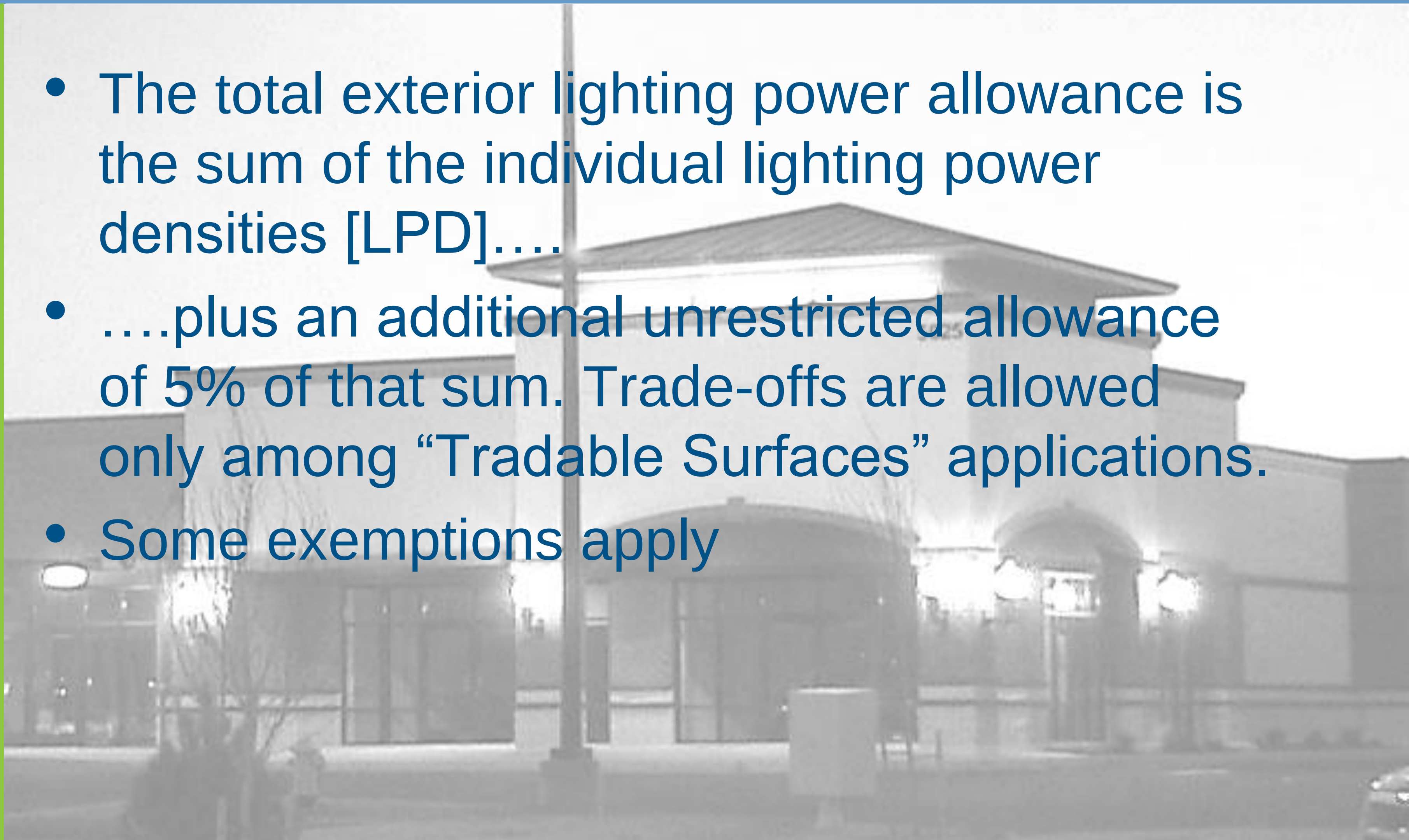


http://www.energycodes.gov/becu/trainers.stm

U.S. Department of Energy (2010)

Date visited: 2/11/2011

Exterior Building Lighting Power *(Section 9.4.5)*



- The total exterior lighting power allowance is the sum of the individual lighting power densities [LPD]….
- ….plus an additional unrestricted allowance of 5% of that sum. Trade-offs are allowed only among “Tradable Surfaces” applications.
- Some exemptions apply

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Exterior Building Lighting Power (Section 9.4.5)

Lighting used for the following exterior applications is exempt when equipped with a control device independent of the control of the nonexempt lighting:

- specialized signal, directional, and marker lighting associated with transportation;
- lighting that is integral to advertising signage or directional signage;
- lighting that is integral to equipment or instrumentation and is installed by its manufacturer;
- lighting for theatrical purposes, including performance, stage, film, and video production;
- lighting for athletic playing areas;
- temporary lighting;
- lighting for industrial production, material handling, transportation sites, and associated storage areas;
- theme elements in theme/amusement parks;
- lighting used to highlight features of public monuments and registered historic landmark structures or buildings

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Exterior LPDs: 90.1-2007 *(Table 9.4.5)*

Example:

Applications	**Lighting Power Densities**
Tradable Surfaces**:**	
Uncovered Parking Areas	
Parking lots and drives	0.15 W/ft^2 (12 fc @ 80 L/W)
Building Grounds	
Walkways less than 10 feet wide	1.0 W/linear foot
Walkways 10 feet wide or greater, Plaza areas and Special feature areas	0.2 W/ft^2 (16 fc @ 80 L/W)
Stairways	1.0 W/ft^2

U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Exterior LPDs: 90.1-2007 *(Table 9.4.5)*

Example:

Applications	Lighting Power Densities
Non-Tradable Surfaces	
Building facades	0.2 W/ft^2 for each illuminated wall or surface or 5.0 W/linear foot for each illuminated wall or surface length
Automated teller machines & night depositories	270 W per location plus 90 watts per additional ATM per location
Entrances and gatehouse inspection stations at guarded facilities	1.25 W/ft^2 of uncovered area (covered areas are included in the Canopies and Overhangs section of Tradable Surfaces)

U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Interior Lighting Power *(Section 9.2.2.3)*

- Lots of exemptions
- Calculation methods
  - Building area *(Section 9.5)*
  - Space-by-space *(Section 9.6)*
  - Trade-offs of interior lighting power allowance among portions of the building for which a different calculation method has been used is not permitted

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

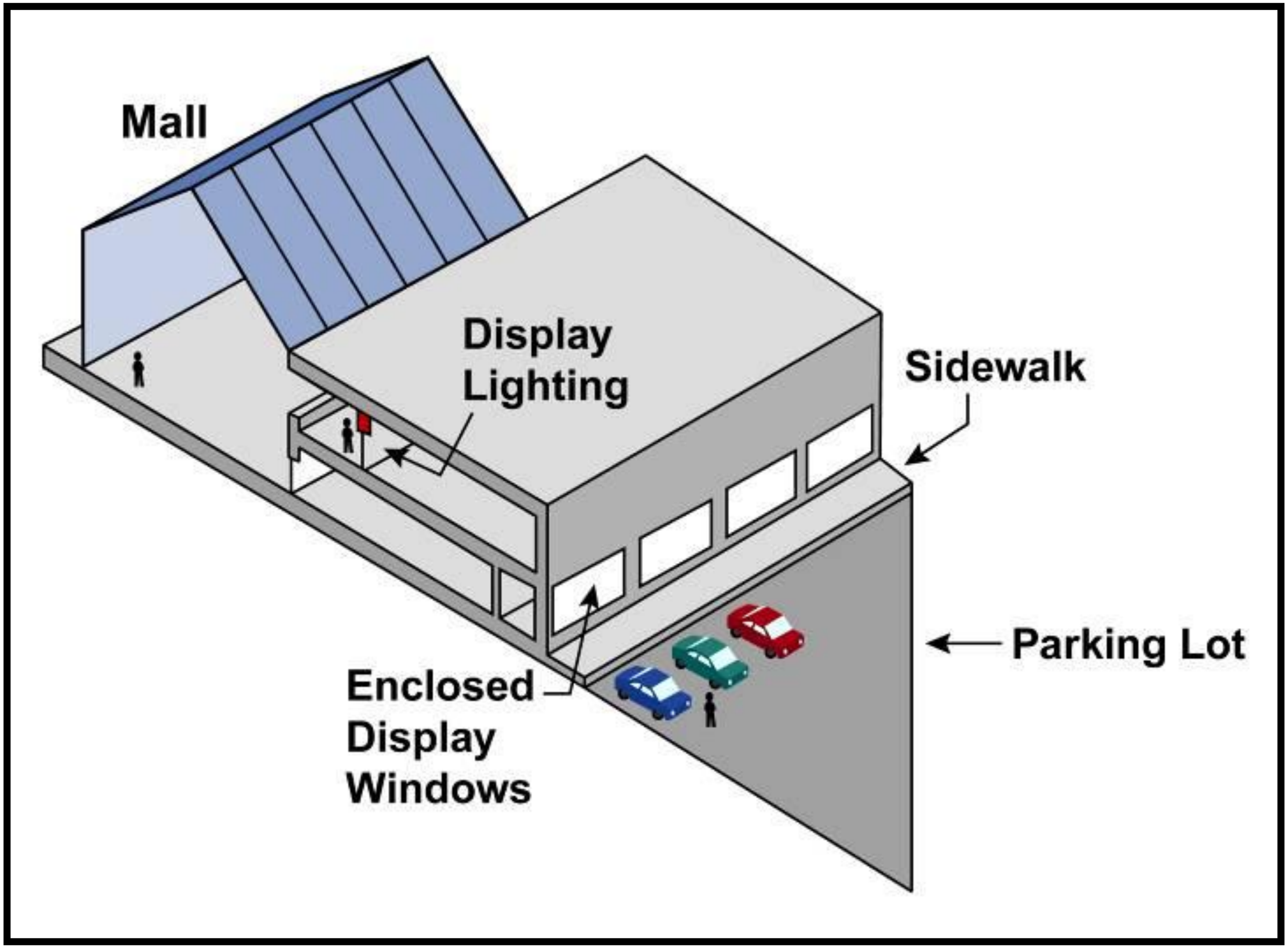
Lighting Power Allowance Exemptions *(Section 9.2.2.3)*

- Theatrical, stage, film, and video production
- Medical and dental procedures
- Exhibit displays for museums, monuments, and galleries
- Plant growth or maintenance
- Integral to equipment or instrumentation installed by manufacturer
- Integral to both open and glass-enclosed refrigerator and freezer cases
- Retail display windows, provided the display is enclosed by ceiling-height partitions
- Food warming and food preparation equipment
- Interior spaces specifically designated as registered interior historic landmarks
- Integral part of advertising or directional signage
- Exit signs
- Sale or lighting educational demonstration systems
- Lighting for television broadcasting in sporting activity areas
- Casino gaming areas
- Furniture-mounted supplemental task lighting controlled by automatic shutoff and complying with 9.4.1.4(d)
- For use in areas specifically designed for occupants with special needs

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Exemption Example



http://www.energycodes.gov/becu/trainers.stm

U.S. Department of Energy (2010)

Date visited: 2/11/2011

Building Area Method of Calculating Interior Lighting Power Allowance *(Section 9.5.1)*

- Used for projects involving
  - An entire building
  - A single, independent, and separate occupancy in a multi-occupancy building
- Gross lighted area is multiplied by allowance from Table 9.5.1
- *Limitations:*
  - Insensitive to specific space functions and room configurations
  - Generally is more restrictive
  - Does not apply to all building types - but "selection of a reasonably equivalent type" is permitted

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Gross Lighted Area *(Section 3 definition)*

- Sum of total lighted area of a building
  - Measured from the exterior faces of the exterior walls or from the centerline of walls separating buildings, but excluding a long list of areas. (See Standard).
- Used in the building area method of determining interior lighting power allowance

U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Building Area Allowances

Table 9.5.1

Building Type	Lighting Power Density (W/ft^2)
Court House	1.2 (1.4)
Dining: Bar Lounge/Leisure	1.3 (1.5)
Dining: Cafeteria/Fast Food	1.4 (1.8)
Dining: Family	1.6 (1.9)
Dormitory	1.0 (1.5)
Exercise Center	1.0 (1.4)
Office	1.0 (1.3)

U.S. Department of Energy (2010)

Presenter's note:
( ) = 1999 ASHRAE 90.1 values

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Space-by-Space Method of Calculating Interior Lighting Power Allowance *(Section 9.6.1)*

- Identify different building types in your project
- Divide gross lighted area of the building into each of the space types
- Calculate lighting power allowance by multiplying area of space type by lighting power density for that specific space type
- Sum all the allowances
- Advantages:
  - More flexible
  - Applicable to all building types
  - Accounts for room geometry (e.g., lighting needs of enclosed office vs. open office)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Space-by-Space LPD

Table 9.6.1

Presenter's note:
( ) = 1999 ASHRAE 90.1 values

Space Type	Lighting Power Density (W/ft^2)
Court House	1.9 (1.5)
Dining: Bar Lounge/Leisure	1.4 (1.5)
Dining: Cafeteria/Fast Food	2.1 (1.5)
Dining: Family	2.1 (1.5)
Dormitory	1.1 (1.5)
Exercise Center	0.9 (1.3)
Office, Enclosed	1.1 (1.5)

U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Additional Interior Lighting Power (Section 9.6.2)

An increase in the ILPA is allowed for specific space functions when using the space-by-space method. Applications must be automatically controlled, separately from the general lighting, to be turned off during non-business hours

- Decorative in addition to general lighting – 1.0 W/ft^2 in space used
- Retail display lighting

U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Retail Display Lighting *(Section 9.6.2)*

Additional Interior Lighting Power Allowance = 1000 watts +
(Retail Area 1 x 1.0 W/ft2) +
(Retail Area 2 x 1.7 W/ft2) +
(Retail Area 3 x 2.6 W/ft2) +
(Retail Area 4 x 4.2 W/ft2),

Where:

- **Retail Area 1** = the floor area for all products not listed in Retail Area 2, 3 or 4
- **Retail Area 2** = the floor area used for the sale of vehicles, sporting goods and small electronics
- **Retail Area 3** = the floor area used for the sale of furniture, clothing, cosmetics and artwork
- **Retail Area 4** = the floor area used for the sale of jewelry, crystal, and china

Exception: Other merchandise categories may be included in Retail Areas 2 through 4 above, provided that justification documenting the need for additional lighting power based on visual inspection, contrast, or other critical display is approved by the authority having jurisdiction.

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

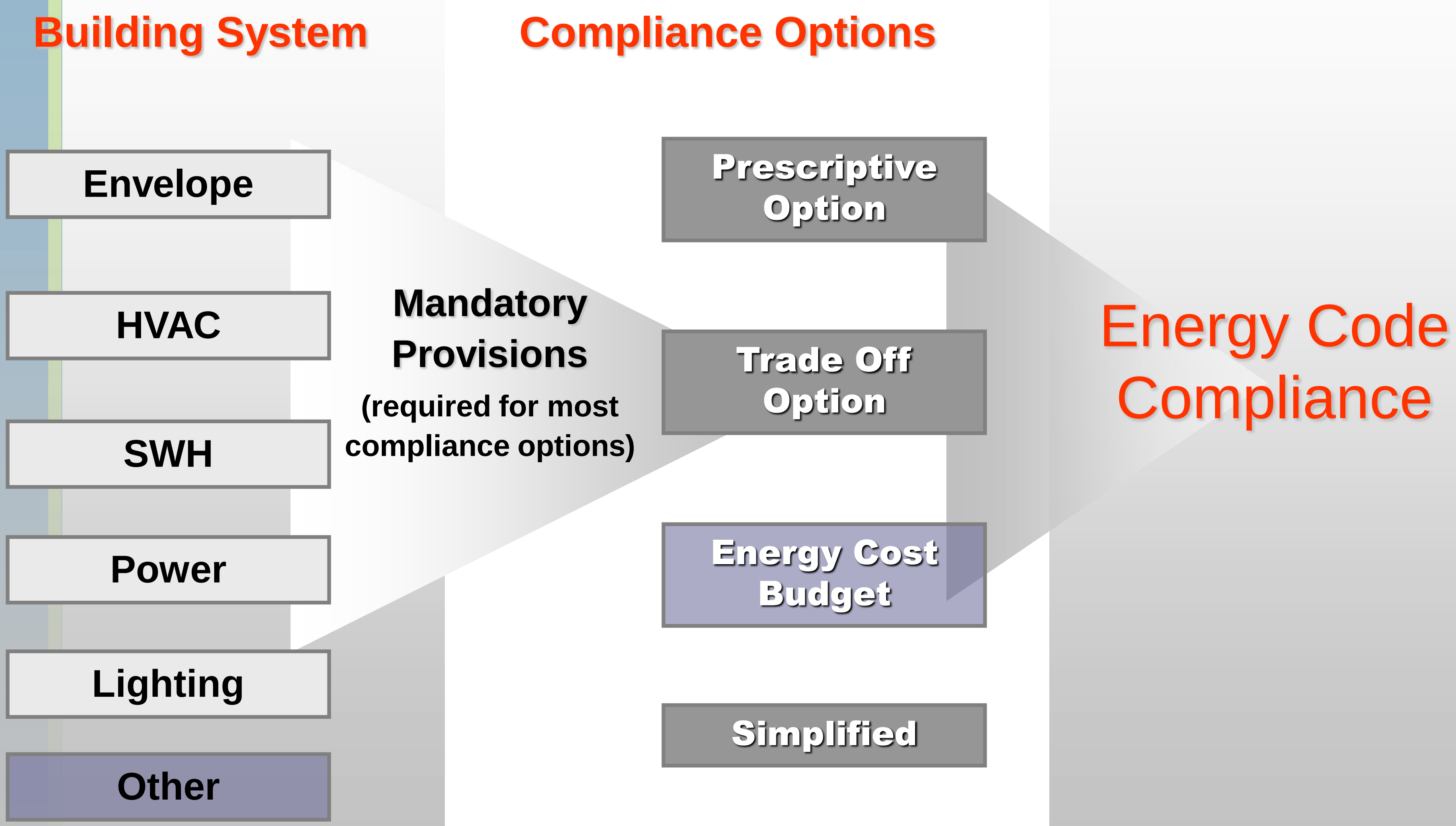
Submittals *(Section 9.7)*

There are no submittals associated with the lighting requirements

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Other Compliance



http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Other Equipment – Motors *(Section 10)*

- Motor efficiency levels correspond to Energy Policy Act of 1992 manufacturing standards *(Section 10.4.1)*
- Mandatory provisions are for General Purpose Design A and Design B motors only *(Section 10.8)*
- Motors in new buildings, additions to existing buildings, and alterations to existing buildings must comply *(Sections 10.1.1.1 through 10.1.1.3)*
  - Relocated or reused existing motors do not have to meet these requirements *(Section 10.1.1.3.2)*
- No small building option, no prescriptive compliance path, no alternative compliance paths, no submittals *(Sections 10.3 and 10.5 through 10.7)*

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Energy Cost Budget Method *(Section 11)*

- The ultimate trade-off method allowing you to trade-off across building systems through the use of annual, hourly simulation tools and a baseline building
- The only real way to deal with unique designs, renewables, high-efficiency equipment, etc.
- The basis of the energy portion of the LEED rating
- Limits allowable energy costs of the design to those of a building meeting the Standard
- Buildings must still meet all mandatory requirements (Section X.4)

U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Energy Cost Budget Method

- Tradeoff limited to building permit *(Section 11.1.2)*
- You have to have an approved building envelope design prior to ECB submittal *(Section 11.1.3)*
- You must meet all the X.4 sections AND the design energy cost cannot exceed the energy cost budget AND the energy efficiency level of components must meet or exceed the levels used to calculate the design energy cost *(Section 11.1.4)*
- You must document all this in great detail *(Section 11.1.5)*

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Energy Cost Budget Method

- Use a good and approved simulation program *(Section 11.2.1)*
- Use appropriate and approved climate data *(Section 11.2.2)*
- Use appropriate and approved purchased energy rates *(Section 11.2.3)*
- Use the same simulation program, climate data, and purchased energy rates for both the design energy cost and energy cost budget *(Section 11.2.4)*
- Get approval to deal with exceptional calculations that aren't covered in the simulation program *(Section 11.2.5)*

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Energy Cost Budget Method

- Develop your proposed building design and budget building design in accordance with Table 11.3.1 *(Section 11.3.1)*
  - This table "locks down" a number of building design parameters
- Choose your budget building HVAC system from Figure 11.3.2 and Table 11.3.2A *(Section 11.3.2)*

Energy Cost Budget Method

If you are attempting to show that your building goes "above code" (say, for instance, for LEED energy points) as opposed to simply using ECB as a very flexible and complex code compliance tradeoff option,

- Be sure to see Informative Appendix G, which contains many of the same elements as Section 11, but with modifications to accommodate the needs of "above code" programs

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Normative References *(Section 12)*

- Normative (read “mandatory”) reference documents
- Includes test methods, rating procedures, and other standards

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Rated R-Value of Insulation and Assembly U-Factor, C-Factor, and F-Factor Determinations *(Normative Appendix A)*

Includes pre-calculated U-factors, C-factors, and F-factors:

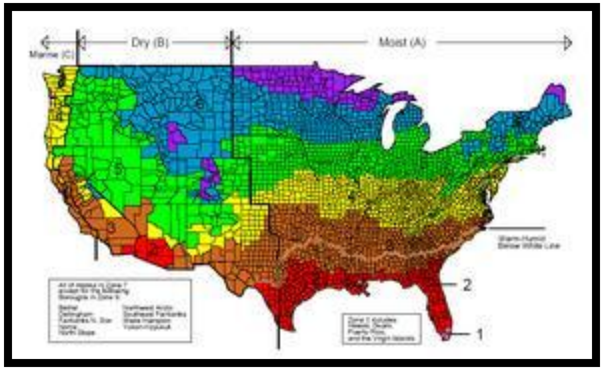
- Above-grade walls *(Section A3)*
- Below-grade walls *(Section A4)*
- Floors *(Section A5)*
- Slab-on-grade floors *(Section A6)*
- Opaque doors *(Section A7)*
- Fenestration *(Section A8)*

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Building Envelope Climate Criteria *(Normative Appendix B)*

- Defines which of the envelope criteria tables (Tables 5.5-X) to use for your location
- General *(Section B1)*:
  - Climate Zone Map
  - U.S. Climate Zones (by County)
  - Canadian Climatic Zones (by City)
  - International Climate Zone (by City)
- Major Climate Type Definitions (for use with non-U.S. locations) *(Section B2)*



U.S. Department of Energy (2010)

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Methodology for Building Envelope Trade-Off Option in Subsection 5.6 *(Normative Appendix C)*

- The details of how the envelope trade-off option referenced in Section 5.6 is implemented
- This methodology is implemented in the ENVSTD software distributed with the 90.1 Users Manual

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Climate Data *(Normative Appendix D)*

- Climatic data for a number of US, Canadian, and international locations
  - HDD65 and CDD50
  - Heating and cooling design temperatures
  - "number of hours between 8 am and 4 pm with Tdb between 55 and 69"
- Used exclusively for HVAC calculations

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Informative References
(Informative Appendix E)

- Other useful references that are not mandatory, but are useful as examples for the user of Standard 90.1-2007
- In general, these are not consensus documents so ASHRAE procedures do not allow them to be mandatory references

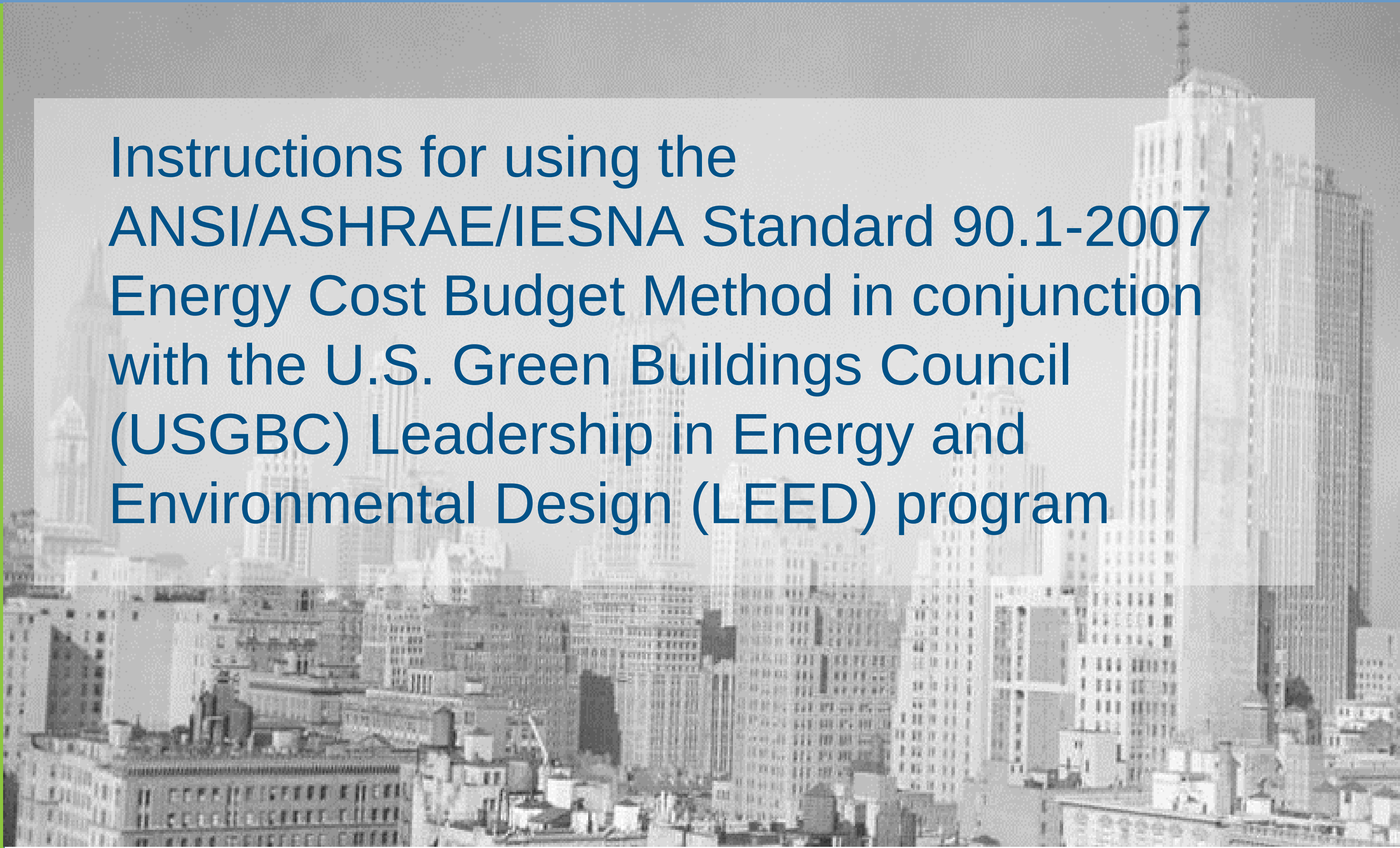
Addenda Description Information
(Informative Appendix F)

- Information on addenda to ANSI/ASHRAE/IENSA Standard 90.1-2004 (the predecessor to Standard 90.1-2007)
- ASHRAE issued 44 addenda to Standard 90.1-2004
- Standard 90.1-2004 plus these addenda forms the basis of Standard 90.1-2007

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Performance Rating Method *(Informative Appendix G)*



Instructions for using the ANSI/ASHRAE/IESNA Standard 90.1-2007 Energy Cost Budget Method in conjunction with the U.S. Green Buildings Council (USGBC) Leadership in Energy and Environmental Design (LEED) program

http://www.energycodes.gov/becu/trainers.stm

Date visited: 2/11/2011

Q + A

Compliance and Implementation Tools

Training Module

School of Planning, Design & Construction

Michigan State University

East Lansing, Michigan

What Does This Mean to *Me*?

ARRA 2009 = American Recovery and Reinvestment Act of 2009 (The Recovery Act)

Target Codes:

- Residential: 2009 IECC
- Commercial: ASHRAE 90.1-2007

90% compliance within 8 years

One time demonstration of 90% compliance required

Measuring State Energy Code Compliance Report. PNNL for U.S. DOE. (2010)

Transitional Period

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

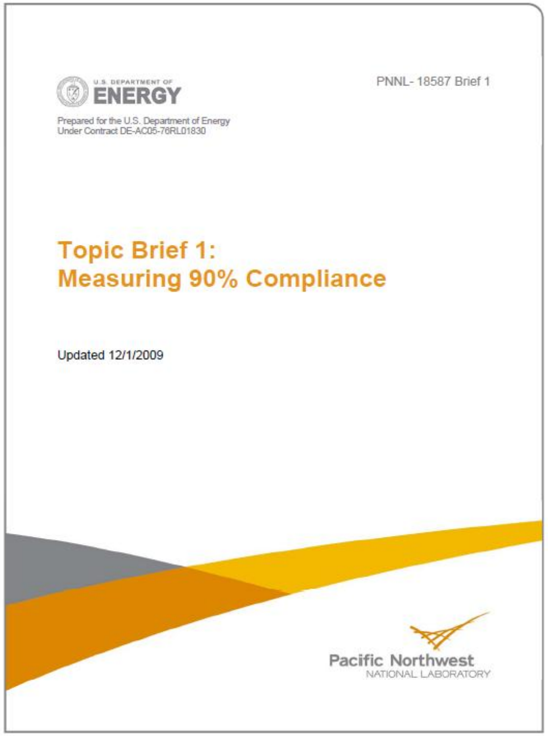
Building Energy Codes Program

BECP is developing guidelines and tools to use in measuring compliance with building energy codes, which:

- Foster uniformity and objectivity in measuring compliance rates
- Eliminate need for each state to develop its own procedures and tools
- Provide tools that states can adapt for their own preferred use
- Collect additional data and support related activities.

PNNL Topic Briefs

- **Brief 1: Measuring 90% Compliance**
- **Brief 2: Sample Size**
- **Brief 3: Onsite Compliance Evaluation**
- **Brief 4: Above-Code Programs**
- **Brief 5: Sample Distribution and Makeup**
- **Brief 6: Evaluation Checklists**
- **Brief 7: Compliance Roadmap**
- **Brief 8: Renovations**
- **Brief 9: Alternative Codes**
- *Period of Evaluation*
- *Annual Measurement Requirements*
- *Approaching Jurisdictions*
- *Training and Tools*
- *Related Outcomes*


U.S. DEPARTMENT OF ENERGY

PNNL- 18587 Brief 1

Prepared for the U.S. Department of Energy
Under Contract DE-AC05-76RL01830

Topic Brief 1:
Measuring 90% Compliance

Updated 12/1/2009

Pacific Northwest
NATIONAL LABORATORY

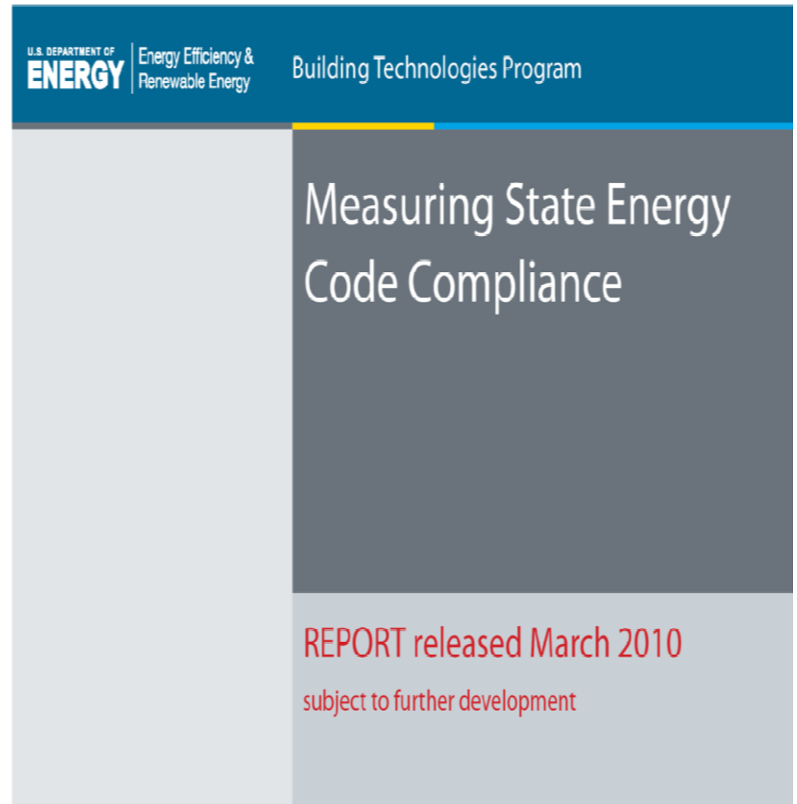
http://www.energycodes.gov/arra/compliance_evaluation.stm *Date visited: 11/22/2010*

Compliance Report

Measuring State Energy Code Compliance Report:

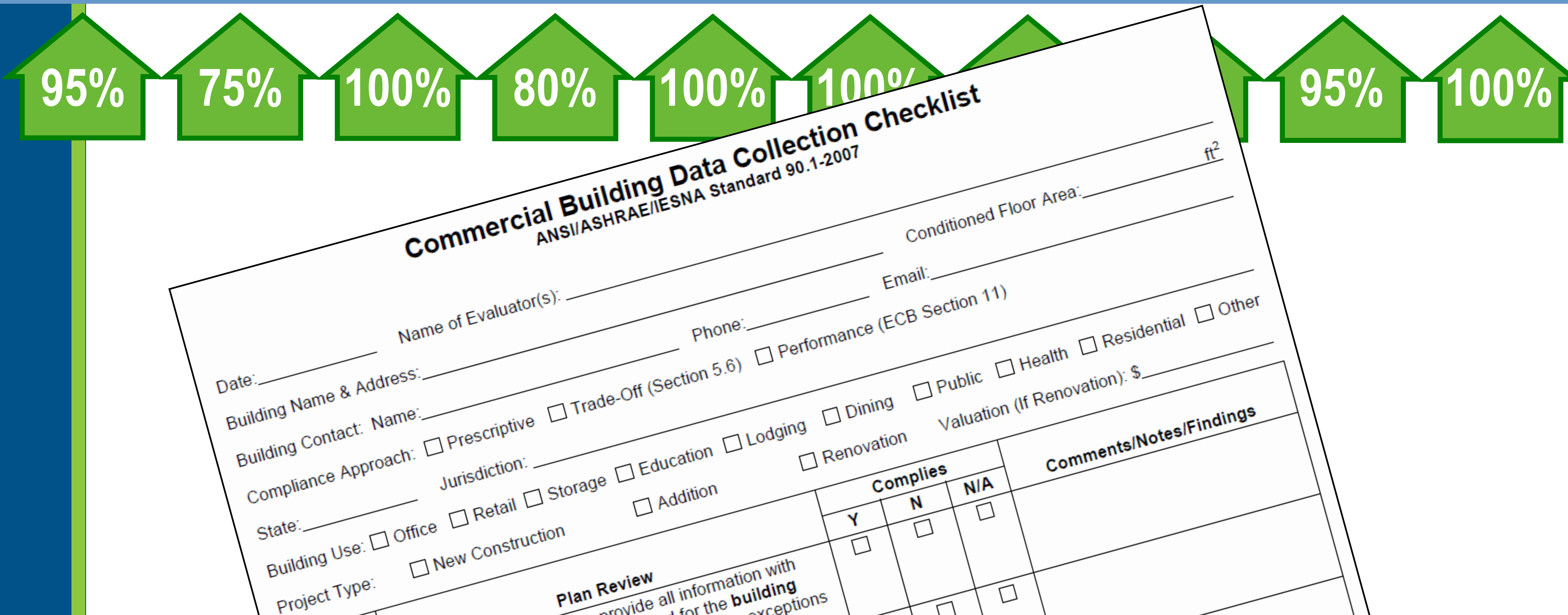
- Aggregate of previously released energy code compliance topic briefs and additional information on remaining topics

- 74 page document
  - Code adoption and equivalency
  - Annual measurement
  - Planning for compliance
  - Evaluation
  - Onsite compliance evaluation procedures (includes generating the sample sets)
  - Evaluation checklists



http://www.energycodes.gov/arra/compliance evaluation.stm Date visited: *11/22/2010*

Compliance Evaluation



Evaluated buildings are each assigned a compliance rating of 0–100% based on the proportion of code requirements that each has met, and the evaluated buildings' scores within a state are averaged to derive an overall compliance metric with an associated confidence.

Compliance Evaluation

Commercial Building Data Collection Checklist

ANSI/ASHRAE/IESNA Standard 90.1-2007

Date:__________ Name of Evaluator(s): ______________________________

Building Name & Address:__________________________ Conditioned Floor Area:________ ft^2

Building Contact: Name:________________ Phone:__________ Email:________________

Compliance Approach: ☐ Prescriptive ☐ Trade-Off (Section 5.6) ☐ Performance (ECB Section 11)

State:__________ Jurisdiction: ________________

Building Use: ☐ Office ☐ Retail ☐ Storage ☐ Education ☐ Lodging ☐ Dining

Project Type: ☐ New Construction ☐ Addition ☐ Renovation

Item Number	Plan Review	Compl Y	N
PR1 [4.2.2][1]	Plans and/or specifications provide all information with which compliance can be determined for the **building envelope** and delineate and document where exceptions to the standard are claimed.	☐	☐
PR2 [4.2.2][1]	Plans and/or specifications provide all information with which compliance can be determined for the **mechanical systems and equipment** and delineate and document where exceptions to the standard are claimed.	☐	☐
PR3 [4.2.2][1]	Plans and/or specifications provide all information with which compliance can be determined for the **service water heating systems and equipment** and delineate and document where exceptions to the standard are	☐	☐

Item Number	Pre-Inspection/Plan Review
PR1 [103.2][1]	**Documentation**. Determine if a complete set of plans/construction drawings, specifications, and energy code compliance documentation is available in the building department. If there is no building department or the locality does not conduct plan review, this information should be obtained from the registered design professional or builder having responsibility for the project. If documentation indicating a trade-off or performance approach is not provided, a prescriptive approach must be assumed for verifying compliance. Construction documents should sufficiently demonstrate energy code compliance, including but not limited to the following information: • The location and R-values of insulation materials • U-factors and SHGC values for windows, doors, skylights, and other fenestration products • Information related to duct and piping location, insulation type and R-value, and means of sealing Under the assumption that only state or local government with a responsible enforcement and/or permitting agency are included in compliance evaluations, plans and documentation are expected to be held by the responsible agency. If this is not the case, mark this code requirement and the next (PR1 and PR2) as non-compliant, unless there is another entity responsible for enforcement identified (e.g. utility, contractor licensing board, etc.) in which case they should be contacted to review PR1 and PR2 information.
PR2 [403.6][2]	**HVAC Load Calculations**. Verify that HVAC load calculations have been completed and submitted. Verify the methodology used in the load calculations. List the resultant heating and/or cooling loads as applicable in the Verified Value column.

Step-by-Step Companion Guide

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

http://www.energycodes.gov/arra/documents/Step_by_Step_Companion_Guide.pdf Date visited: 12/15/2010

Code Officials Companion Guide

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Code Officials Edition

View or download:

http://www.energycodes.gov/publications/resourceguides/

- Plan review and inspection resources
- RES*check* and COM*check* reference guides
- Case studies
- Sample checklists

- Download the PDF or flip through the online version
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Building Energy Codes Resource Guide: Code Officials Edition — Now Available!

Physical versions of the Resource Guide are being disseminated in October 2010 through local ICC chapters, advocacy organizations, and regional energy efficiency partnerships. You may also flip through our online version or download the entire Resource Guide as a PDF for in-house printing.

To support greater compliance with energy codes, the U.S. Department of Energy's Building Energy Codes Program (BECP) and the International Code Council (ICC) have collaborated to publish a collection of each organization's most useful resources for code enforcement officials.

The guide includes practical plan review and inspection resources, including BECP's REScheck™ and COMcheck™ quick reference guides, case studies, and sample inspection checklists; as well as excerpts from ICC's commentaries, workbooks, and code companion materials.

This collection also includes many other helpful items and points to further resources available on the web. Residential and commercial building officials can easily add state and local guidance in order to use this binder as a one-stop resource to support compliance in the field.

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http://www.energycodes.gov/publications/resourceguides/ Date visited: 11/22/2010

Next Step - Data Submission

Checklist Consolidation and Scoring

- BECP will provide an online database and web form

- BECP will provide services to states for converting paper checklists to the electronic format.

PNNL Survey:

- Better understand compliance rates
- Jurisdictional practices
- Identify training needs
- Attempt to coordinate best practices with measured compliance rates
- Confidential results

Taking a Pulse of Building Efficiency Evaluating compliance will help identify energy-saving code provisions that aren't being successfully implemented in buildings. This will allow less energy to "slip through the cracks"—lowering both costs to building owners and greenhouse gas emissions.

State Energy Code Jurisdictional Survey

Please review the survey and gather the needed information before continuing.

Questions About Your Jurisdiction

Jurisdictional information

Agency name:

Jurisdiction served: (Click here for choices)

Other jurisdiction not listed above (please specify):

Estimate of the population served:

Q + A

MICHIGAN STATE
UNIVERSITY

COM*check* Compliance Software

Training Module

School of Planning, Design & Construction

Michigan State University
East Lansing, Michigan

Demonstrate Compliance

Prescriptive

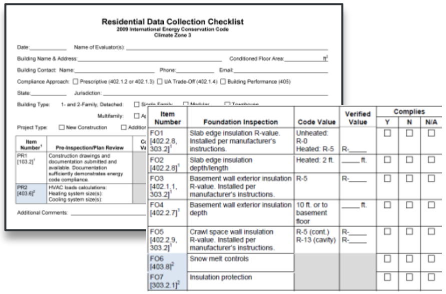
"Prescriptive Packages Approach"

Trade-off

"Trade-off Approach"

Performance

"Performance Approach"



Residential Data Collection Checklist
2009 International Energy Conservation Code
Climate Zone 3

Date:______ Name of Evaluator(s): ______

Building Name & Address:______ Conditioned Floor Area:______ ft²

Building Contact: Name:______ Phone:______ Email:______

Compliance Approach: ☐ Prescriptive (402.1.2 or 402.1.3) ☐ UA Trade-Off (402.1.4) ☐ Building Performance (405)

State:______ Jurisdiction: ______

Building Type: 1- and 2-Family, Detached:

Multifamily:

Project Type: ☐ New Construction

Item Number[1]	Pre-Inspection/Plan Review
PR1 [103.2][1]	Construction drawings and documentation submitted and available. Documentation sufficiently demonstrates energy code compliance.
PR2 [403.6][2]	HVAC loads calculations: Heating system size(s): Cooling system size(s):

Additional Comments: ______

Item Number	Foundation Inspection	Code Value	Verified Value	Complies Y	N	N/A
FO1 [402.2.8, 303.2][1]	Slab edge insulation R-value. Installed per manufacturer's instructions.	Unheated: R-0 Heated: R-5	R-___	☐	☐	☐
FO2 [402.2.8][1]	Slab edge insulation depth/length	Heated: 2 ft.	___ ft.	☐	☐	☐
FO3 [402.1.1, 303.2][1]	Basement wall exterior insulation R-value. Installed per manufacturer's instructions.	R-5	R-___	☐	☐	☐
FO4 [402.2.7][1]	Basement wall exterior insulation depth	10 ft. or to basement floor	___ ft.	☐	☐	☐
FO5 [402.2.9, 303.2][1]	Crawl space wall insulation R-value. Installed per manufacturer's instructions.	R-5 (cont.) R-13 (cavity)	R-___ R-___	☐	☐	☐
FO6 [403.8][2]	Snow melt controls			☐	☐	☐
FO7 [303.2.1][2]	Insulation protection			☐	☐	☐

COMcheck™

DOE-2

COM*check* Introduction

- Based on UA tradeoff
- COM*check* Software Options
  - Web-based Version
    - Automatically updates
    - Save files online or download
  - Desktop Version
    - No internet connection required
    - Must check for updates
  - COMcheck package generator
    - Design your own code-compliant insulation and window packages based on regional requirements

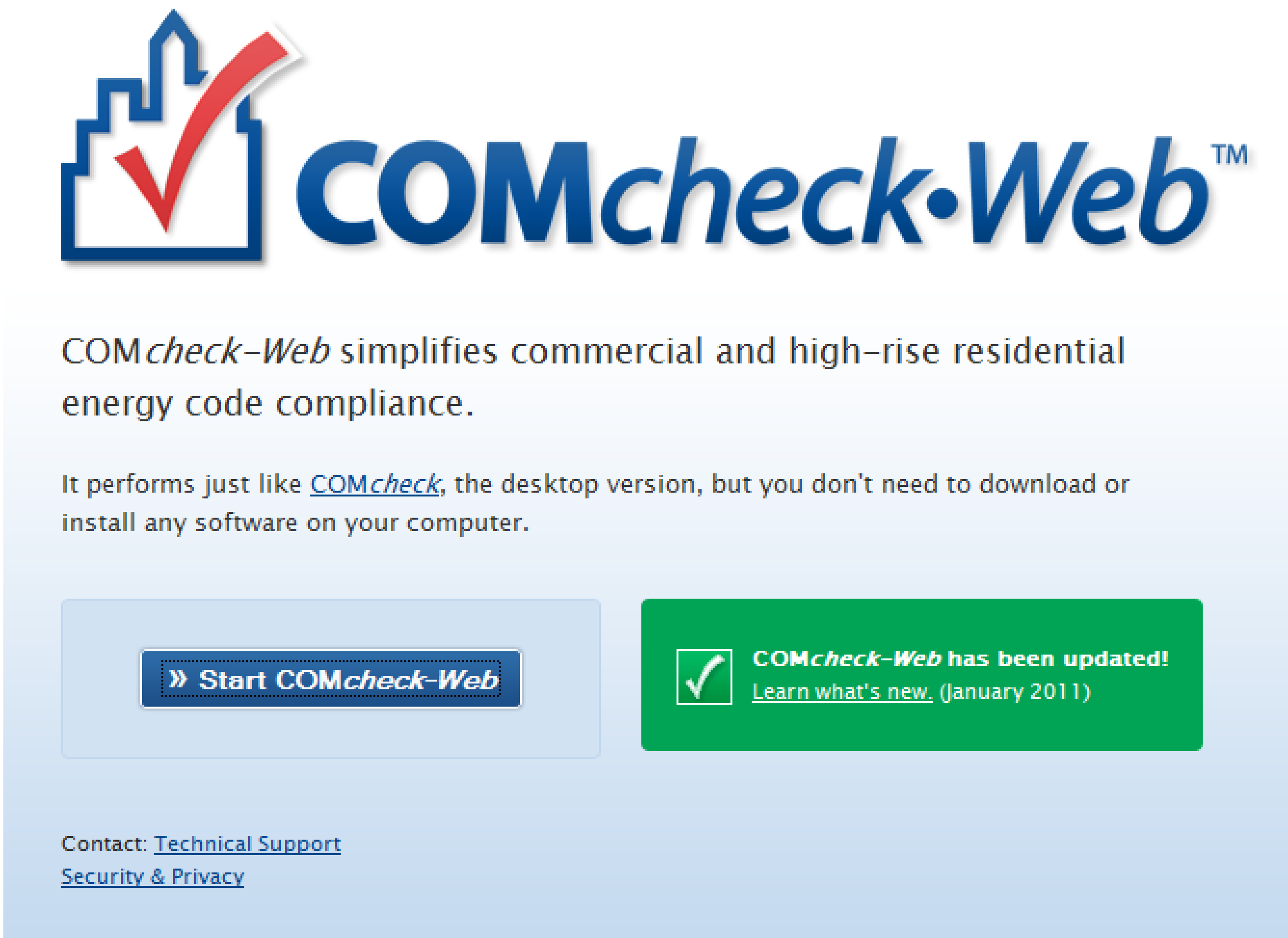
REScheck Software: Case Study. Building Energy Codes Program. (2003)

COM*check* Basics

Before Using COM*check*, You Will Need:

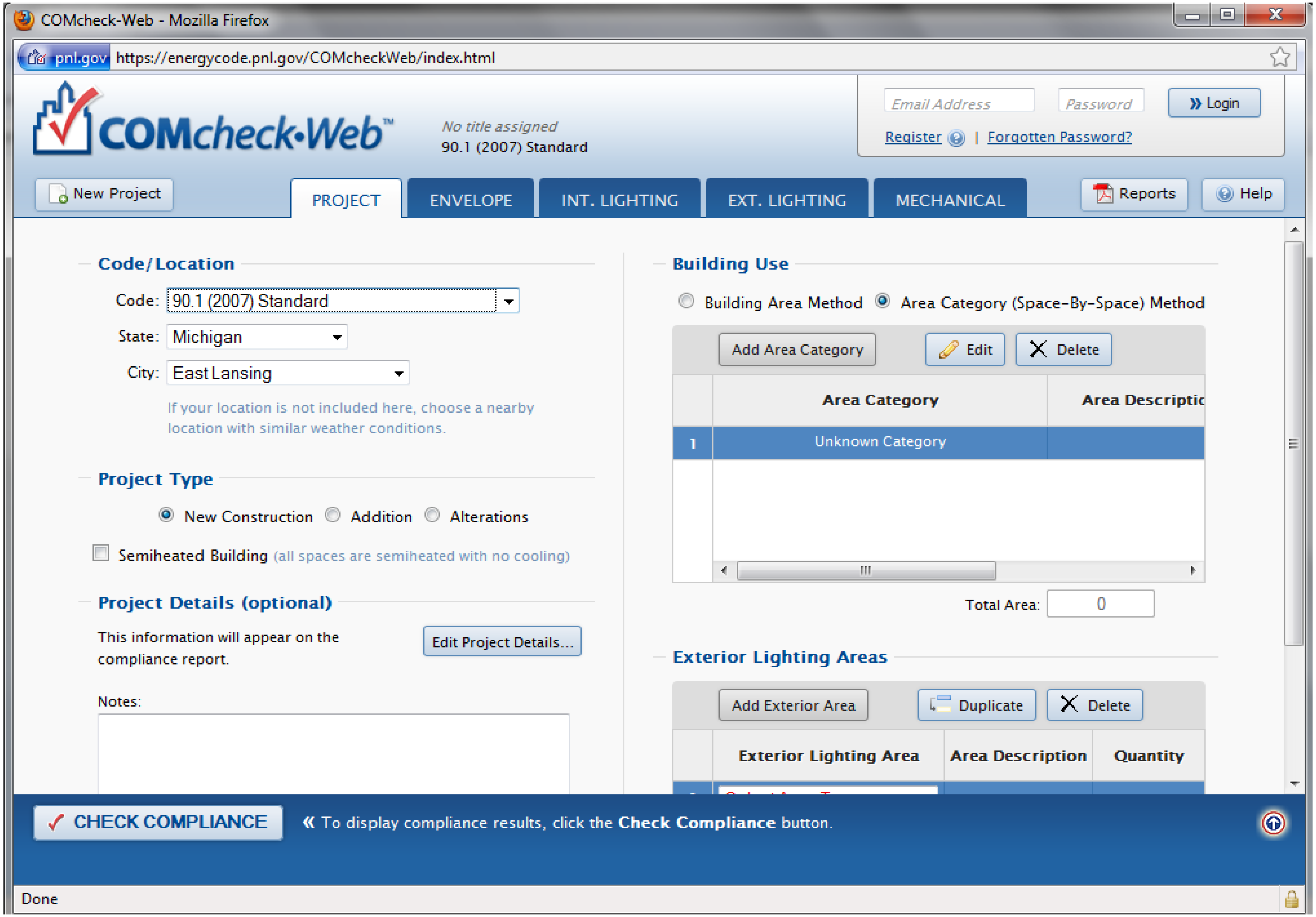
- Basic understanding of Windows-based programs
- Basic information about the builder and building to be constructed
- Plans including:
  - Areas of exterior walls, glazing, roof/ceiling, basement walls, doors, crawl walls and floors
  - R-values, U-values, wall heights and insulation depths
  - Heating and cooling system efficiencies

COMcheck Online Tool



https://energycode.pnl.gov/COMcheckWeb/

COMcheck Project Screen



https://energycode.pnl.gov/COMcheckWeb/index.html

Case Study – Sample Office Building 2222 Redwood Rd.

Envelope – Typical Wall Section

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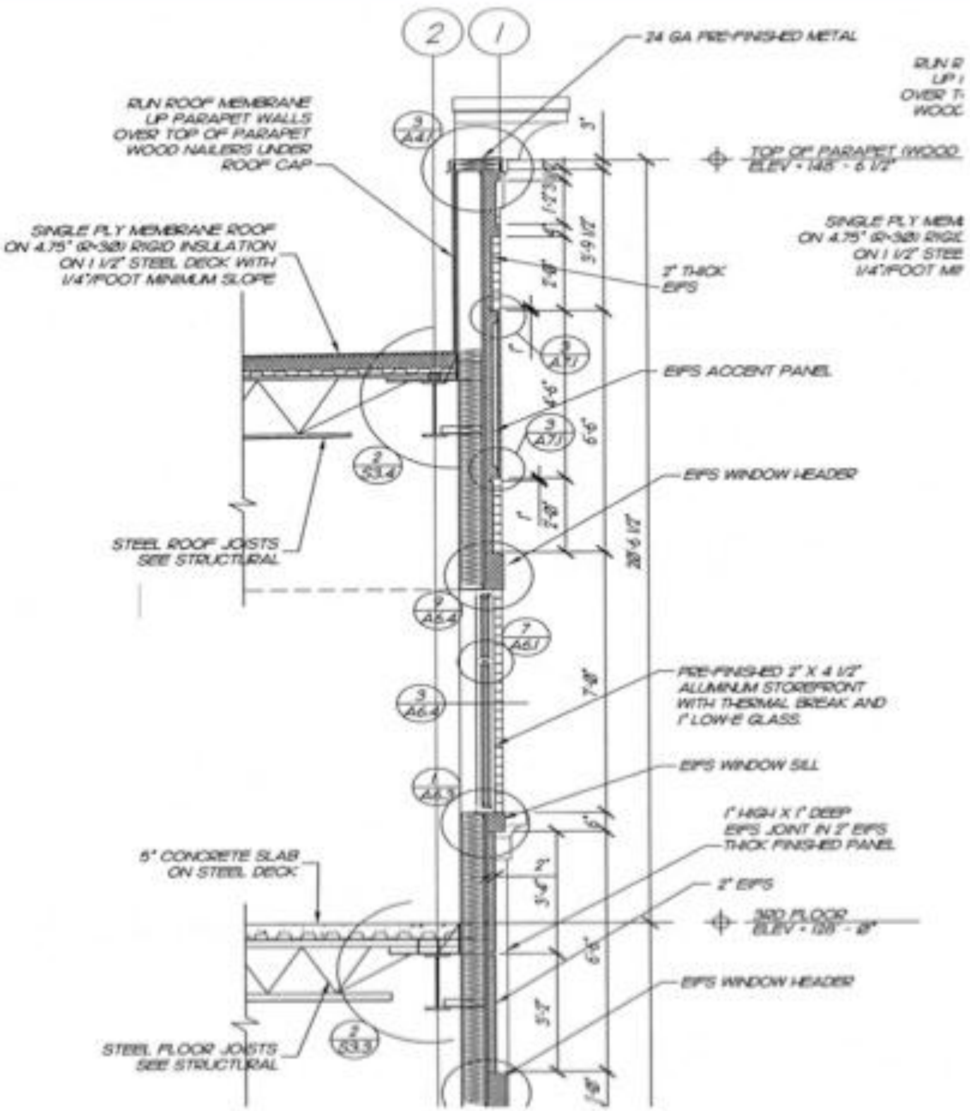


Identifies assembly type and insulation R-value

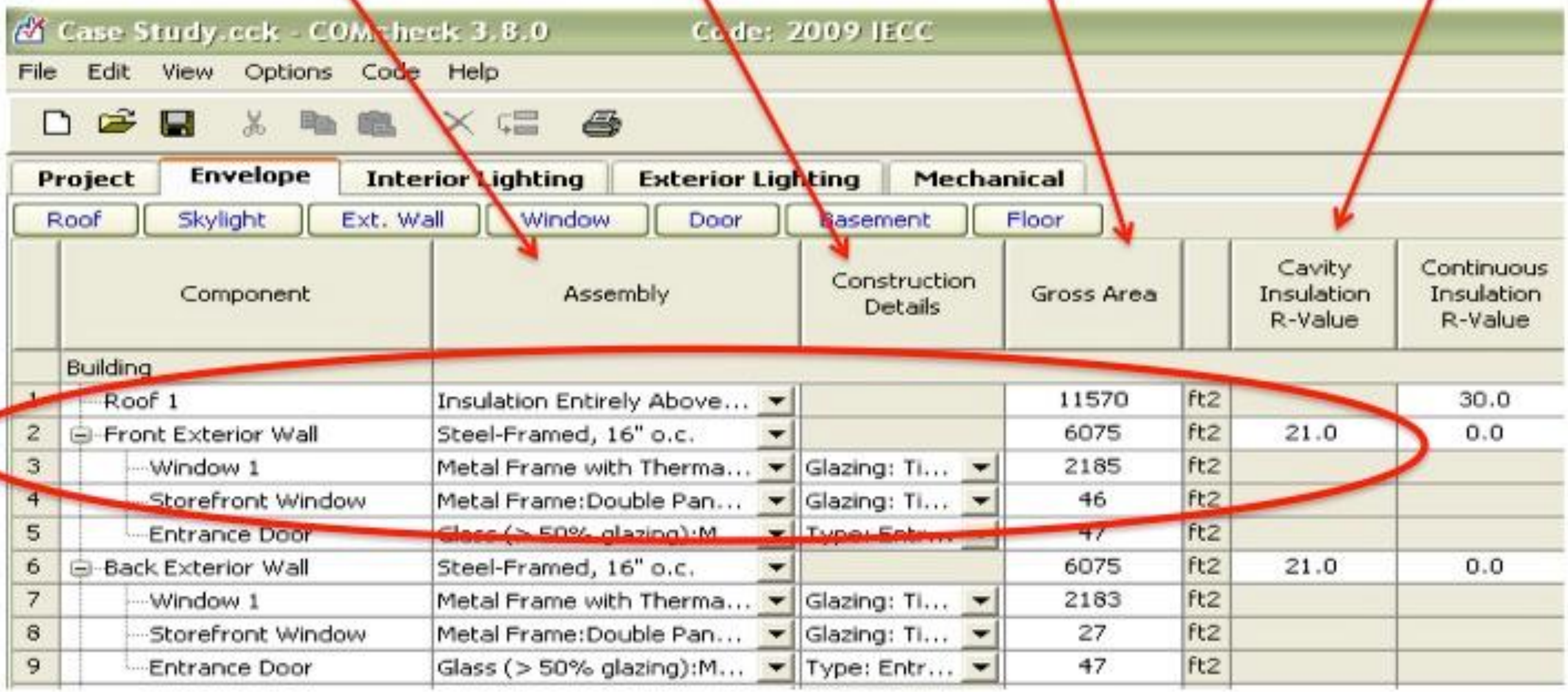
Wall Assembly:

- Steel Frame
- 16” oc
- R21 Cavity Insulation

Roof Assembly:

- Single membrane
- R30 Continuous Insulation

Define Assembly, Construction Details, Gross Area and insulation R-value



	Component	Assembly	Construction Details	Gross Area		Cavity Insulation R-Value	Continuous Insulation R-Value
	Building						
1	Roof 1	Insulation Entirely Above...		11570	ft2		30.0
2	Front Exterior Wall	Steel-Framed, 16" o.c.		6075	ft2	21.0	0.0
3	Window 1	Metal Frame with Therma...	Glazing: Ti...	2185	ft2		
4	Storefront Window	Metal Frame:Double Pan...	Glazing: Ti...	46	ft2		
5	Entrance Door	Glass (> 50% glazing):M...	Type: Entr...	47	ft2		
6	Back Exterior Wall	Steel-Framed, 16" o.c.		6075	ft2	21.0	0.0
7	Window 1	Metal Frame with Therma...	Glazing: Ti...	2183	ft2		
8	Storefront Window	Metal Frame:Double Pan...	Glazing: Ti...	27	ft2		
9	Entrance Door	Glass (> 50% glazing):M...	Type: Entr...	47	ft2		

WINDOW SCHEDULE

WINDOW TYPE	DIMENSIONS			DETAILS			GLAZING	REMARKS (F) FLOAT GLASS (T) TEMPERED GLASS (S) SPANDREL GLASS (A) FLOAT GLASS WITH INSERT
	WIDTH	HEIGHT	THICK'	HEAD	JAMB	SILL		
A	9'-5 1/2"	6'-Ø"	4 1/2"	7/A6.4	3/A6.4	1/A6.3	1" INSULATED W/ LOW E	2" X 4 1/2" ALUM STOREFRONT W/ T-BREAK
B	9'-Ø"	6'-Ø"	4 1/2"	7/A6.4	3/A6.4	1/A6.3	1" INSULATED W/ LOW E	2" X 4 1/2" ALUM STOREFRONT W/ T-BREAK
C	15'-Ø"	6'-Ø"	4 1/2"	7/A6.4	3/A6.4	1/A6.3	1" INSULATED W/ LOW E	2" X 4 1/2" ALUM STOREFRONT W/ T-BREAK
D	17'-1Ø"	6'-Ø"	4 1/2"	7/A6.4	3/A6.4	1/A6.3	1" INSULATED W/ LOW E	2" X 4 1/2" ALUM STOREFRONT W/ T-BREAK
E	16-8"	6'-Ø"	4 1/2"	7/A6.4	3/A6.4	1/A6.3	1" INSULATED W/ LOW E	2" X 4 1/2" ALUM STOREFRONT W/ T-BREAK
F	9'-5 1/2"	8'-6"	4 1/2"	9/A6.4	3/A6.4	2/A6.3	1" INSULATED W/ LOW E	2" X 4 1/2" ALUM STOREFRONT W/ T-BREAK
G	9'-Ø"	8'-6"	4 1/2"	9/A6.4	3/A6.4	2/A6.3	1" INSULATED W/ LOW E	2" X 4 1/2" ALUM STOREFRONT W/ T-BREAK
H	15'-Ø"	8'-6"	4 1/2"	9/A6.4	3/A6.4	2/A6.3	1" INSULATED W/ LOW E	2" X 4 1/2" ALUM STOREFRONT W/ T-BREAK
J	12'-2"	8'-6"	4 1/2"	1Ø/A6.4	4/A6.4	1/A6.4	1" INSULATED W/ LOW E	2" X 4 1/2" ALUM STOREFRONT W/ T-BREAK
K	17'-1Ø"	8'-6"	4 1/2"	9/A6.4	3/A6.4	2/A6.3	1" INSULATED W/ LOW E	2" X 4 1/2" ALUM STOREFRONT W/ T-BREAK
L	16'-8"	8'-6"	4 1/2"	9/A6.4	3/A6.4	2/A6.3	1" INSULATED W/ LOW E	2" X 4 1/2" ALUM STOREFRONT W/ T-BREAK
M	9'-5 1/2"	6'-Ø"	4 1/2"	9/A6.4	5/A6.4	3/A6.3	1" INSULATED W/ LOW E	2" X 4 1/2" ALUM STOREFRONT W/ T-BREAK
N	9'-Ø"	6'-Ø"	4 1/2"	9/A6.4	5/A6.4	3/A6.3	1" INSULATED W/ LOW E	2" X 4 1/2" ALUM STOREFRONT W/ T-BREAK
P	15'-Ø"	6'-Ø"	4 1/2"	9/A6.4	5/A6.4	3/A6.3	1" INSULATED W/ LOW E	2" X 4 1/2" ALUM STOREFRONT W/ T-BREAK
Q	12'-2"	6'-Ø"	4 1/2"	1Ø/A6.4	7/A6.4	2/A6.4	1" INSULATED W/ LOW E	2" X 4 1/2" ALUM STOREFRONT W/ T-BREAK
R	17'-1Ø"	6'-Ø"	4 1/2"	9/A6.4	5/A6.4	3/A6.3	1" INSULATED W/ LOW E	2" X 4 1/2" ALUM STOREFRONT W/ T-BREAK
S	16'-8"	6'-Ø"	4 1/2"	9/A6.4	5/A6.4	3/A6.3	1" INSULATED W/ LOW E	2" X 4 1/2" ALUM STOREFRONT W/ T-BREAK

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Define Assembly, Construction Details, Gross Area, U-factor and SHGC

	Component	Assembly	Construction Details	Gross Area		Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	SHGC	Projection Factor
	Building									
1	Roof 1	Insulation Entirely Above...		11570	ft2		30.0	0.032		
2	Front Exterior Wall	Steel-Framed, 16" o.c.		6075	ft2	21.0	0.0	0.106		
3	Window 1	Metal Frame with Therma...	Glazing: Ti...	2185	ft2			0.500	0.40	0.00
4	Storefront Window	Metal Frame:Double Pan...	Glazing: Ti...	46	ft2			0.500	0.40	0.00
5	Entrance Door	Glass (> 50% glazing):M...	Type: Entr...	47	ft2			0.800	0.40	0.00
6	Back Exterior Wall	Steel-Framed, 16" o.c.		6075	ft2	21.0	0.0	0.106		
7	Window 1	Metal Frame with Therma...	Glazing: Ti...	2183	ft2			0.500	0.40	0.00

Envelope – COM*check*™ summary

BUILDING ENVELOPE SUMMARY			
Total Building Area	34,710 ft^2		
Number of Floors	3		
Total Finished Out Area	2,014 ft^2		
Assembly Type	**Description**	**Area**	**R-value**
Roof	Single Ply Membrane Roof on 4.75" Rigid Insulation on 1 ½" Steel Deck	11,570 ft^2	R-30
Exterior Walls	6" Steel Studs @ 16" O.C. w/R-19 unfaced Batts	19,152 ft^2 (Gross)	R-19
Floor	Slab-on-grade – R-5 perimeter insulation down 2 ft.	447 Linear feet	R-5
Glazing	Storefront Window Metal Frame with Thermal Break, Double Glazed Low E	6,436 ft^2	U-0.50 SHGC – 0.40
	Storefront Window Metal Frame with Thermal Break, Double Glazed Low E	294 ft^2	U-0.50 SHGC – 0.40
Exterior Doors	All Glass Metal Frame Entrance Doors	188 ft^2	U-0.80 SHGC – 0.40

Mechanical – Rooftop Cooling Units

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Packaged Rooftop Unit Schedule

RTU-1

DESCRIPTION:	PACKAGED ROOFTOP MOUNTED VARIABLE AIR VOLUME AIR CONDITIONING UNIT COMPLETE WITH: INDOOR BLOWER WITH VARIABLE FREQUENCY DRIVE; 100% EXHAUST BLOWER WITH ADJUSTABLE V-BELT DRIVE; HIGH EFFICIENCY VFD COMPATIBLE MOTORS; INSULATED CABINET; PACKAGED DX REFRIGERATION COILS AND COMPRESSORS WITH MULTIPLE STEP LOADING / UNLOADING AND LOW AMBIENT OPERATION CAPABILITY; VAV CONTROLS; FILTER RACKS WITH FILTERS; FULL ECONOMIZER CAPABILITY WITH FIXED MINIMUM POSITION OUTSIDE AIR DAMPER; FACTORY ROOF MOUNTING CURB/FRAME. APPROX. OPERATING WEIGHT: 10,500 LB.
COOLING:	55.0 NOM. TONS. 721.4 MBH TOTAL COOLING CAPACITY; 586.1 GROSS SENSIBLE AT OUTPUT AT 80.0 DEG. F. ENT. D.B., 64 DEG. F. ENT. W.B., 97 DEG. F. AMB., 22,000 CFM AT 55.4 DEG. F. LDB; 53.6 DEG. F. LWB. ALL AT 4400 FT. ELEVATION. THREE 15 TON AND ONE 10 TON COMPRESSORS. 9.7 EER.
SUPPLY BLOWER:	22,000 CFM S.A., 2200 CFM MIN. O.A. AT 1.75 IN. WG. EXTERNAL, 3.6 IN. WG TOTAL STATIC. 1130 RPM VARIABLE SPEED BLOWER, 24.9 BHP, ALL AT 4400 FT. ELEV. 25.0 HP 460 V 3PH VFD COMPATIBLE BLOWER MOTOR.
EXHAUST BLOWER:	20,000 CFM EXHAUST AIR AT 0.75 IN. WG. EXTERNAL, 0.8 IN. WG TOTAL STATIC. 759 RPM BELT DRIVE BLOWER, 9.0 BHP, ALL AT 4400 FT. ELEV. 10.0 HP 460 V 3PH SINGLE SPEED BLOWER MOTOR.
UNIT WIRING:	396.6 MCA, 450 A. MINIMUM RECOMMENDED RDE FUSE AT 208 VOLTS, 3 PHASE
FILTERS:	20 - 20" X 25" X 2" DISPOSABLE PLEATED GLASS MEDIA FILTERS IN FRAME.
MANUFACTURER:	TRANE CO. MODEL SXHFC554 OR ENGINEER APPROVED EQUAL.

Packaged Rooftop Unit Schedule

RTU-2

DESCRIPTION:	PACKAGED ROOFTOP MOUNTED VARIABLE AIR VOLUME AI CONDITIONING UNIT COMPLETE WITH: INDOOR BLOWER WITH VARIABLE FREQUENCY DRIVE; 100% EXHAUST BLOWER WITH ADJUSTABLE V-BELT DRIVE; HIGH EFFICIENCY VFD COMPATIBLE MOTORS; INSULATED CABINET; PACKAGED DX REFRIGERATION COILS AND COMPRESSORS WITH MULTIPLE STEP LOADING / UNLOADING AND LOW AMBIENT OPERATION CAPABILITY; VAV CONTROLS; FILTER RACKS WITH FILTERS; FULL ECONOMIZER CAPABILITY WITH FIXED MINIMUM POSITION OUTSIDE AIR DAMPER; FACTORY ROOF MOUNTING CURB/FRAME. APPROX. OPERATING WEIGHT: 6,790 LB.
COOLING:	30.0 NOM. TONS. 363.5 MBH TOTAL COOLING CAPACITY; 304.5 GROSS SENSIBLE AT OUTPUT AT 80.0 DEG. F. ENT. D.B., 64 DEG. F. ENT. W.B., 97 DEG. F. AMB., 12,000 CFM AT 56.7 DEG. F. LDB; 54.5 DEG. F. LWB. ALL AT 4400 FT. ELEVATION. TWO 15 TON COMPRESSORS. 9.8 EER.
SUPPLY BLOWER:	12,000 CFM S.A., 1500 CFM MIN. O.A. AT 1.75 IN. WG. EXTERNAL, 3.7 IN. WG TOTAL STATIC. 1230 RPM VARIABLE SPEED BLOWER, 13.3 BHP, ALL AT 4400 FT. ELEV. 15.0 HP 460 V 3PH VFD COMPATIBLE BLOWER MOTOR.
EXHAUST BLOWER:	11,000 CFM EXHAUST AIR AT 0.75 IN. WG. EXTERNAL, 0.8 IN. WG TOTAL STATIC. 845 RPM BELT DRIVE BLOWER, 3.8 BHP, ALL AT 4400 FT. ELEV. 5.0 HP 460 V 3PH SINGLE SPEED BLOWER MOTOR.
UNIT WIRING:	214.2 MCA, 250.0 A. MINIMUM RECOMMENDED RDE FUSE AT 208 VOLTS, 3 PHASE
FILTERS:	16 - 20" X 20" X 2" DISPOSABLE PLEATED GLASS MEDIA FILTERS IN FRAME.
MANUFACTURER:	TRANE CO. MODEL SXHFC304 OR ENGINEER APPROVED EQUAL.

Mechanical – VAV Terminal Unit

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

VAV Terminal Unit Schedule

UNIT TAG	TRANE CO. MODEL NO.	INLET DIA (IN.)	DSGN CLG FLOW (CFM)	MIN CLG FLOW (CFM)	MIN HTG FLOW (CFM)	PD @DESIGN CLG FLOW (IN.WG)	PRIM HTG FLOW (CFM)	UNIT HTG FLOW (CFM)	FAN FLOW (CFM)	FAN SPEED	FAN MOTOR POWER (HP)	COIL HEAT (MBH)	WATER FLOW (GPM)	COIL WPD (FT)	B&G CIRC. SET.
V-101	VPWF-1203SQ	12	1600	240	240	0.01	240	800	560	VAR	1/3 HP	36.05	2.88	2.55	1/2"
V-102	VPWF-1003SQ	10	1200	180	180	0.03	180	600	420	VAR	1/3 HP	18.34	1.47	0.57	1/2"
V-103	VPWF-0802SQ	8	800	120	120	0.14	120	500	380	VAR	1/8 HP	16.53	1.32	1.26	1/2"

NOTES:

1 FAN MOTORS FOR VAV BOXES SHALL BE 115 V. SINGLE PHASE

2 COIL HEAT CAPACITIES FOR FAN POWERED UNITS ARE BASED ON 175 DEG. EWT, 65 DEG. EAT. 105 DEG. LAT, APPROX 30 DEG. WTD. ALL COILS SHALL BE HIGH CAP.

3 COIL HEAT CAPACITIES FOR RE-HEAT UNITS ARE BASED ON 175 DEG. EWT, 55 DEG. EAT.

4 ALL CAPACITIES SHOWN ARE BASED ON ACTUAL AIR, DERATED FOR ALTITUDE

Mechanical – Heating Water Boiler Schedule

Heating Water Boiler Schedule

PACKAGED ATMOSPHERIC PRESSURE, NATURAL GAS FIRED WATER TUBE STYLE HEATING WATER BOILER COMPLETE WITH: OPERATING CONTROLS; ATMOSPHERIC BURNERS; MAIN AND PILOT GAS COCKS; GAS PRESSURE REGULATOR(S); BAROMETRIC DAMPER; LOW WATER CUT-OFF; 60 LB. ASME RELIEF VALVE; HIGH LIMIT CONTROL; PRESSURE AND TEMPERATURE GAUGE.

1,250 MBH INPUT, 1,037.5 MBH OUTPUT AT SEA LEVEL, 850 MBH OUTPUT AT 4500 FT. ELEVATION. 73 GAL CAPACITY; 161 SQ.FT. HEATING SURFACE; RATED AT UP TO 2,075 GPH AT 60 DEG. F. TEMP RISE. 1-16" DIA. VENT COLLAR. APPROX. 3,510 LBS OPERATING WEIGHT.

120 VOLT CONTROL CIRCUIT.

AJAX CO. MODEL WRN-1250 OR ENGINEER APPROVED EQUAL.

Lighting Schedule

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

LIGHT FIXTURE SCHEDULE				
TYPE	MANUFACTURER	CATALOG NUMBER	LAMPING	DESCRIPTION
A	DAY-BRITE LIGHTING	2LP3GS33236ALUNV-1/3-EB	(3) 32W T8	FLUORESCENT 2'X4' LAY-IN 18 CELL PARABOLIC LOUEVER
A-EM	DAY-BRITE LIGHTING	2LP3GS33236ALUNV-1/3-EB	(3) 32W T8	SAME AS A BUT WITH ONE LAMP ON EMERGENCY BATTERY PACK
B	CAPRI LIGHTING	CM6-FV26/32/42U-V65	(1) 26W CFM	COMPACT FLUORESCENT RECESSED DOWNLIGHT
B-EM	CAPRI LIGHTING	CM6-FV26/32/42UER-V65	(1) 26W CFM	SAME AS B BUT WITH AN EMERGENCY BATTERY PACK
C	DAY-BRITE LIGHTING	CAN32UNV-1/2-EB	(2) 32W T8	NARROW FLUORESCENT WRAPAROUND
D	T.B.D.	T.B.D.	T.B.D.	BATHROOM VANINTY LIGHT ($200.00 ALLOWANCE)
E	T.B.D.	T.B.D.	T.B.D. MIN EFFICACY: 60 LUMENS/WATT	CONTEMPORARY WALL SCONCE ($200.00 ALLOWANCE)
E-EM	T.B.D.	T.B.D.	T.B.D.	SAME AS E BUT WITH AN EMERGENCY BATTERY PACK
F	US ARCHITECTURAL LIGHTING	DSSHR-111250MH120XPDDBM	250W MH	PARKING AREA LIGHTS MOUNTED ON 20'-0" POLE
G	T.B.D.	T.B.D.	T.B.D.	LOBBY CEILING CHANDELIER ($300.00 ALLOWANCE)
EX1	DAY-BRITE LIGHTING	VEGWEM	LED	GREEN LED EMERGENCY EXIT LIGHT
EX2	DAY-BRITE LIGHTING	VEGWEM	LED	DOUBLE SIDED GREEN LED EMERGENCY EXIT LIGHT
EX3	DAY-BRITE LIGHTING	CCTXL1GWLH	LED	GREEN LED EMERGENCY EXIT LIGHT WITH EMERGENCY BUG LIGHTS

Lighting – Com*check*™ Interior Lighting Inputs

Case Study.cck - COMcheck 3.8.0   Code: 2009 IECC

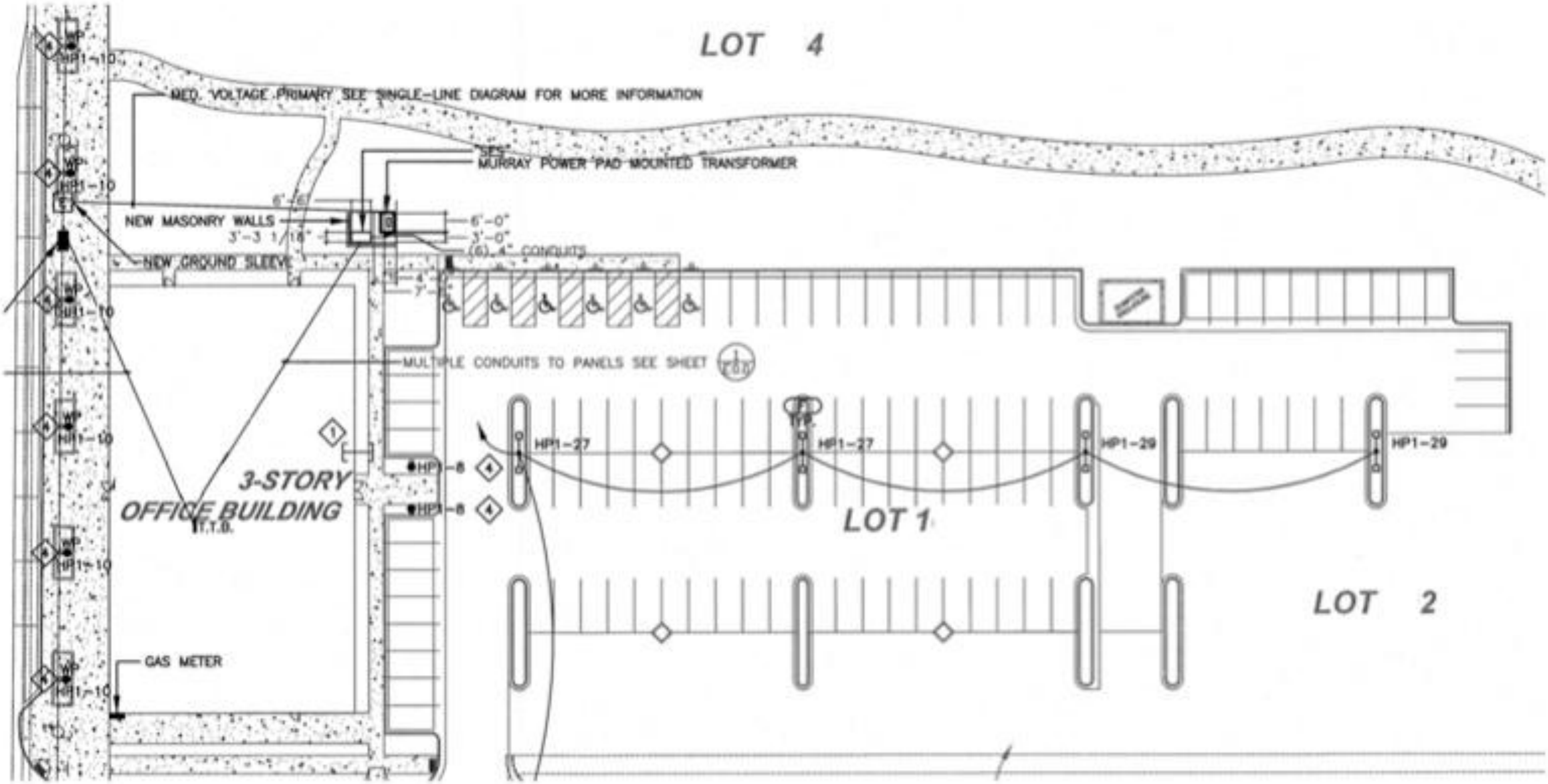
File Edit View Options Code Help

Project | Envelope | **Interior Lighting** | Exterior Lighting | Mechanical

Linear Fluorescent | Compact Fluorescent | HID | Incandescent | Halogen | Track Lighting

	Component	Fixture ID	Fixture Description	Lamp Description/ Wattage Per Lamp	Ballast	Lamps Per Fixture	Number of Fixtures	Fixture Wattage	Track Lighting Wattage
	Building	Allowed wattage = 2014 Proposed wattage = 1765							
1	Office (2014 sq.ft.)	Allowed wattage = 2014 Proposed wattage = 1765							
2	Linear Fluorescent 2	Type A	32 W T8	48" T8 32W	Electronic	3	10	95	
3	Compact Fluorescent 1	Type B	CFL	Triple 4-pin 26W	Electronic	1	10	29	
4	Linear Fluorescent 1	Type C	32 W T8	48" T8 32W	Electronic	2	5	65	
5	Incandescent 1	Type D	Bathroom Fan Lighting	Incandescent 100W		1	2	100	

Lighting – Parking Lot



Exterior Lighting Applications

Description	Area
Uncovered Parking Areas - Parking Lots and Drives	40,360 ft^2
Building Grounds - Walkways (<10 ft wide)	355 ft
Building Grounds - Walkways (≥ 10 ft wide)	4,320 ft^2
Building Entrances - Main Entries	12 ft
Building Entrances – Other Doors	12 ft

Lighting – COM*check*™ Exterior Lighting Inputs

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Case Study.cck - COMcheck 3.8.0 Code: 2009 IECC

File Edit View Options Code Help

Project | Envelope | Interior Lighting | **Exterior Lighting** | Mechanical

Linear Fluorescent | Compact Fluorescent | HID | Incandescent | Halogen

	Component	Fixture ID	Fixture Description	Lamp Description/ Wattage Per Lamp	Ballast	Lamps Per Fixture	Number of Fixtures	Fixture Wattage
	Exterior Lighting Areas:	Tradable Wattage: Allowed = 3754 Proposed = 3480 Supplemental wattage: 600 (see Help for details)						
1	Parking area (40360 ft2)	Tradable Wattage: Allowed = 2421 Proposed = 2040						
2	HID 1			Metal Halide 250W	Pulse start	1	8	255
3	Walkway < 10 feet wide (355 ft of wa	Tradable Wattage: Allowed = 248 Proposed = 320						
4	HID 2			Metal Halide 75W	Pulse start	1	4	80
5	Walkway >= 10 feet wide (4320 ft2)	Tradable Wattage: Allowed = 604 Proposed = 800						
6	HID 2 copy 1			Metal Halide 75W	Pulse start	1	10	80
7	Main entry (12 ft of door width)	Tradable Wattage: Allowed = 240 Proposed = 160						
8	HID 2 copy 2			Metal Halide 75W	Pulse start	1	2	80
9	Other door (not main entry) (12 ft of	Tradable Wattage: Allowed = 240 Proposed = 160						
10	HID 2 copy 3			Metal Halide 75W	Pulse start	1	2	80

Commercial Plan Review

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy   BUILDING TECHNOLOGIES PROGRAM

COM*check*™
COMMERCIAL PLAN REVIEW
QUICK REFERENCE GUIDE

COM*check*™

Plan review for energy code compliance can be conducted quickly and efficiently. The U.S. Department of Energy's COM*check*™ Compliance Software is designed to create simplified compliance certificates that can be easily reviewed by enforcement personnel. The Quick Reference Guide identifies the objectives of plan review and code compliance responsibilities, and will take you step-by-step through a typical plan review of a COM*check*™ submittal.

Plan Review Objectives: There are three objectives in conducting a building energy code plan review; verify:

A. the documentation has been correctly prepared
B. the levels of efficiency shown on the plans meet or exceed that shown in the documentation
C. all information needed to conduct a field inspection is included in the plans or documentation for the inspector to use on site

Code Compliance Responsibilities: Successful compliance requires the cooperation of many individuals involved in a building project: designers, engineers, architects, building owners, etc. Compliance also requires the efforts of certain individuals to whom the code gives specific responsibilities:

- Applicant
- Building Official
- Plans Examiner or Special Plans Examiner
- Inspector or Special Inspector

Commercial Plan Review

COMcheck Software Version 3.8.0

Envelope Compliance Certificate

Step 1: Verify the **Project Information** matches the information on the building plans. The code, location, and project type will impact compliance.

2009 IECC

Section 1: Project Information

Project Type: **New Construction**

Project Title : Sample Office Building

Construction Site:
2222 Redwood Road
Salt Lake City, UT 22262
Permit No. 10-463
Permit Date: August 19, 2010

Owner/Agent:
ABC Property Company
1677 2nd Street
Salt Lake City, UT 22311

Designer/Contractor:
Designs Are Us
1453 McMinnion Street
Park City, UT 99422

Commercial Plan Review

Step 2: Verify the **Building Type or Activity Type(s)** and **Floor Area** match the project type. Verify the floor area does not exceed the project floor area shown on the building plans. Single occupancy buildings should always use Whole Building Method unless each **Activity Type** within the building is identified separately.

Section 2: General Information

Building Location (for weather data):	Salt Lake City, Utah
Climate Zone:	5b
Vertical Glazing / Wall Area Pct.:	26%

Activity Type(s)	Floor Area
Office	2014

Commercial Plan Review

Step 3: Verify the exterior building thermal envelope complies with the code by +0% or greater.

Step 4: Verify the construction assemblies listed under **Component Name/Description** match the construction assemblies shown on the plans.

Step 5: Verify the **Gross Area or Perimeter** values represent the proposed project. Verify the fenestration is calculated correctly (rough opening).

Section 3: Requirements Checklist

Envelope PASSES: Design 0.4% better than code.

Climate-Specific Requirements:

Component Name/Description	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U-Factor(a)
Roof 1: Insulation Entirely Above Deck	11570	---	30.0	0.032	0.048
Front Exterior Wall: Steel-Framed, 16" o.c.	6075	21.0	0.0	0.106	0.064
Window 1: Metal Frame with Thermal Break:Double Pane with Low-E, Tinted, SHGC 0.40	2185	---	---	0.500	0.550
Storefront Window: Metal Frame:Double Pane with Low-E, Tinted, SHGC 0.40	46	---	---	0.500	0.550
Entrance Door: Glass (> 50% glazing):Metal Frame, Entrance Door, SHGC 0.40	47	---	---	0.800	0.800
Back Exterior Wall: Steel-Framed, 16" o.c.	6075	21.0	0.0	0.106	0.064
Window 1: Metal Frame with Thermal Break:Double Pane with Low-E, Tinted, SHGC 0.40	2183	---	---	0.500	0.550
Storefront Window: Metal Frame:Double Pane with Low-E, Tinted, SHGC 0.40	27	---	---	0.500	0.550
Entrance Door: Glass (> 50% glazing):Metal Frame, Entrance Door, SHGC 0.40	47	---	---	0.800	0.800

Building Energy Codes Resource Guide: Code Officials Edition. Building Energy Codes Program. (2010)

Commercial Plan Review

Entrance Door: Glass (> 50% glazing):Metal Frame, Entrance Door, SHGC 0.40	47	---	---	0.800	0.800
Left Exterior Wall: Steel-Framed, 16" o.c.	3501	21.0	0.0	0.106	0.064
Window 1: Metal Frame with Thermal Break:Double Pane with Low-E, Tinted, SHGC 0.40	46	---	---	0.500	0.550
Storefront Window: Metal Frame:Double Pane with Low-E, Tinted, SHGC 0.40	88	---	---	0.500	0.550
Entrance Door: Glass (> 50% glazing):Metal Frame, Entrance Door, SHGC 0.40	47	---	---	0.800	0.800
Right Exterior Wall: Steel-Framed, 16" o.c.	3501	21.0	0.0	0.106	0.064
Window 1: Metal Frame with Thermal Break:Double Pane with Low-E, Tinted, SHGC 0.40	46	---	---	0.500	0.550
Storefront Window: Metal Frame:Double Pane with Low-E, Tinted, SHGC 0.40	133	---	---	0.500	0.550
Entrance Door: Glass (> 50% glazing):Metal Frame, Entrance Door, SHGC 0.40	47	---	---	0.800	0.800
Floor 1: Slab-On-Grade:Unheated, Vertical 2 ft.	447	---	5.0	---	---

(a) Budget U-factors are used for software baseline calculations ONLY, and are not code requirements.

Step 6: Verify the insulation R-values shown on the building plans meet or exceed the values in the **Cavity R-Value and Continuous R-Value** section. Verify the insulation will fit uncompressed in the framing cavity. Continuous R-values are for insulation installed over the face of framing; insulation installed with no thermal breaks.

Step 7: Verify the fenestration and door **U-Factors** shown meet or exceed what is provided on the building plans. If shown, **SHGC** and **Projection Factor (PF)** should also be verified.

Commercial Plan Review

Air Leakage, Component Certification, and Vapor Retarder Requirements:

☐ 1. All joints and penetrations are caulked, gasketed or covered with a moisture vapor-permeable wrapping material installed in accordance with the manufacturer's installation instructions.

☐ 2. Windows, doors, and skylights certified as meeting leakage requirements.

☐ 3. Component R-values & U-factors labeled as certified.

☐ 4. No roof insulation is installed on a suspended ceiling with removable ceiling panels.

☐ 5. 'Other' components have supporting documentation for proposed U-Factors.

☐ 6. Insulation installed according to manufacturer's instructions, in substantial contact with the surface being insulated, and in a manner that achieves the rated R-value without compressing the insulation.

☐ 7. Stair, elevator shaft vents, and other outdoor air intake and exhaust openings in the building envelope are equipped with motorized dampers.

☐ 8. Cargo doors and loading dock doors are weather sealed.

☐ 9. Recessed lighting fixtures installed in the building envelope are Type IC rated as meeting ASTM E283, are sealed with gasket or caulk.

☐ 10. Building entrance doors have a vestibule equipped with closing devices.

Exceptions:

Building entrances with revolving doors.

Doors that open directly from a space less than 3000 sq. ft. in area.

Section 4: Compliance Statement

Compliance Statement: The proposed envelope design represented in this document is consistent with the building plans, specifications and other calculations submitted with this permit application. The proposed envelope system has been designed to meet the 2009 IECC requirements in COM*check* Version 3.8.0 and to comply with the mandatory requirements in the Requirements Checklist.

Name - Title	Signature	Date

Project Notes:

Core and Shell Example. Energy Code Compliance is for the building envelope, mechanical system and lighting for the Floor 1 finished out core area.

Step 8: Checklist items: **Insulation, Fenestration and Doors, and Air Leakage and Component Certification** should be reviewed to ensure these mandatory requirements will be met or are exempt (not applicable). For example, review documentation as to whether a vestibule is required.

Commercial Plan Review

COM*check* Software Version 3.8.0

Interior Lighting Compliance Certificate

2009 IECC

Section 1: Project Information

Project Type: **New Construction**
Project Title : Sample Office Building

Construction Site:	Owner/Agent:	Designer/Contractor:
2222 Redwood Road	ABC Property Company	Designs Are Us
Salt Lake City, UT 22262	1677 2nd Street	1453 McMinnion Street
Permit No. 10-463	Salt Lake City, UT 22311	Park City, UT 99422

Step 1: Verify the **Project Information** matches the information on the building plans. The code, location, and project type will impact compliance.

Commercial Plan Review

Step 2: Verify the **Building Type or Area Category(s)** and **Floor Area** match the project type. Verify the floor area does not exceed the project floor area shown on the building plans. Single occupancy buildings should always use Whole Building Method unless each **Area Category** within the building is identified separately.

Section 2: Interior Lighting and Power Calculation

A Area Category	B Floor Area (ft2)	C Allowed Watts / ft2	D Allowed Watts (B x C)
Office	2014	1	2014

Total Allowed Watts = 2014

Step 3: Verify the **Lighting Power Calculation** is consistent with the lighting plans.

Commercial Plan Review

Step 4: Verify the **Fixture Description, Lamps per Fixture, Ballast Type,** and **Number of Fixtures** shown in the documentation is consistent with the lighting plans/fixture schedule.

Step 5: Verify the **Fixture Wattage** is accurate. Default values can be used in COM*check* or from the manufacture literature. However, careful attention to overall wattage installed against the proposed should be reviewed.

Section 3: Interior Lighting Fixture Schedule

A Fixture ID : Description / Lamp / Wattage Per Lamp / Ballast	B Lamps/ Fixture	C # of Fixtures	D Fixture Watt.	E (C X D)
Office (2014 sq.ft.)				
Linear Fluorescent 2: Type A: 32 W T8 / 48" T8 32W / Electronic	3	10	95	950
Compact Fluorescent 1: Type B: CFL / Triple 4-pin 26W / Electronic	1	10	29	290
Linear Fluorescent 1: Type C: 32 W T8 / 48" T8 32W / Electronic	2	5	65	325
Incandescent 1: Type D: Bathroom Fan Lighting / Incandescent 100W	1	2	100	200
Total Proposed Watts =				1765

Commercial Plan Review

Step 6: Verify the **Proposed Wattage** is less than or equal to the **Allowed Wattage**.

Section 4: Requirements Checklist

Lighting Wattage:

☐ 1. Total proposed watts must be less than or equal to total allowed watts.

Allowed Watts	Proposed Watts	Complies
2014	1765	YES

Commercial Plan Review

Step 7: Verify all mandatory requirements have been met. For example, verify switching for each interior space is shown on the lighting plans and is applicable to the space type.

Controls, Switching, and Wiring:

☐ 2. Daylight zones under skylights more than 15 feet from the perimeter have lighting controls separate from daylight zones adjacent to vertical fenestration.

☐ 3. Daylight zones have individual lighting controls independent from that of the general area lighting.

Exceptions:

Contiguous daylight zones spanning no more than two orientations are allowed to be controlled by a single controlling device.

Daylight spaces enclosed by walls or ceiling height partitions and containing two or fewer light fixtures are not required to have a separate switch for general area lighting.

☐ 4. Independent controls for each space (switch/occupancy sensor).

Exceptions:

Areas designated as security or emergency areas that must be continuously illuminated.

Lighting in stairways or corridors that are elements of the means of egress.

☐ 5. Master switch at entry to hotel/motel guest room.

☐ 6. Individual dwelling units separately metered.

☐ 7. Medical task lighting or art/history display lighting claimed to be exempt from compliance has a control device independent of the control of the nonexempt lighting.

☐ 8. Each space required to have a manual control also allows for reducing the connected lighting load by at least 50 percent by either controlling all luminaires, dual switching of alternate rows of luminaires, alternate luminaires, or alternate lamps, switching the middle lamp luminaires independently of other lamps, or switching each luminaire or each lamp.

Commercial Plan Review

Interior Lighting PASSES: Design 12% better than code.

Section 5: Compliance Statement

Compliance Statement: The proposed lighting design represented in this document is consistent with the building plans, specifications and other calculations submitted with this permit application. The proposed lighting system has been designed to meet the 2009 IECC requirements in COMcheck Version 3.8.0 and to comply with the mandatory requirements in the Requirements Checklist.

Name - Title	Signature	Date

Step 8: Verify the **Interior Lighting** complies with the code by +0% or greater.

Commercial Plan Review

COMcheck Software Version 3.8.0

Exterior Lighting Compliance Certificate

2009 IECC

Section 1: Project Information

Project Type: **New Construction**

Project Title : Sample Office Building

Exterior Lighting Zone: **2 (Neighborhood business district)**

Construction Site:
2222 Redwood Road
Salt Lake City, UT 22262
Permit No. 10-463
Permit Date: August 19, 2010

Owner/Agent:
ABC Property Company
1677 2nd Street
Salt Lake City, UT 22311

Designer/Contractor:
Designs Are Us
1453 McMinnion Street
Park City, UT 99422

Step 1: Verify the **Project Information** matches the information on the building plans. The code, location, and project type will impact compliance.

Commercial Plan Review

Step 2: Verify the lighting application(s) (Exterior Area/Surface), Quantity, and Totals match lighting specifications.

Section 2: Exterior Lighting Area/Surface Power Calculation

A Exterior Area/Surface	B Quantity	C Allowed Watts / Unit	D Tradable Wattage	E Allowed Watts (B x C)	F Proposed Watts
Parking area	40360 ft2	0.06	Yes	2422	2040
Walkway < 10 feet wide	355 ft of walkway length	0.7	Yes	248	320
Walkway >= 10 feet wide	4320 ft2	0.14	Yes	605	800
Main entry	12 ft of door width	20	Yes	240	160
Other door (not main entry)	12 ft of door width	20	Yes	240	160
Total Tradable Watts* =				3755	3480
Total Allowed Watts =				3755	
Total Allowed Supplemental Watts** =				600	

* Wattage tradeoffs are only allowed between tradable areas/surfaces.

** A supplemental allowance equal to 600 watts may be applied toward compliance of both non-tradable and tradable areas/surfaces.

Commercial Plan Review

Step 3: Verify the **Fixture Description, Lamps per Fixture, Ballast Type, and Number of Fixtures** shown in the documentation is consistent with the lighting plans/fixture schedule.

Step 4: Verify the **Fixture Wattage** is accurate. Default values can be from COM*check* or from manufacture literature. However, careful attention to overall wattage installed against the proposed should be reviewed.

Section 3: Exterior Lighting Fixture Schedule

A Fixture ID : Description / Lamp / Wattage Per Lamp / Ballast	B Lamps/ Fixture	C # of Fixtures	D Fixture Watt.	E (C X D)
Parking area (40360 ft2): Tradable Wattage				
HID 1: Metal Halide 250W / Pulse start	1	8	255	2040
Walkway < 10 feet wide (355 ft of walkway length): Tradable Wattage				
HID 2: Metal Halide 75W / Pulse start	1	4	80	320
Walkway >= 10 feet wide (4320 ft2): Tradable Wattage				
HID 2 copy 1: Metal Halide 75W / Pulse start	1	10	80	800
Main entry (12 ft of door width): Tradable Wattage				
HID 2 copy 2: Metal Halide 75W / Pulse start	1	2	80	160
Other door (not main entry) (12 ft of door width): Tradable Wattage				
HID 2 copy 3: Metal Halide 75W / Pulse start	1	2	80	160
Total Tradable Proposed Watts =				3480

Commercial Plan Review

Step 5: Verify all mandatory requirements have been met.

Section 4: Requirements Checklist

Lighting Wattage:

☐ 1. Within each non-tradable area/surface, total proposed watts must be less than or equal to total allowed watts. Across all tradable areas/surfaces, total proposed watts must be less than or equal to total allowed watts.

Compliance: Passes.

Controls, Switching, and Wiring:

☐ 2. All exemption claims are associated with fixtures that have a control device independent of the control of the nonexempt lighting.

☐ 3. Lighting not designated for dusk-to-dawn operation is controlled by either a a photosensor (with time switch), or an astronomical time switch.

☐ 4. Lighting designated for dusk-to-dawn operation is controlled by an astronomical time switch or photosensor.

☐ 5. All time switches are capable of retaining programming and the time setting during loss of power for a period of at least 10 hours.

Commercial Plan Review

Exterior Lighting Efficacy:

☐ 6. All exterior building grounds luminaires that operate at greater than 100W have minimum efficacy of 60 lumen/watt.

Exceptions:

Lighting that has been claimed as exempt and is identified as such in Section 3 table above.
Lighting that is specifically designated as required by a health or life safety statue, ordinance, or regulation.
Emergency lighting that is automatically off during normal building operation.
Lighting that is controlled by motion sensor.

Exterior Lighting PASSES: Design 20% better than code.

Section 5: Compliance Statement

Compliance Statement: The proposed exterior lighting design represented in this document is consistent with the building plans, specifications and other calculations submitted with this permit application. The proposed lighting system has been designed to meet the 2009 IECC requirements in COMcheck Version 3.8.0 and to comply with the mandatory requirements in the Requirements Checklist.

Name - Title   Signature   Date

Step 6: Verify the Exterior Lighting complies with the code by +0% or greater.

Commercial Plan Review

COMcheck Software Version 3.8.0

Mechanical Compliance Certificate

2009 IECC

Section 1: Project Information

Project Type: **New Construction**

Project Title : Sample Office Building

Construction Site:
2222 Redwood Road
Salt Lake City, UT 22262
Permit No. 10-463
Permit Date: August 19, 2010

Owner/Agent:
ABC Property Company
1677 2nd Street
Salt Lake City, UT 22311

Designer/Contractor:
Designs Are Us
1453 McMinnion Street
Park City, UT 99422

Step 1: Verify the **Project Information** matches the information on the building plans. The code, location, and project type will impact compliance.

Section 2: General Information

Building Location (for weather data):	**Salt Lake City, Utah**
Climate Zone:	**5b**

Commercial Plan Review

Step 2: Verify the Mechanical System(s) specified in Section 3 matches what is called out on the mechanical plans/specifications and the quantity and type of each unit are correct.

Section 3: Mechanical Systems List

Quantity	System Type & Description
1	HVAC System 1: Cooling: Cooling equipment (Rooftop Package Unit), Capacity Unknown, Efficiency: 12.10 , Evaporatively Cooled Condenser / Multiple-Zone
1	HVAC System 3: Cooling: Cooling equipment (Rooftop Package Unit), Capacity Unknown, Evaporatively Cooled Condenser / Multiple-Zone
1	Plant 1: Heating: Hot Water Boiler, Capacity 1038 kBtu/h, Gas, Efficiency: 75.00 % Et

Section 4: Requirements Checklist

Requirements Specific To: HVAC System 1 :

- ☐ 1. Equipment minimum efficiency: Rooftop Package Unit: 12.1 EER
- ☐ 2. Minimum one temperature control device per zone
- ☐ 3. Leak testing > 3 per in. static pressure - report submitted showing CL < 6.0
- ☐ 4. Balancing and pressure test connections on all hydronic terminal devices
- ☐ 5. Systems serving more than one zone must be VAV systems
  - Exception: Where pressure relationships must be maintained
  - Exception: Zones or supply air systems with at least 75% of reheating/recooling energy site recovered or site solar
  - Exception: Zones with humidity requirements for special processes
  - Exception: Zones with cfm <300 and flow rate <10% of total design flow rate
  - Exception: Outside air needed to meet IMC Chapter 4

☐ 13. Balancing devices provided in accordance with IMC (2006) 603.17

☐ 14. Demand control ventilation (DCV) present for high design occupancy areas (>40 person/1000 ft2 in spaces >500 ft2) and served by systems with any one of 1) an air-side economizer, 2) automatic modulating control of the outdoor air damper, or 3) a design outdoor airflow greater than 3000 cfm.

Exception: Systems with heat recovery.
Exception: Multiple-zone systems without DDC of individual zones communicating with a central control panel.
Exception: Systems with a design outdoor airflow less than 1200 cfm.
Exception: Spaces where the supply airflow rate minus any makeup or outgoing transfer air requirement is less than 1200 cfm.

☐ 15. Motorized, automatic shutoff dampers required on exhaust and outdoor air supply openings

Exception: Gravity dampers acceptable in buildings <3 stories
Exception: Gravity dampers acceptable in systems with outside or exhaust air flow rates less than 300 cfm where dampers are interlocked with fan

☐ 16. Automatic controls for freeze protection systems present

☐ 17. Three-pipe systems not used

☐ 18. Exhaust air heat recovery included for systems 5,000 cfm or greater with more than 70% outside air fraction or specifically exempted

Exception: Hazardous exhaust systems, commercial kitchen and clothes dryer exhaust systems that the International Mechanical Code prohibits the use of energy recovery systems.
Exception: Systems serving spaces that are heated and not cooled to less than 60°F.
Exception: Where more than 60 percent of the outdoor heating energy is provided from site-recovered or site solar energy.
Exception: Heating systems in climates with less than 3600 HDD.
Exception: Cooling systems in climates with a 1 percent cooling design wet-bulb temperature less than 64°F.
Exception: Systems requiring dehumidification that employ energy recovery in series with the cooling coil.
Exception: Laboratory fume hood exhaust systems that have either a variable air volume system capable of reducing exhaust and makeup air volume to 50 percent or less of design values or, a separate make up air supply meeting the following makeup air requirements: a) at least 75 percent of exhaust flow rate, b) heated to no more than 2°F below room setpoint temperature, c) cooled to no lower than 3°F above room setpoint temperature, d) no humidification added, e) no simultaneous heating and cooling.

Section 5: Compliance Statement

Compliance Statement: The proposed mechanical design represented in this document is consistent with the building plans, specifications and other calculations submitted with this permit application. The proposed mechanical systems have been designed to meet the 2009 IECC requirements in COMcheck Version 3.8.0 and to comply with the mandatory requirements in the Requirements Checklist.

Name - Title | Signature | Date

COM*check* Software Version 3.8.0

Mechanical Requirements Description

2009 IECC

The following list provides more detailed descriptions of the requirements in Section 4 of the Mechanical Compliance Certificate.

Requirements Specific To: HVAC System 1 :

1.The specified heating and/or cooling equipment is covered by the ASHRAE 90.1 Code and must meet the following minimum efficiency: Rooftop Package Unit: 12.1 EER

2.Each zone of a multiple-zone system must have its own temperature control device.

3.The specified distribution system is designed to operate at static pressure over 3 in. water column. The system must be leak tested in accordance with SMACNA standards. The contractor or engineer must submit a report to the enforcing jurisdiction documenting that a minimum of 25% of all duct surfaces have been tested and that tested ducts have a SMACNA rated air leakage class of under 6.0.

4.Hydronic heating and cooling coils must be equipped with a way to pressure test connections and measure and balance water flow and pressure.

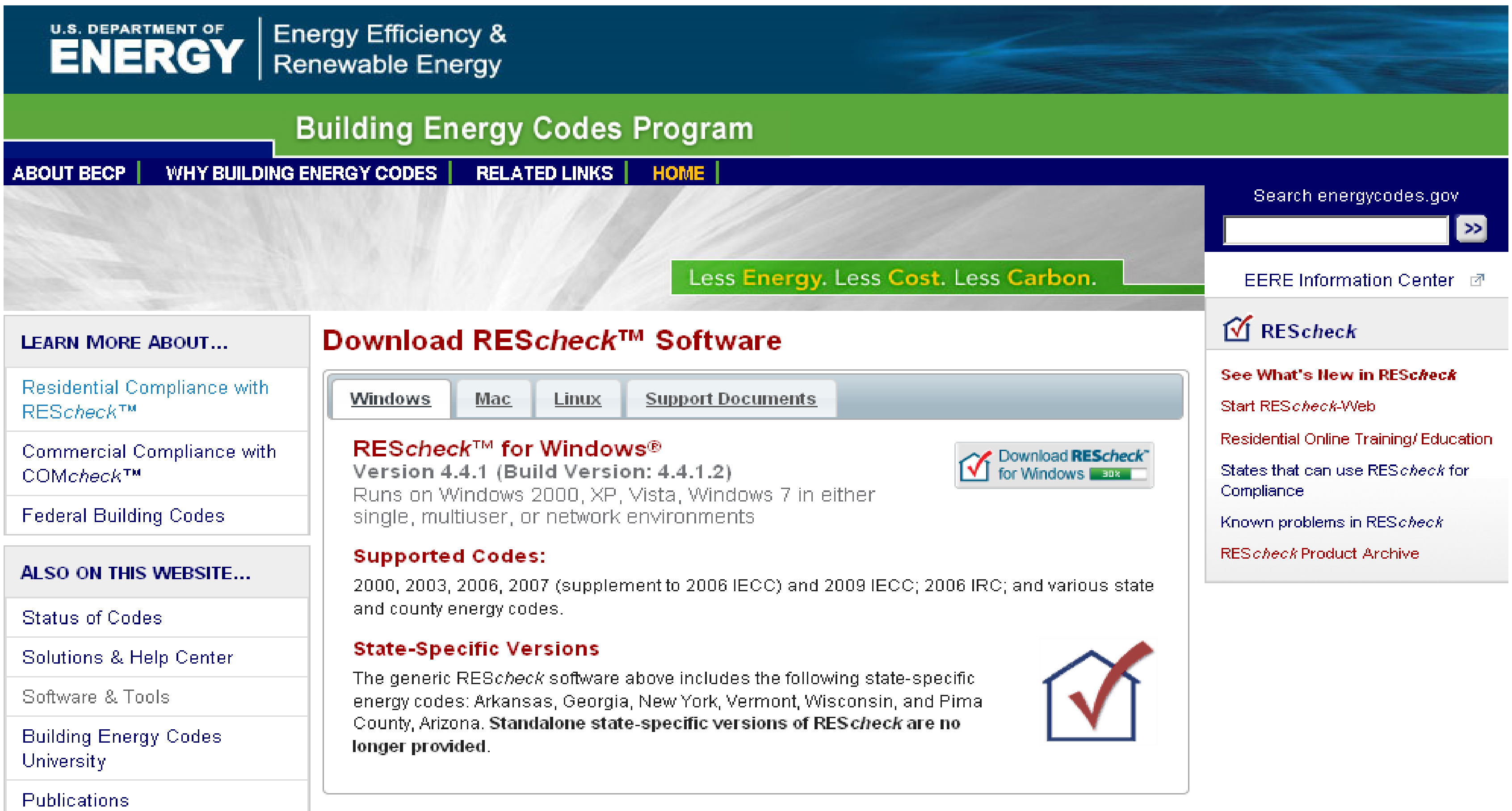
5.Systems serving multiple thermostatic control zones must be variable-flow systems. Zone terminal controls must reduce the flow of primary supply air before reheating, recooling, or mixing air streams to one of the following:
a) 30% of the maximum supply air to each zone,
b) 300 cfm or less where the maximum flow rate is less than 10% of the total fan system supply airflow rate, or
c) minimum ventilation requirements of Chapter 4 of the International Mechanical Code.

Exception: VAV controls are not required for zones with special pressurization or cross-contamination requirements. These zones must be called out in the construction documents for easy identification during field inspection.
Exception: VAV controls are not required for zones or supply air systems where at least 75% of the reheating and recooling energy is made available through the use of site-recovered or site solar energy. These zones must be called out in the construction documents for easy identification during field inspection.
Exception: VAV controls are not required for zones with special humidity control requirements for specialized processes. These zones must be called out in the construction documents for easy identification during field inspection.
Exception: VAV controls are not required for zones that require less than 300 cfm of supply air provided the total airflow to these zones does not exceed 10% of the total design flow rate for the system.
Exception: VAV controls are not required where constant volume supply air is necessary to meet the minimum outside air requirements of Chapter 4 of the International Mechanical Code. These zones must be called out in the construction documents for easy identification during field inspection.

RES*check* Software

RES*check* software also available for residential projects:

http://www.energycodes.gov/rescheck/download.stm



http://www.energycodes.gov/comcheck/ Date visited: 12/15/2010

Q + A

MICHIGAN STATE UNIVERSITY

Additional Information Resources

Training Module

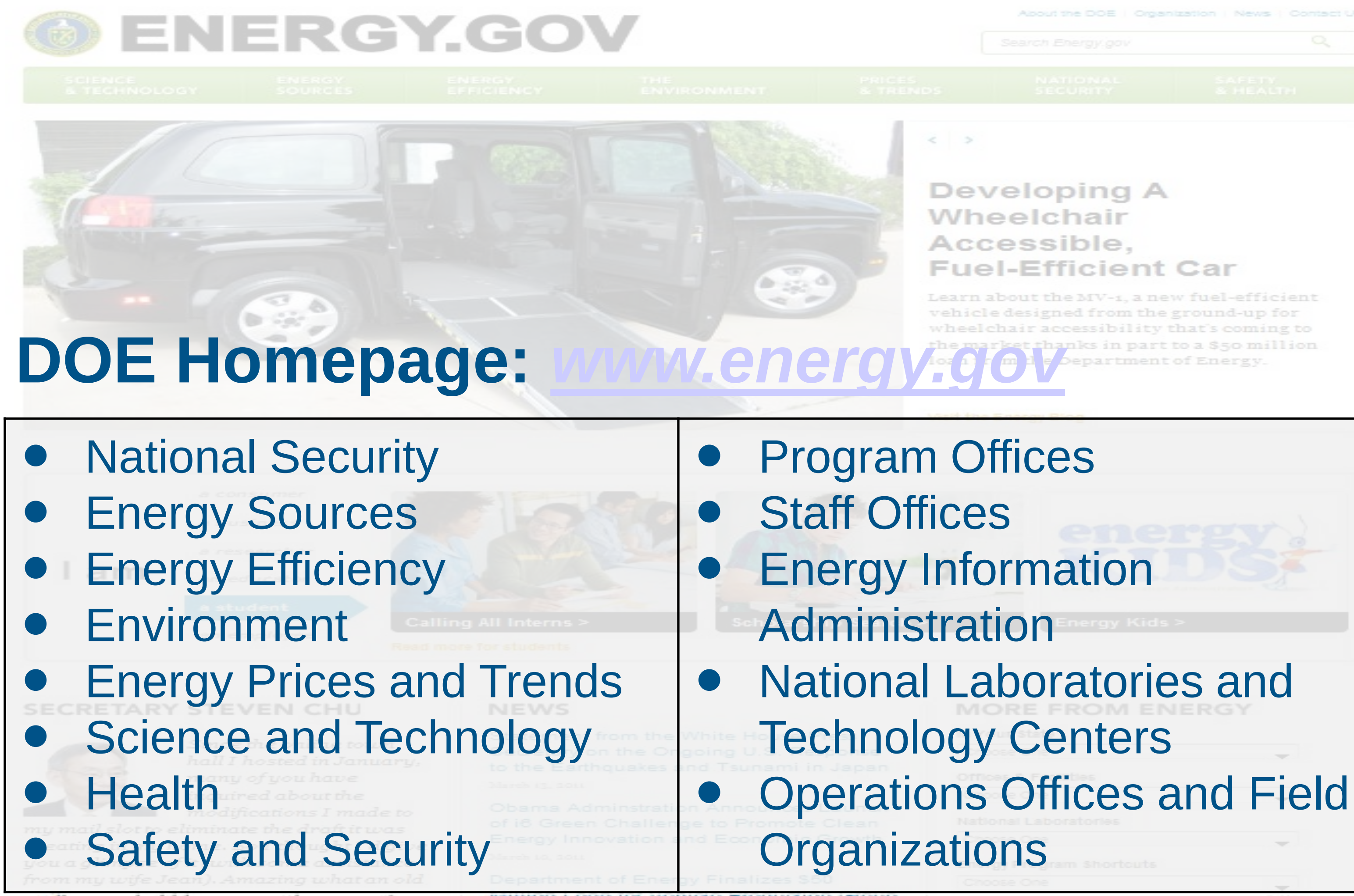
School of Planning, Design & Construction

Michigan State University
East Lansing, Michigan

MICHIGAN STATE UNIVERSITY

MEEA Midwest Energy Efficiency Alliance

U.S. Department of Energy



DOE Homepage: www.energy.gov

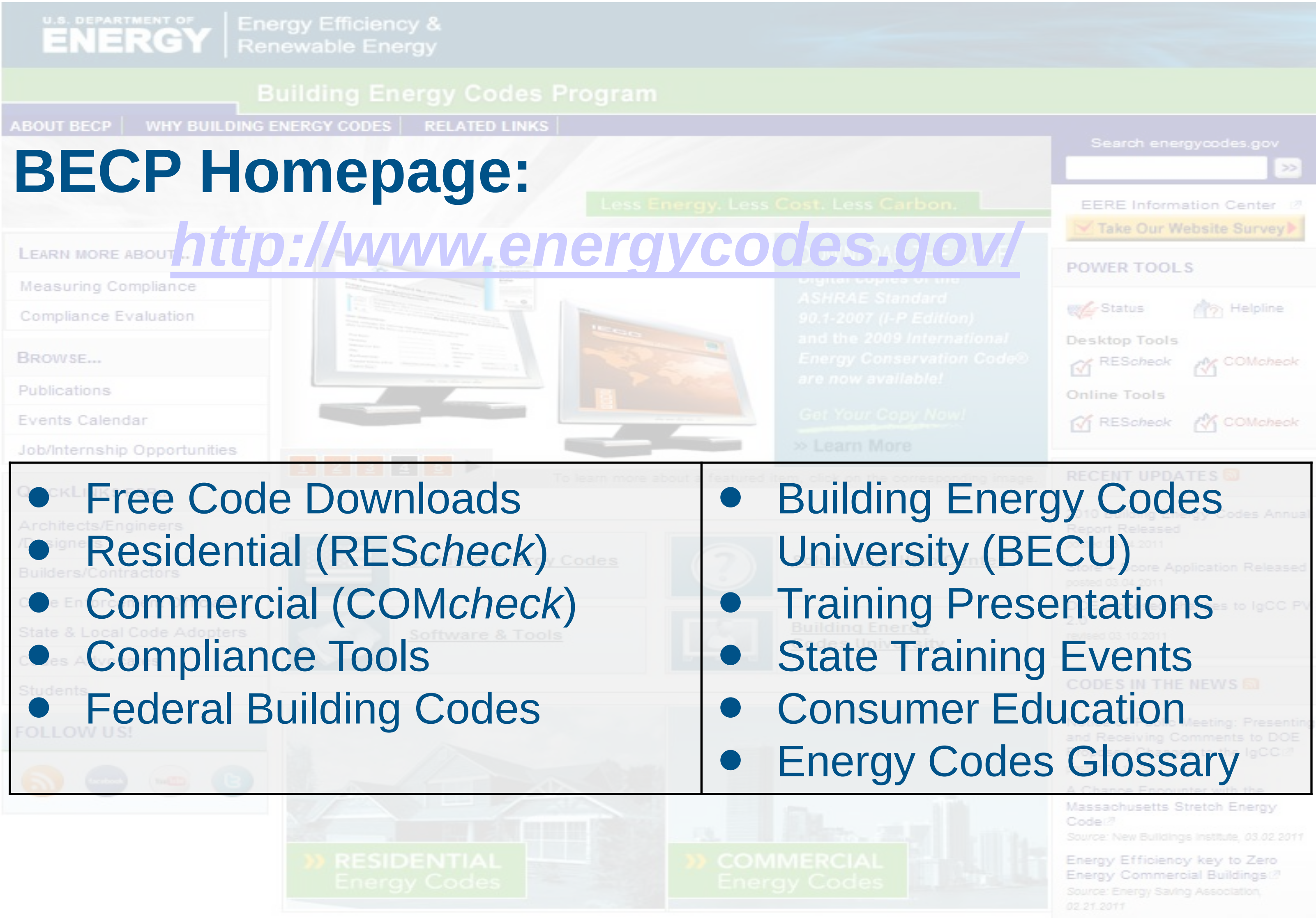
• National Security • Energy Sources • Energy Efficiency • Environment • Energy Prices and Trends • Science and Technology • Health • Safety and Security	• Program Offices • Staff Offices • Energy Information Administration • National Laboratories and Technology Centers • Operations Offices and Field Organizations

http://www.energy.gov Date visited: 3/14/2011

Go To: www.energycodes.gov

Date visited: 3/14/2011

Building Energy Codes Program



BECP Homepage:

http://www.energycodes.gov/

- Free Code Downloads
- Residential (RES*check*)
- Commercial (COM*check*)
- Compliance Tools
- Federal Building Codes

- Building Energy Codes University (BECU)
- Training Presentations
- State Training Events
- Consumer Education
- Energy Codes Glossary

http://www.energycodes.gov Date visited: 3/14/2011

BECP Resource Center

Building Energy Codes
RESOURCE CENTER

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Welcome to the Building Energy Codes Resource Center

This system has been developed to provide users with information about energy codes and beyond code technologies. You can SEARCH by keyword, or BROWSE the available topics. Start your research using the toolbar at the top of the page.

Resources are available in a variety of different media types, including Articles, Graphics, Online Tools, Presentations, and Videos. The BECP Resource Center gathers content not only from our own archives, but also provides links to energy code resources from around the web. Learn more about the Resource Center.

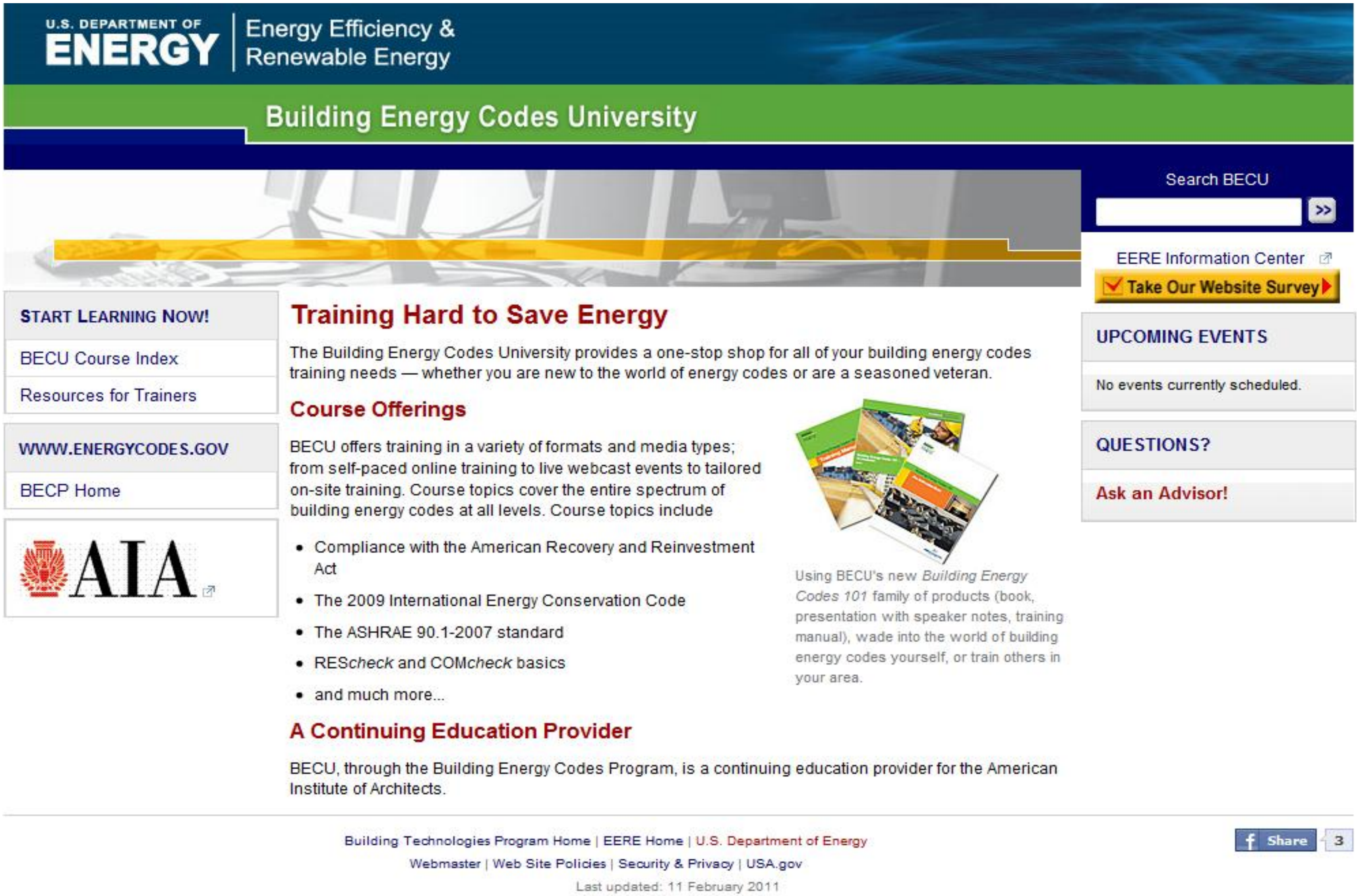
Something missing? Send us your materials if you see something outdated, or let us know if you have requests for information we don't have.

Resource Center Home | Email Us | Security & Privacy | www.energycodes.gov

http://resourcecenter.pnl.gov/cocoon/morf/ResourceCenter

Date visited: 3/14/2011

Building Energy Codes University (BECU)



http://www.energycodes.gov/becu/ Date visited: 3/14/2011

BECU Home: http://www.energycodes.gov/becu/

General | Residential | Commercial | Live/On-Site Events

General Information

- Building Energy Codes 101 - An Introduction

Webcasts On-Demand

- Comply! Energy Code Tools You May Be Missing
- Duct Testing

Self-Paced Training

- Codes 101
- Area Takeoffs 101

Instructions

- Webcasts On-Demand
- Self-Paced Courses

Start Learning with Building Energy Codes 101

Online Learning Modules:

http://www.energycodes.gov/becu/

RES*check* Basics

Course Description:

This training covers the basics of using RES*check* software and is geared toward the beginning user.

Original Webcast Date

February 19, 2009

Presented by:

Rosemarie Bartlett and Pam Cole
Pacific Northwest National Laboratory

Downloads:

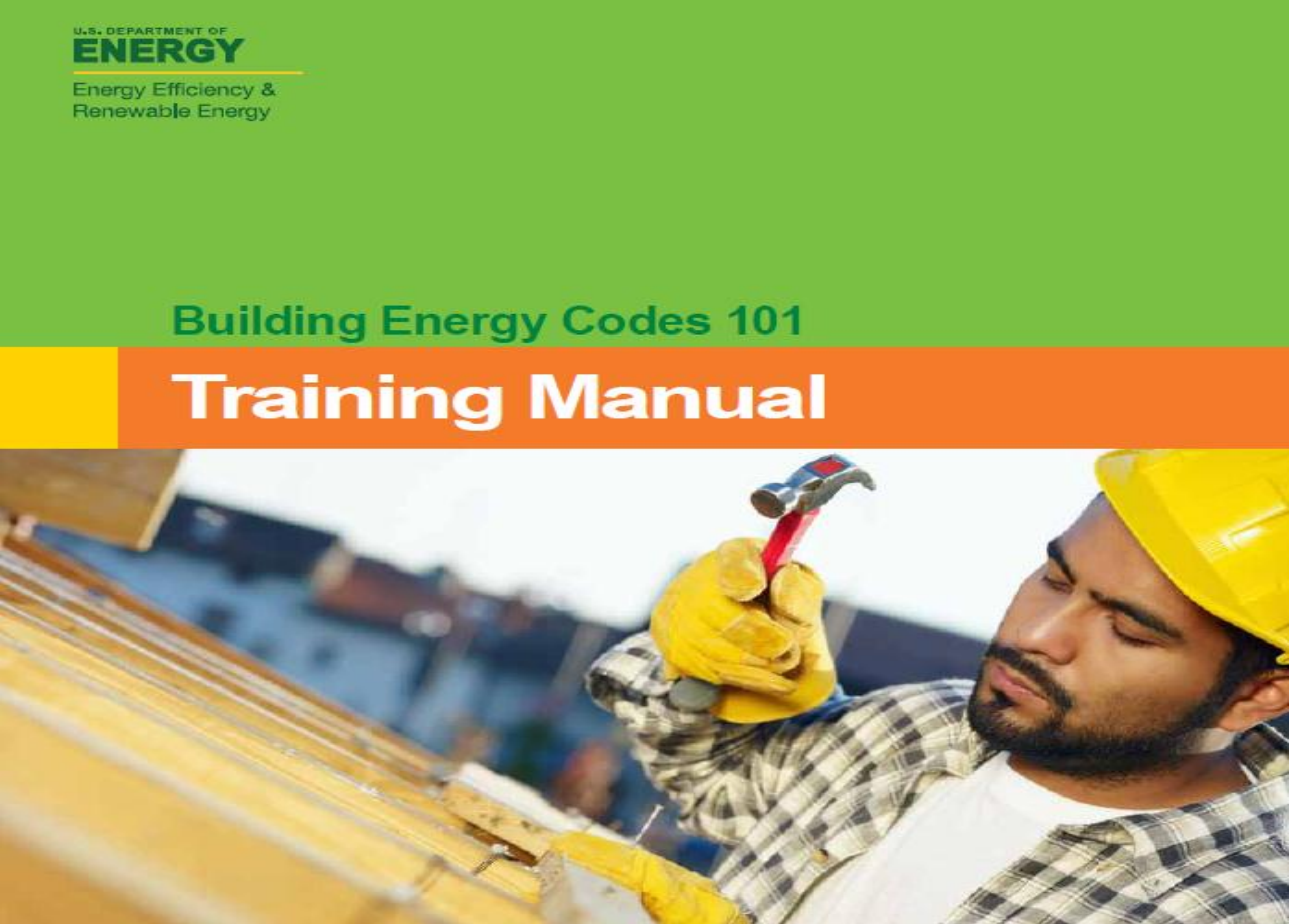
Video; (1 hour, 8 minutes)
Video Transcript
Presentation Slides

http://www.energycodes.gov/becu/ Date visited: 3/14/2011

Energy Codes YouTube Channel

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

http://www.youtube.com/user/EnergyCodes Date visited: 3/14/2011



Building Energy Codes 101: Training Manual. Building Energy Codes University. U.S. DOE. (2010)

ASHRAE 90.1—2007 Download

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Building Energy Codes Program

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Less Energy. Less Cost. Less Carbon.

EERE Information Center

ASHRAE

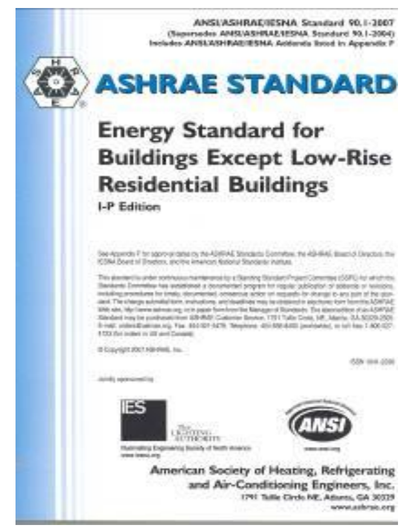
Digital Copies of the *Standard 90.1-2007 (I-P Edition)*

Through funding from the U.S. Department of Energy (DOE), the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) had offered the Standard 90.1-2007 Inch Pound Edition (I-P Edition) available to download at no-cost for a limited time.

Due to overwhelming popularity, no-cost copies of 90.1-2007 are no longer available.

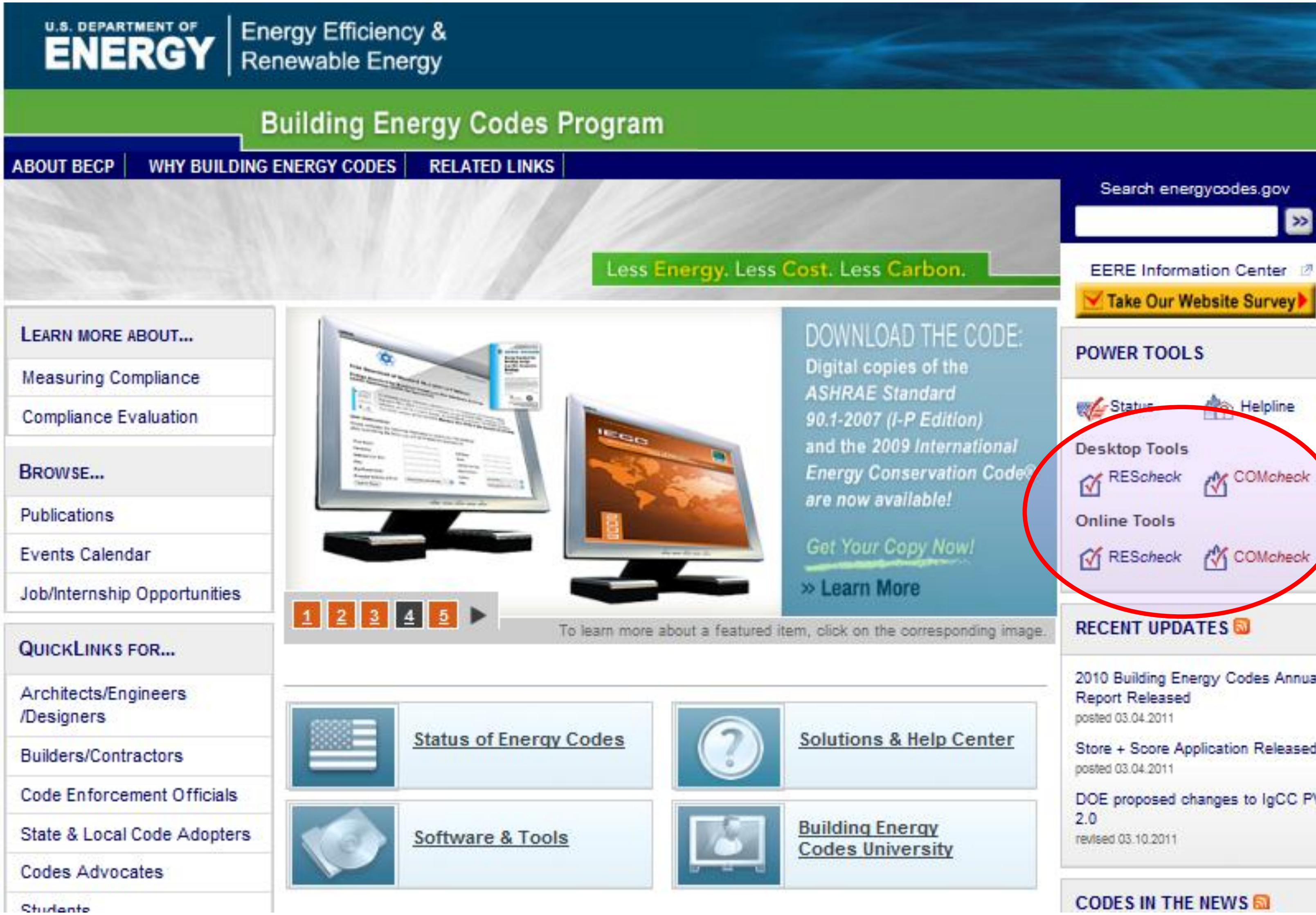
ASHRAE is now offering the digital version of the Standard at a reduced price of $19.00 for a limited time.

Visit ASHRAE's website to purchase a copy of Standard 90.1-2007 at this reduced price now.



http://www.energycodes.gov/publications/code_books.stm

RES*check* and COM*check*

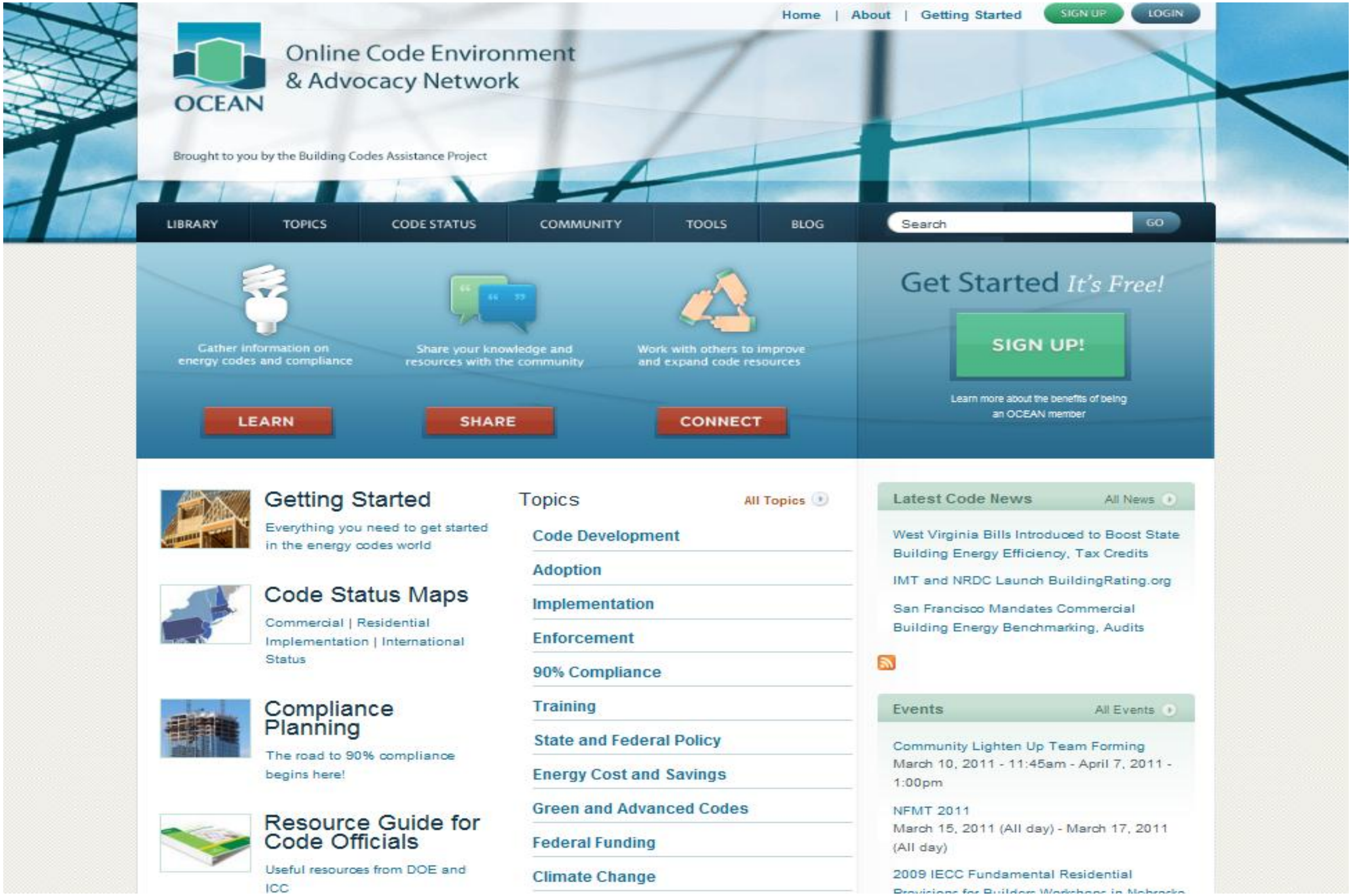


http://www.energycodes.gov Date visited: 3/14/2011

Building Codes Assistance Project

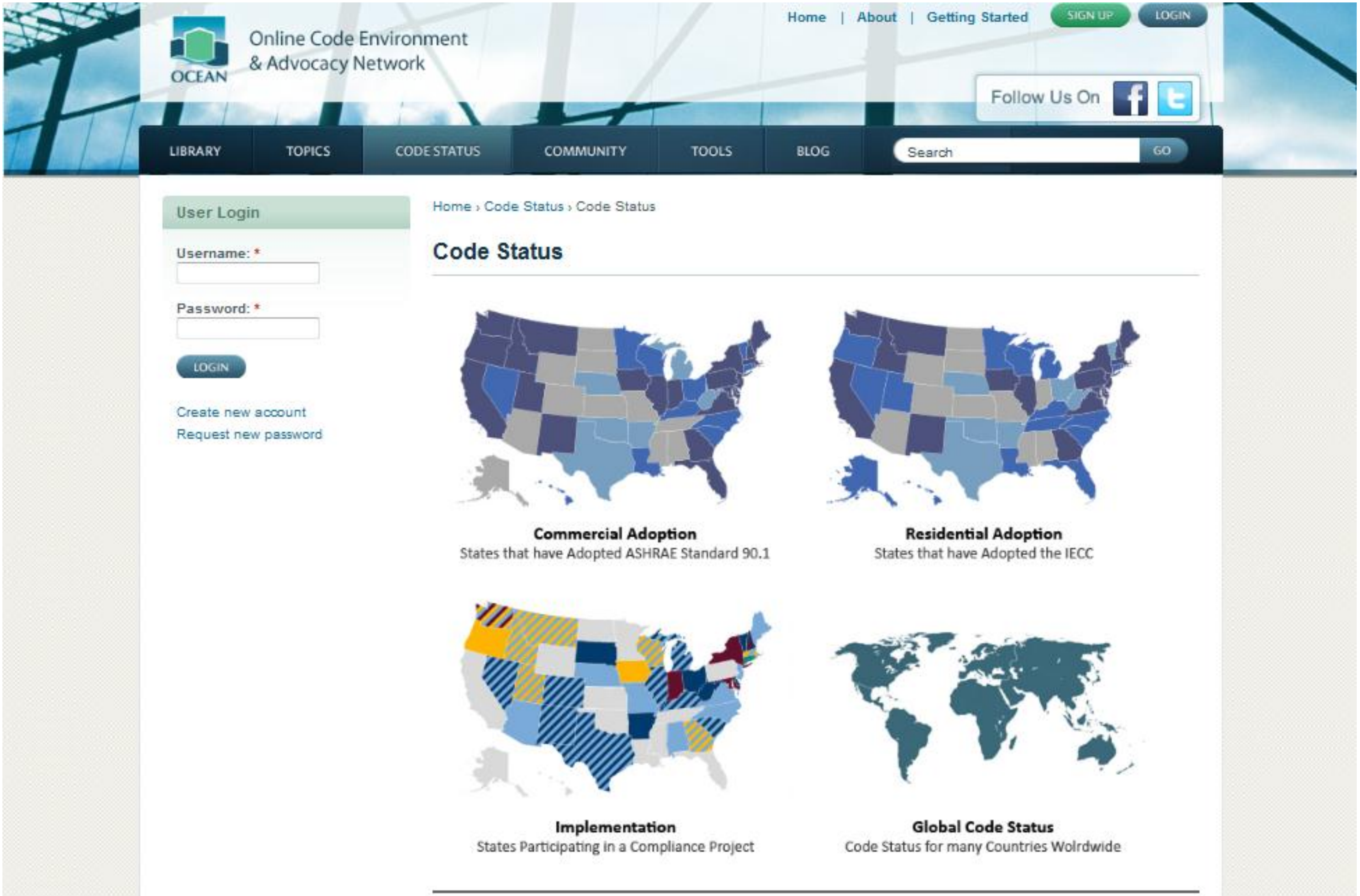
http://bcap-energy.org/ Date visited: 3/14/2011

BCAP: OCEAN



http://bcap-ocean.org/ Date visited: 3/14/2011

BCAP: OCEAN



http://bcap-ocean.org/code-status Date visited: 3/14/2011

BCAP: OCEAN

OCEAN

The Online Code Environment and Advocacy Network

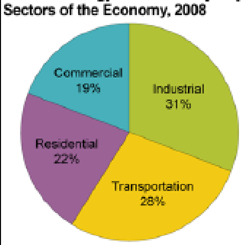
Navigating the World of Energy Codes | www.bcap-ocean.org

Why Energy Codes Matter

What Consumers Need to Know

We don't often think about how much energy used in buildings impacts society. Yet buildings account for over 40 percent of total energy use in the United States—more than either the transportation or industrial sectors.

Share of Energy Consumed by Major Sectors of the Economy, 2008



Source: Energy Information Administration, *Annual Energy Review 2008*.

Building energy codes matter because they:

Save Consumers Money

For most people, buying a home is the most expensive investment they will ever make. It is surprising, then, that so many of us don't look at the operational costs of our homes when making a purchase. Most homes waste energy needlessly, and those costs add up. In 2008, US households spent about $2,225 on average for energy bills. Energy efficient buildings use less energy, which reduces utility bills and puts money back into consumers' pockets. Millions of additional dollars are now available to...

Help Stimulate the Economy and Create Green Jobs

Consumers spend the money they save from reduced energy bills on other goods and services, which bolsters the local economy. Businesses can transfer savings to other areas of need, such as production, investment, and employee retention, as well as provide more work for local inspection departments. Setting new standards for efficiency also creates a growing market for energy audits, retrofits, and weatherization. In short, investing in energy efficiency projects creates or sustains a wide-range of green jobs. Of course, at their most basic level, building codes are designed to...

Ensure Health and Safety

First, energy codes reduce heating and cooling costs, helping protect millions of low-income Americans who can now afford to stay warm in the winter and cool in the summer. Second, they reduce pollution from electricity generation and improves indoor air quality, both of which keep us healthier. Finally, they reduce greenhouse gas emissions, which mitigates the impacts of global climate change. Finally, energy codes ...

Provide Comfort

An important advantage of energy-efficient homes is that they receive a higher rate of homeowner satisfaction. Lower air infiltration rates, along with lower utility bills and higher potential resale values, lead to happy customers with comfortable homes. Energy efficient construction also cuts back the time and money that may be spent in the future on home improvement projects to make living spaces more comfortable.

OCEAN is an online resource of the Building Codes Assistance Project

For more information, please visit us at: www.bcap-ocean.org

BCAP

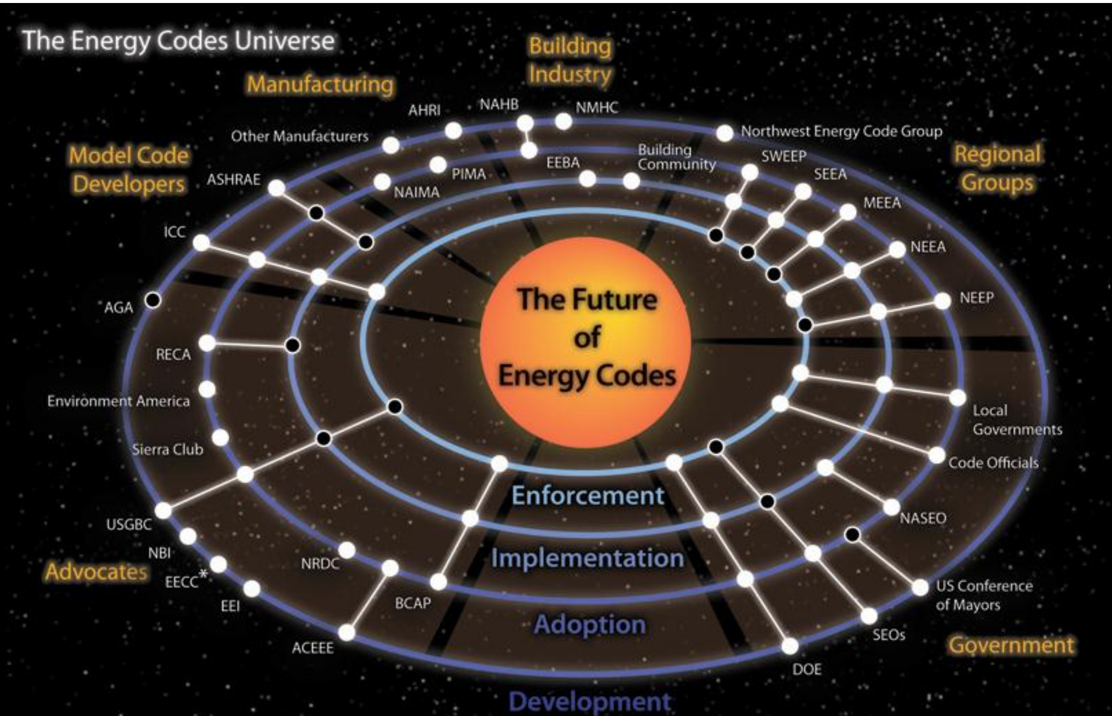
A joint initiative of the Alliance to Save Energy (ASE), the Natural Resources Defense Council (NRDC), and the American Council for an Energy Efficient Economy (ACEEE)

OCEAN

1850 M St. NW Suite 600 | Washington, DC | www.bcap-ocean.org

http://bcap-ocean.org/why-energy-codes-matter Date visited: 3/14/2011

BCAP: OCEAN



Key

- ● Groups engaged in activity
- ○ Opportunities for involvement
- * Coalition of orgainzations

Click on an organization above to learn more about their role in the energy codes universe.

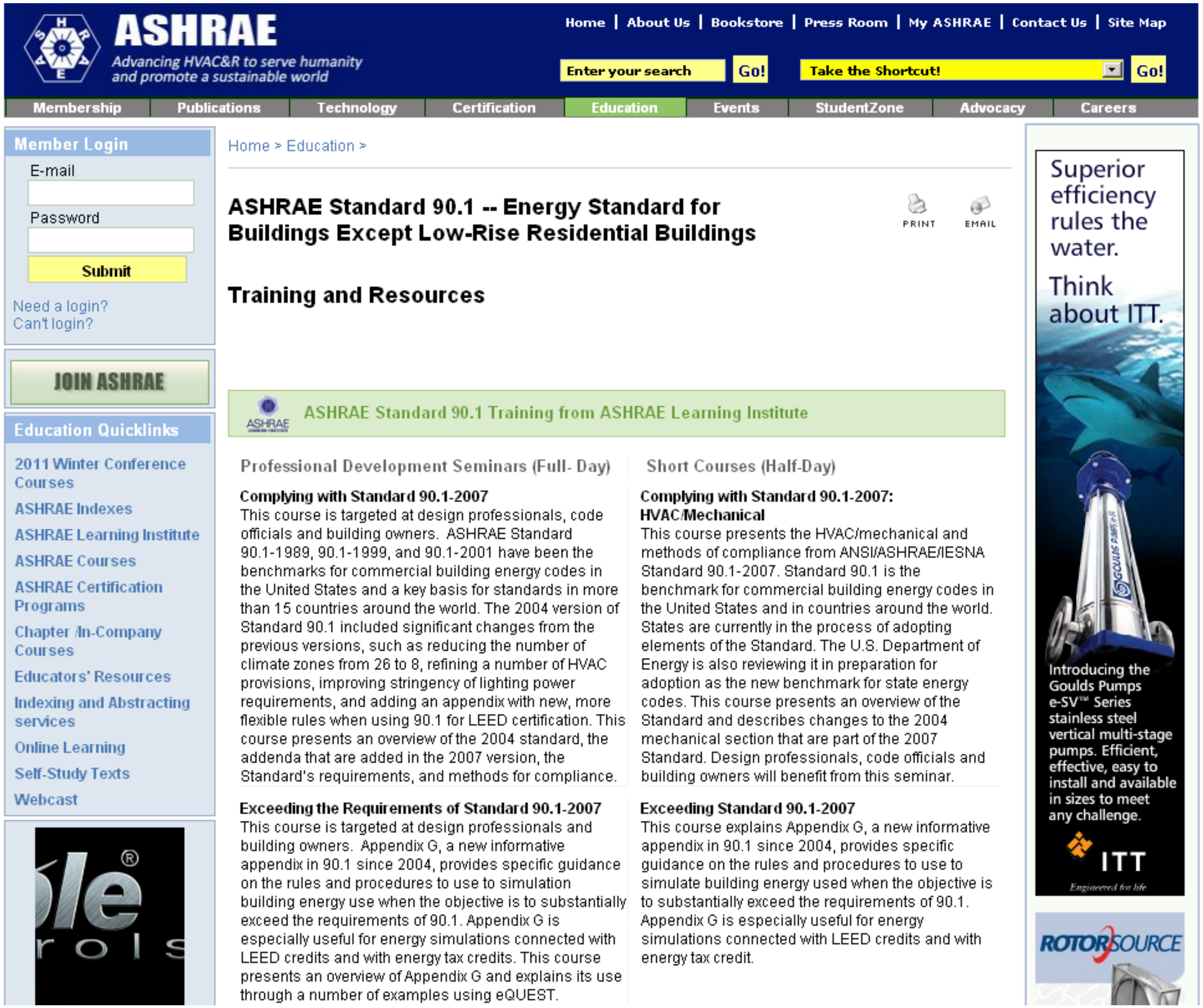
Energy efficiency is in! But as demand for more stringent energy codes grows, so does the complexity of the codes process and the need for a broad coalition of stakeholders. For anyone new to codes, simply identifying the many actors involved can be a daunting task, much less finding opportunities for involvement. Even veteran code experts must stay up-to-date with the changing landscape.

To help make sense of it all, BCAP is proud to introduce the **Energy Codes Universe**!

Disclaimer: The intent of this resource is to include all participants in the energy codes process. However, BCAP acknowledges the possibility of excluding deserving organizations. All omissions are inadvertent. If you believe that your organization merits recognition in the Energy Codes Universe, please contact us at **bcap-ocean@ase.org**.

http://bcap-ocean.org/ext/codeuniverse/index.html Date visited: 3/14/2011

ASHRAE Training Resources



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Advancing HVAC&R to serve humanity and promote a sustainable world

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ASHRAE Standard 90.1 -- Energy Standard for Buildings Except Low-Rise Residential Buildings

PRINT EMAIL

Training and Resources

ASHRAE Standard 90.1 Training from ASHRAE Learning Institute

Professional Development Seminars (Full- Day)

Complying with Standard 90.1-2007
This course is targeted at design professionals, code officials and building owners. ASHRAE Standard 90.1-1989, 90.1-1999, and 90.1-2001 have been the benchmarks for commercial building energy codes in the United States and a key basis for standards in more than 15 countries around the world. The 2004 version of Standard 90.1 included significant changes from the previous versions, such as reducing the number of climate zones from 26 to 8, refining a number of HVAC provisions, improving stringency of lighting power requirements, and adding an appendix with new, more flexible rules when using 90.1 for LEED certification. This course presents an overview of the 2004 standard, the addenda that are added in the 2007 version, the Standard's requirements, and methods for compliance.

Exceeding the Requirements of Standard 90.1-2007
This course is targeted at design professionals and building owners. Appendix G, a new informative appendix in 90.1 since 2004, provides specific guidance on the rules and procedures to use to simulation building energy use when the objective is to substantially exceed the requirements of 90.1. Appendix G is especially useful for energy simulations connected with LEED credits and with energy tax credits. This course presents an overview of Appendix G and explains its use through a number of examples using eQUEST.

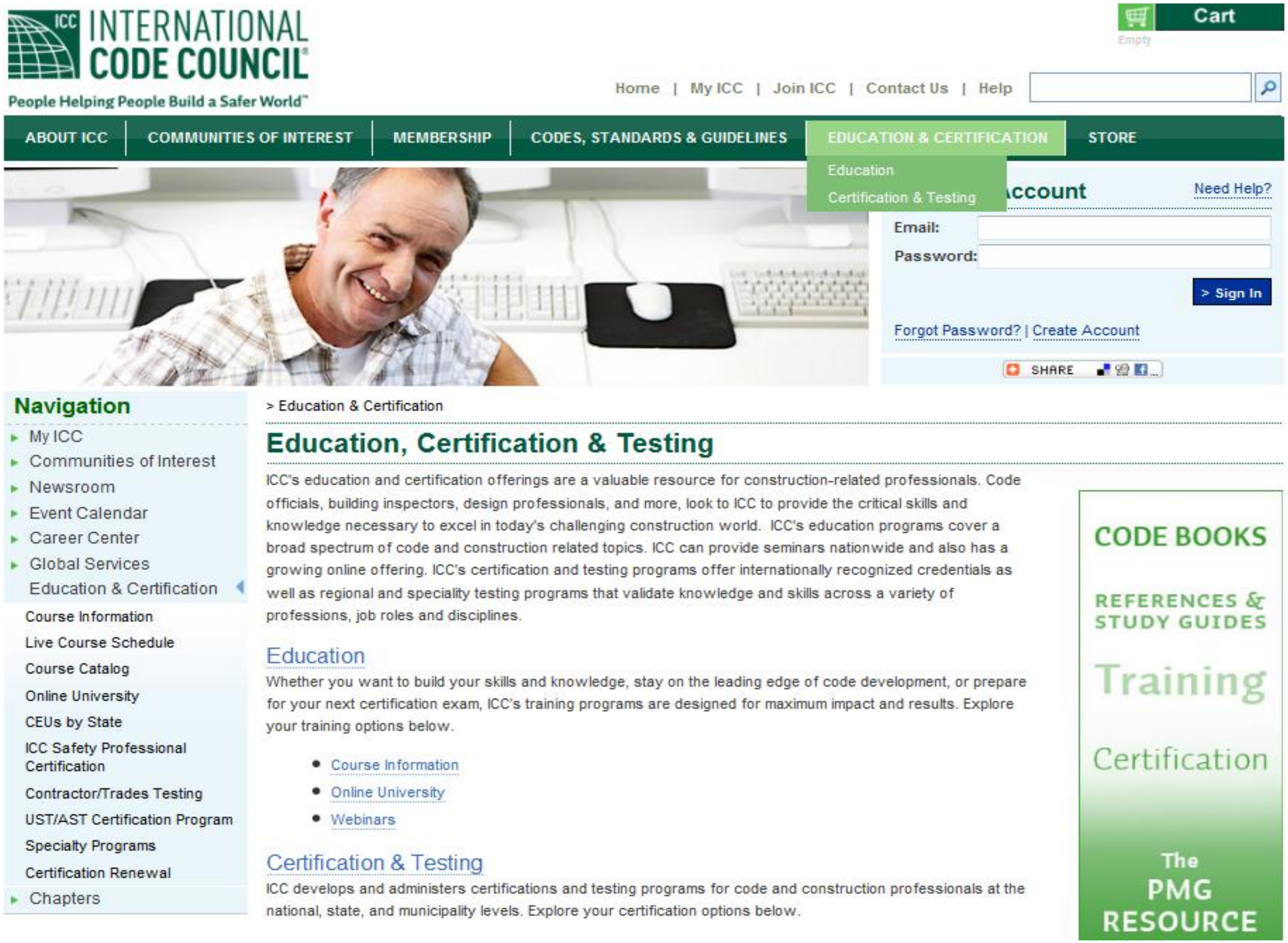
Short Courses (Half-Day)

Complying with Standard 90.1-2007: HVAC/Mechanical
This course presents the HVAC/mechanical and methods of compliance from ANSI/ASHRAE/IESNA Standard 90.1-2007. Standard 90.1 is the benchmark for commercial building energy codes in the United States and in countries around the world. States are currently in the process of adopting elements of the Standard. The U.S. Department of Energy is also reviewing it in preparation for adoption as the new benchmark for state energy codes. This course presents an overview of the Standard and describes changes to the 2004 mechanical section that are part of the 2007 Standard. Design professionals, code officials and building owners will benefit from this seminar.

Exceeding Standard 90.1-2007
This course explains Appendix G, a new informative appendix in 90.1 since 2004, provides specific guidance on the rules and procedures to use to simulate building energy used when the objective is to substantially exceed the requirements of 90.1. Appendix G is especially useful for energy simulations connected with LEED credits and with energy tax credit.

http://www.ashrae.org/education/page/1834 Date visited: 3/14/2011

ICC Training Resources



http://www.iccsafe.org/Edu-Cert/Pages/default.aspx Date visited: 3/14/2011

Training Workshops

Energy Codes 2010

http://www.energycodes.gov/events/energycodes/agenda_presentations.stm

Energy Codes 2011

http://www.energycodes.gov/events/energycodes

BEST3 Conference 2012

http://www.thebestconference.org/program.php

Efficiency Vermont 2011 Conference Presentations

http://www.efficiencyvermont.com/for_our_partners/bbd/conference_schedule.aspx

Greenbuild International Conference and Expo

http://www.greenbuildexpo.org/Home.aspx

Upcoming Workshops

For a list of upcoming energy related conferences, workshops and events:

U.S. DOE: Energy Information Administration:

http://www.eia.doe.gov/calendar/meetings.htm

State of Michigan Resources

Michigan Bureau of Construction Codes (BCC):
http://www.michigan.gov/dleg/0,1607,7-154-10575---,00.html

Michigan Bureau of Energy Systems (BES):
http://www.michigan.gov/dleg/0,1607,7-154-25676---,00.html

Energy Efficiency for Small Businesses:
http://www.michigan.gov/documents/CIS_EO_Small_Businesses_Guide_94204_7.pdf

Energy Star Homes Brochure:
http://www.michigan.gov/documents/cis/CIS_EO_EnergyStarHome_Brochure_193355_7.pdf

Home Maintenance and Operations:
http://www.michigan.gov/documents/CIS_EO_Home_Maintenance_Tips_94189_7.pdf

U.S. EPA Energy Star Homes Program®

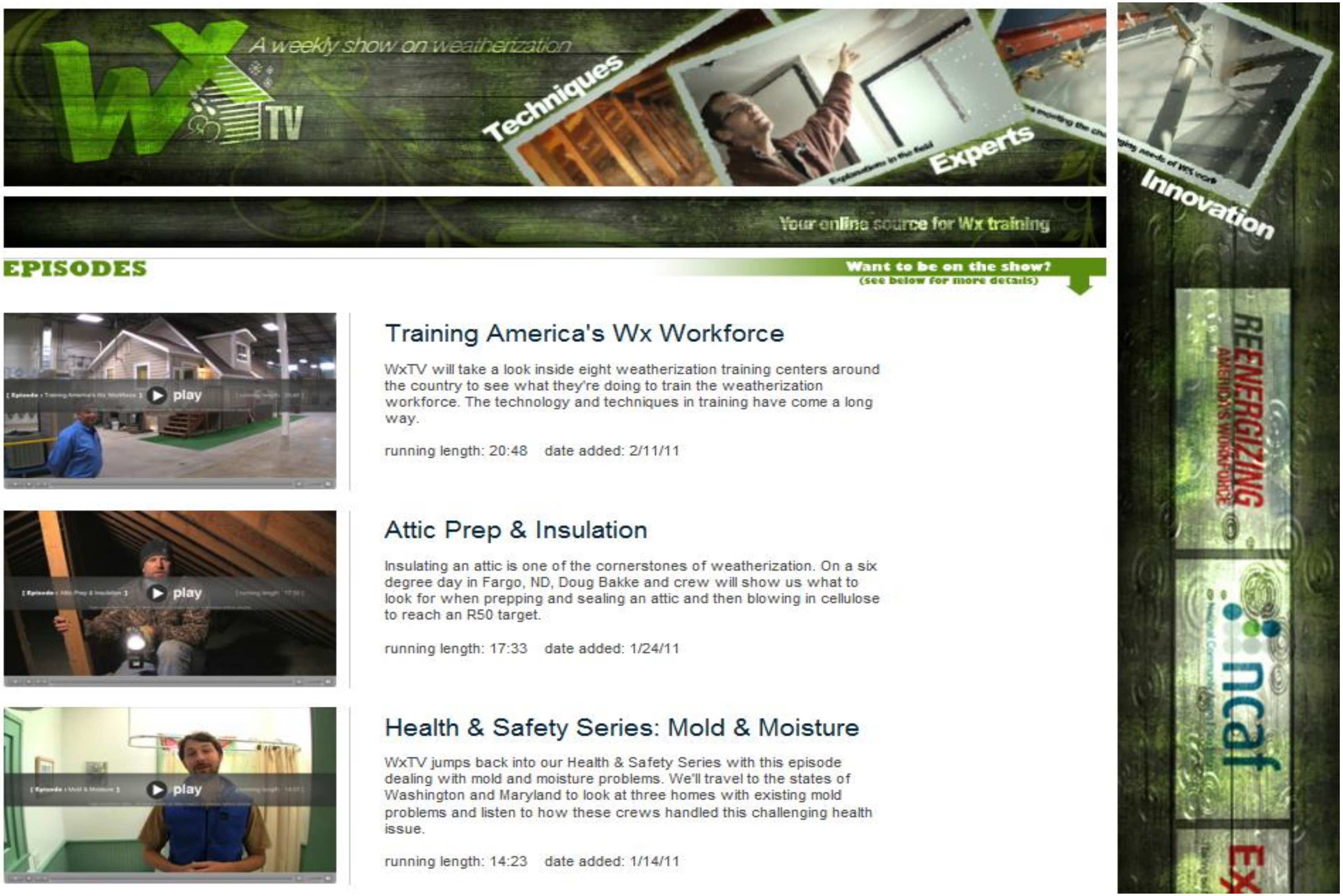
Energy Star is a government-backed program helping businesses and individuals protect the environment through superior energy efficiency

For more information: http://www.energystar.gov/

Energy Star Program

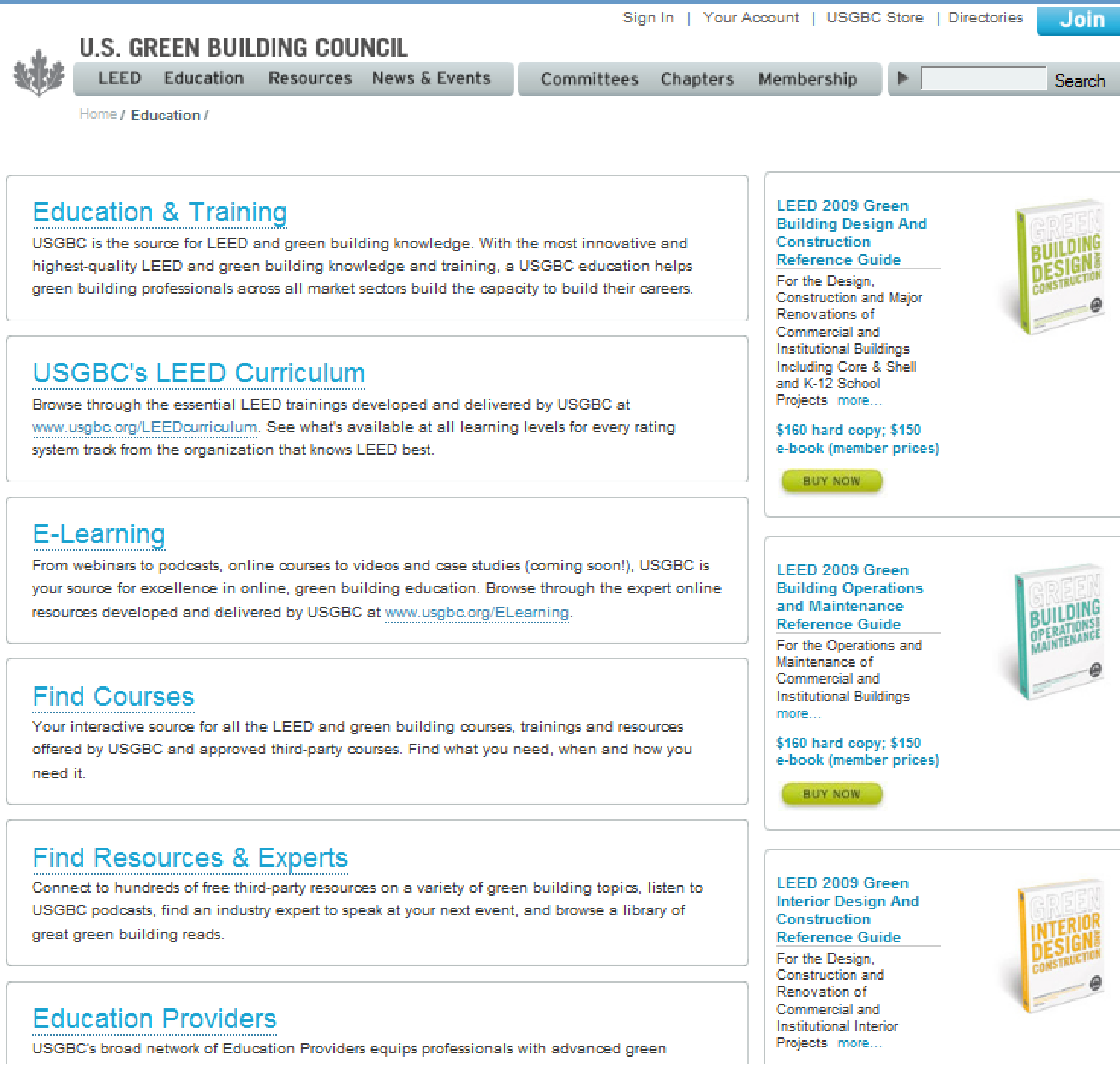
www.energystar.gov Date visited: 3/15/2011

Video Resource: Weatherization TV



http://weatherization.org/wxtv/ Date visited: 3/15/2011

U.S. Green Building Council (USGBC)



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USGBC is the source for LEED and green building knowledge. With the most innovative and highest-quality LEED and green building knowledge and training, a USGBC education helps green building professionals across all market sectors build the capacity to build their careers.

USGBC's LEED Curriculum

Browse through the essential LEED trainings developed and delivered by USGBC at www.usgbc.org/LEEDcurriculum. See what's available at all learning levels for every rating system track from the organization that knows LEED best.

E-Learning

From webinars to podcasts, online courses to videos and case studies (coming soon!), USGBC is your source for excellence in online, green building education. Browse through the expert online resources developed and delivered by USGBC at www.usgbc.org/ELearning.

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Your interactive source for all the LEED and green building courses, trainings and resources offered by USGBC and approved third-party courses. Find what you need, when and how you need it.

Find Resources & Experts

Connect to hundreds of free third-party resources on a variety of green building topics, listen to USGBC podcasts, find an industry expert to speak at your next event, and browse a library of great green building reads.

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LEED 2009 Green Building Design And Construction Reference Guide

For the Design, Construction and Major Renovations of Commercial and Institutional Buildings Including Core & Shell and K-12 School Projects more...

$160 hard copy; $150 e-book (member prices)

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LEED 2009 Green Building Operations and Maintenance Reference Guide

For the Operations and Maintenance of Commercial and Institutional Buildings more...

$160 hard copy; $150 e-book (member prices)

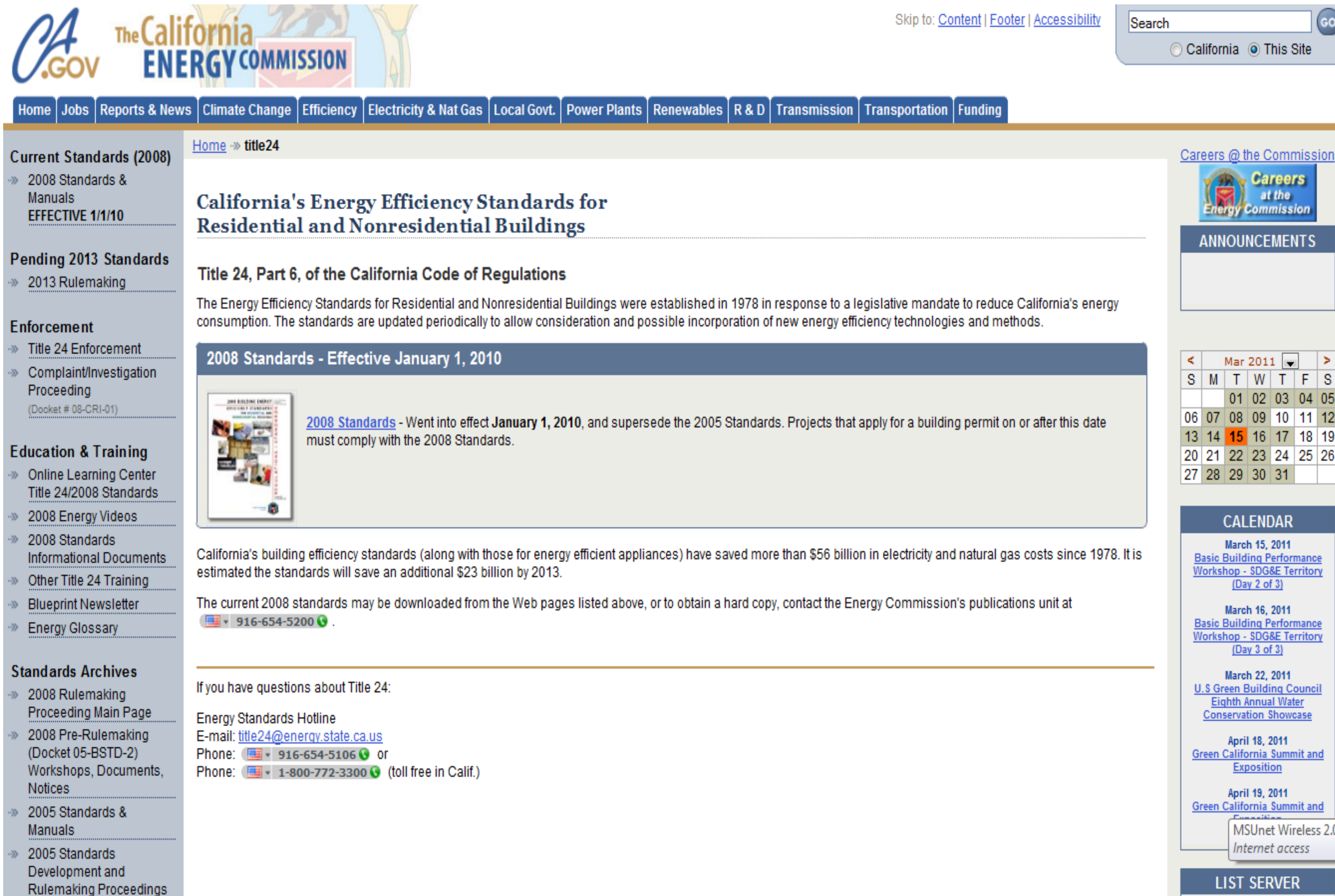
BUY NOW

LEED 2009 Green Interior Design And Construction Reference Guide

For the Design, Construction and Renovation of Commercial and Institutional Interior Projects more...

http://www.usgbc.org/DisplayPage.aspx?CategoryID=127 Date visited: 3/15/2011

State of California: Title 24 Code Training



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Current Standards (2008)
- 2008 Standards & Manuals EFFECTIVE 1/1/10

Pending 2013 Standards
- 2013 Rulemaking

Enforcement
- Title 24 Enforcement
- Complaint/Investigation Proceeding (Docket # 08-CRI-01)

Education & Training
- Online Learning Center Title 24/2008 Standards
- 2008 Energy Videos
- 2008 Standards Informational Documents
- Other Title 24 Training
- Blueprint Newsletter
- Energy Glossary

Standards Archives
- 2008 Rulemaking Proceeding Main Page
- 2008 Pre-Rulemaking (Docket 05-BSTD-2) Workshops, Documents, Notices
- 2005 Standards & Manuals
- 2005 Standards Development and Rulemaking Proceedings

Home » title24

California's Energy Efficiency Standards for Residential and Nonresidential Buildings

Title 24, Part 6, of the California Code of Regulations

The Energy Efficiency Standards for Residential and Nonresidential Buildings were established in 1978 in response to a legislative mandate to reduce California's energy consumption. The standards are updated periodically to allow consideration and possible incorporation of new energy efficiency technologies and methods.

2008 Standards - Effective January 1, 2010

2008 Standards - Went into effect **January 1, 2010**, and supersede the 2005 Standards. Projects that apply for a building permit on or after this date must comply with the 2008 Standards.

California's building efficiency standards (along with those for energy efficient appliances) have saved more than $56 billion in electricity and natural gas costs since 1978. It is estimated the standards will save an additional $23 billion by 2013.

The current 2008 standards may be downloaded from the Web pages listed above, or to obtain a hard copy, contact the Energy Commission's publications unit at 916-654-5200 .

If you have questions about Title 24:

Energy Standards Hotline
E-mail: title24@energy.state.ca.us
Phone: 916-654-5106 or
Phone: 1-800-772-3300 (toll free in Calif.)

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ANNOUNCEMENTS

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20	21	22	23	24	25	26
27	28	29	30	31		

CALENDAR

March 15, 2011
Basic Building Performance Workshop - SDG&E Territory (Day 2 of 3)

March 16, 2011
Basic Building Performance Workshop - SDG&E Territory (Day 3 of 3)

March 22, 2011
U.S Green Building Council Eighth Annual Water Conservation Showcase

April 18, 2011
Green California Summit and Exposition

April 19, 2011
Green California Summit and

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Internet access

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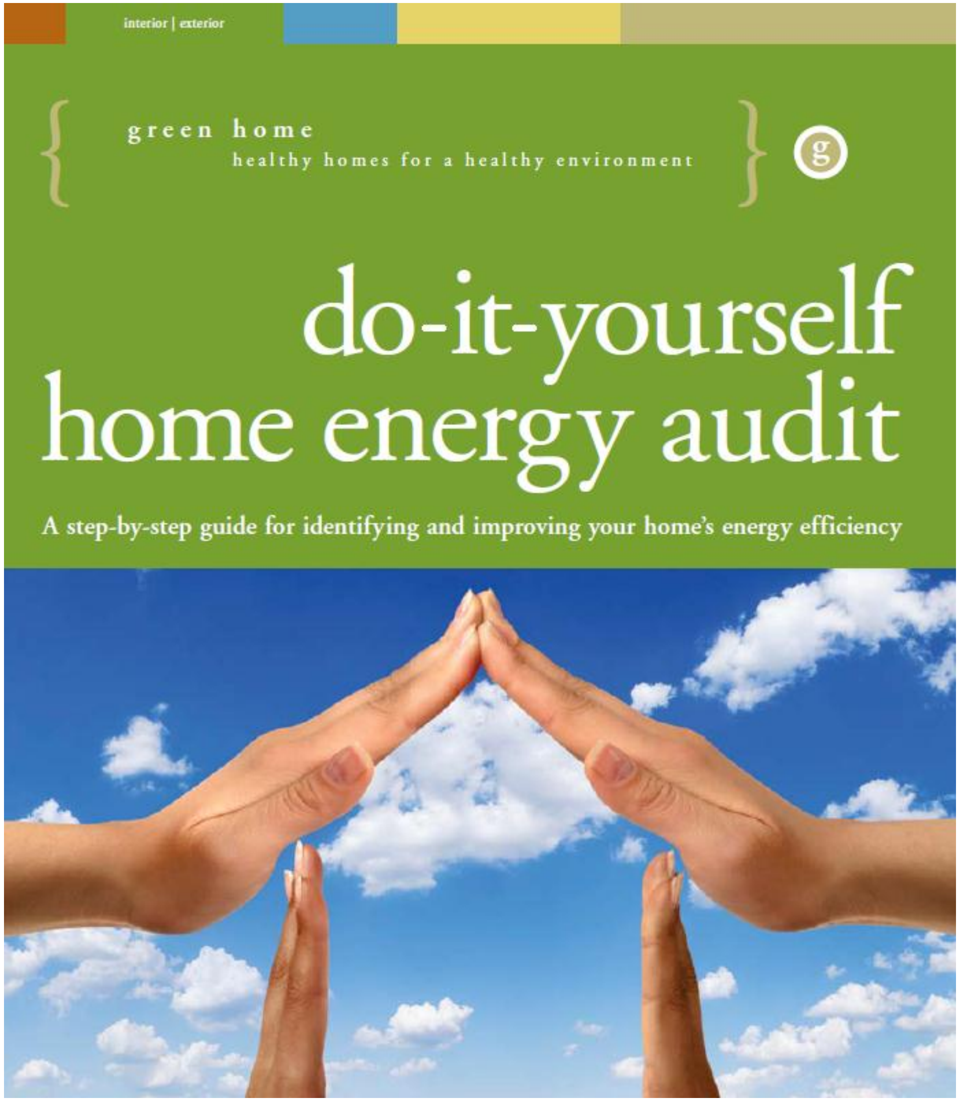
http://www.energy.ca.gov/title24/ Date visited: 3/15/2011

City of Seattle: DIY Energy Audit



http://www.seattle.gov/dpd/static/DIYweb_LatestReleased_DPDP016083.pdf

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Code college network

Code College NETWORK
Building Best Practices, Codes and Beyond

Code College NETWORK
Building Best Practices, Codes and Beyond

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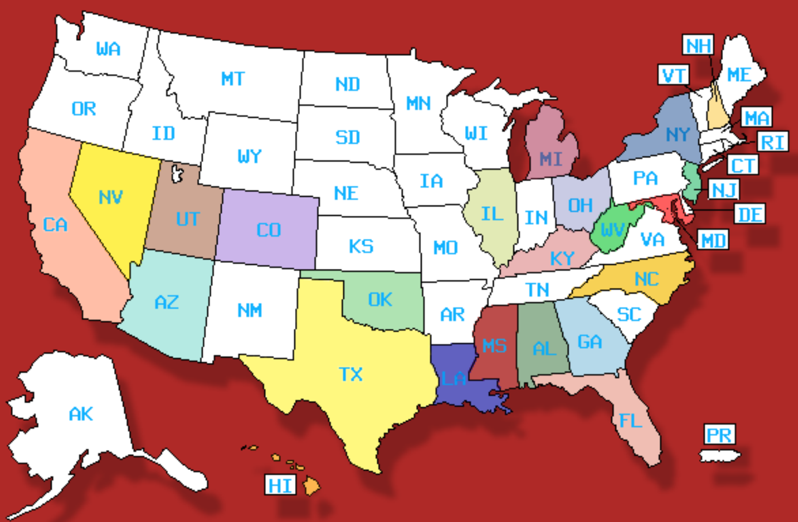
The Code College Initiative is designed to address the building and energy code and building science training needs of the building industry, including code officials, state agencies, builders, and trade groups across the nation. Code College presents objective, industry-sponsored online training from national experts that brings the audience to the field with our "online jobsite" approach available 24/7 for the ultimate convenience of the building professional.



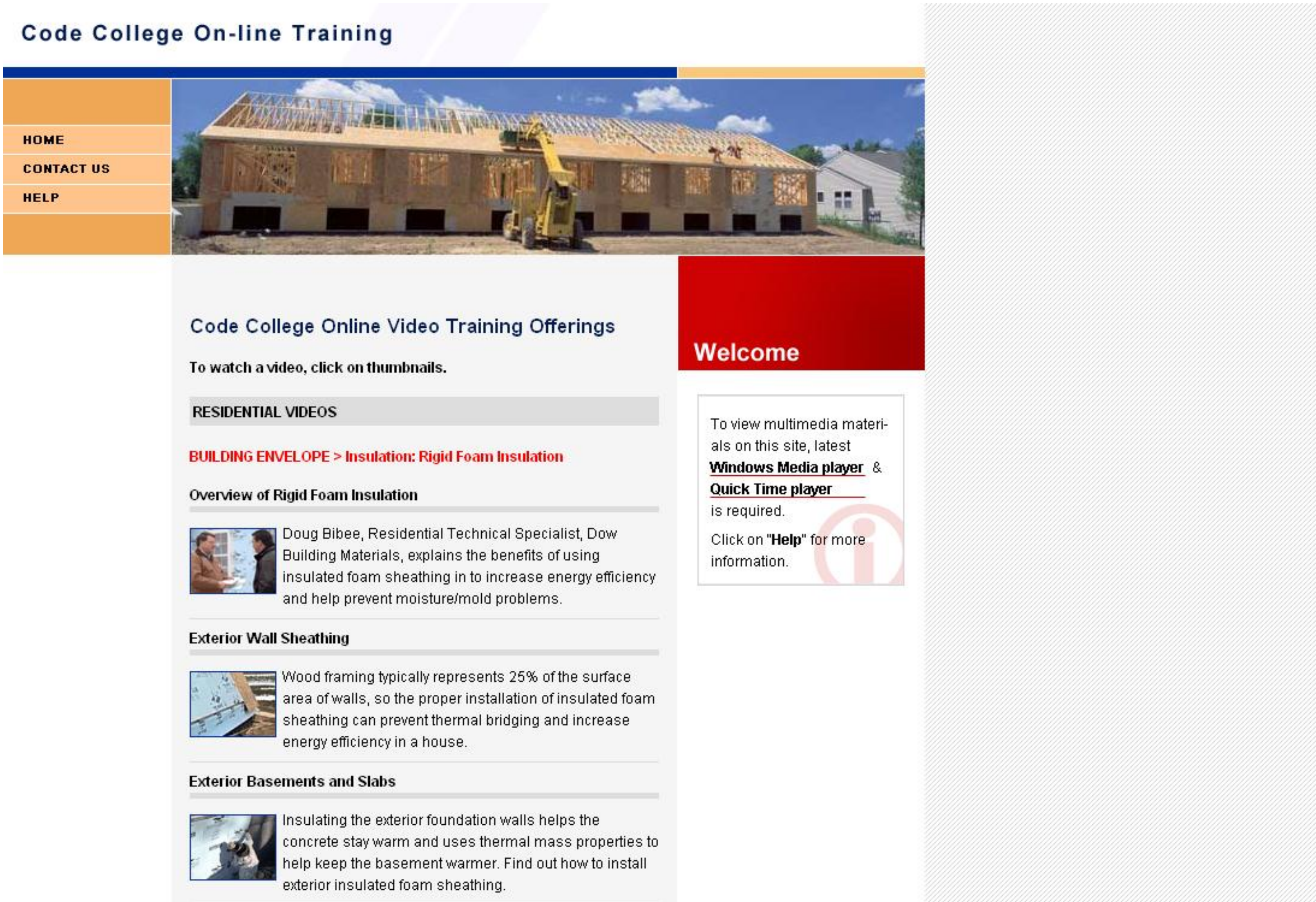
Learn more about....

Advertising on the Code College Network

Want to reach 1000's of people in the construction industry with information about your product? BCAP's Cosimina Panetti explains the concept behind the code college network and highlights the many reasons why product manufacturers and industry professionals should take advantage of this exceptional marketing venue. Double click on the video for a full scene version of this 3 minute video.

http://www.codecollegenetwork.com/ Date visited: 3/15/2011

CCN: Video Training Series



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RESIDENTIAL VIDEOS

BUILDING ENVELOPE > Insulation: Rigid Foam Insulation

Overview of Rigid Foam Insulation

Doug Bibee, Residential Technical Specialist, Dow Building Materials, explains the benefits of using insulated foam sheathing in to increase energy efficiency and help prevent moisture/mold problems.

Exterior Wall Sheathing

Wood framing typically represents 25% of the surface area of walls, so the proper installation of insulated foam sheathing can prevent thermal bridging and increase energy efficiency in a house.

Exterior Basements and Slabs

Insulating the exterior foundation walls helps the concrete stay warm and uses thermal mass properties to help keep the basement warmer. Find out how to install exterior insulated foam sheathing.

Welcome

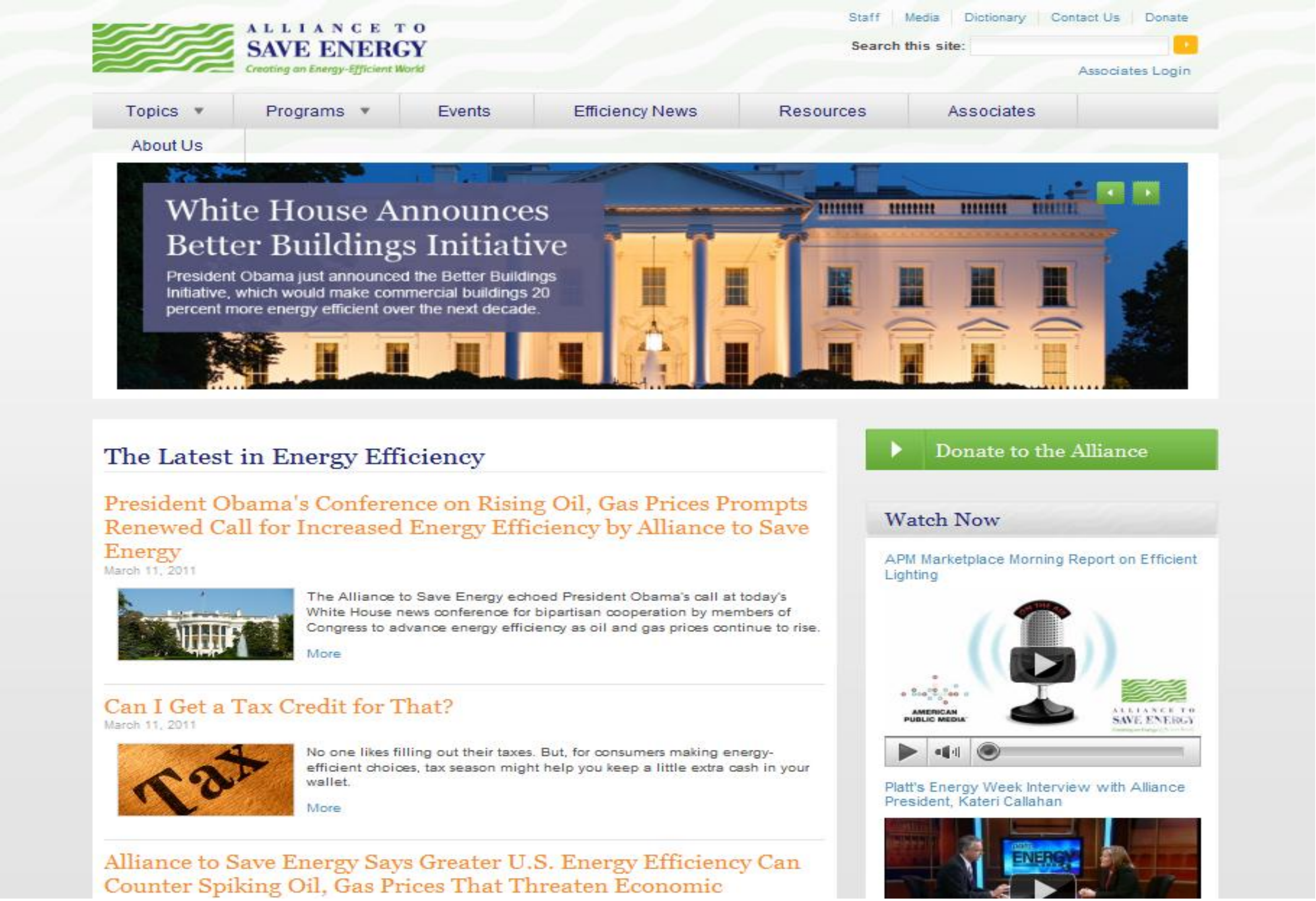
To view multimedia materials on this site, latest **Windows Media player** & **Quick Time player** is required.

Click on "**Help**" for more information.

http://www.codecollegenetwork.com/video_center/ Date visited: 3/15/2011

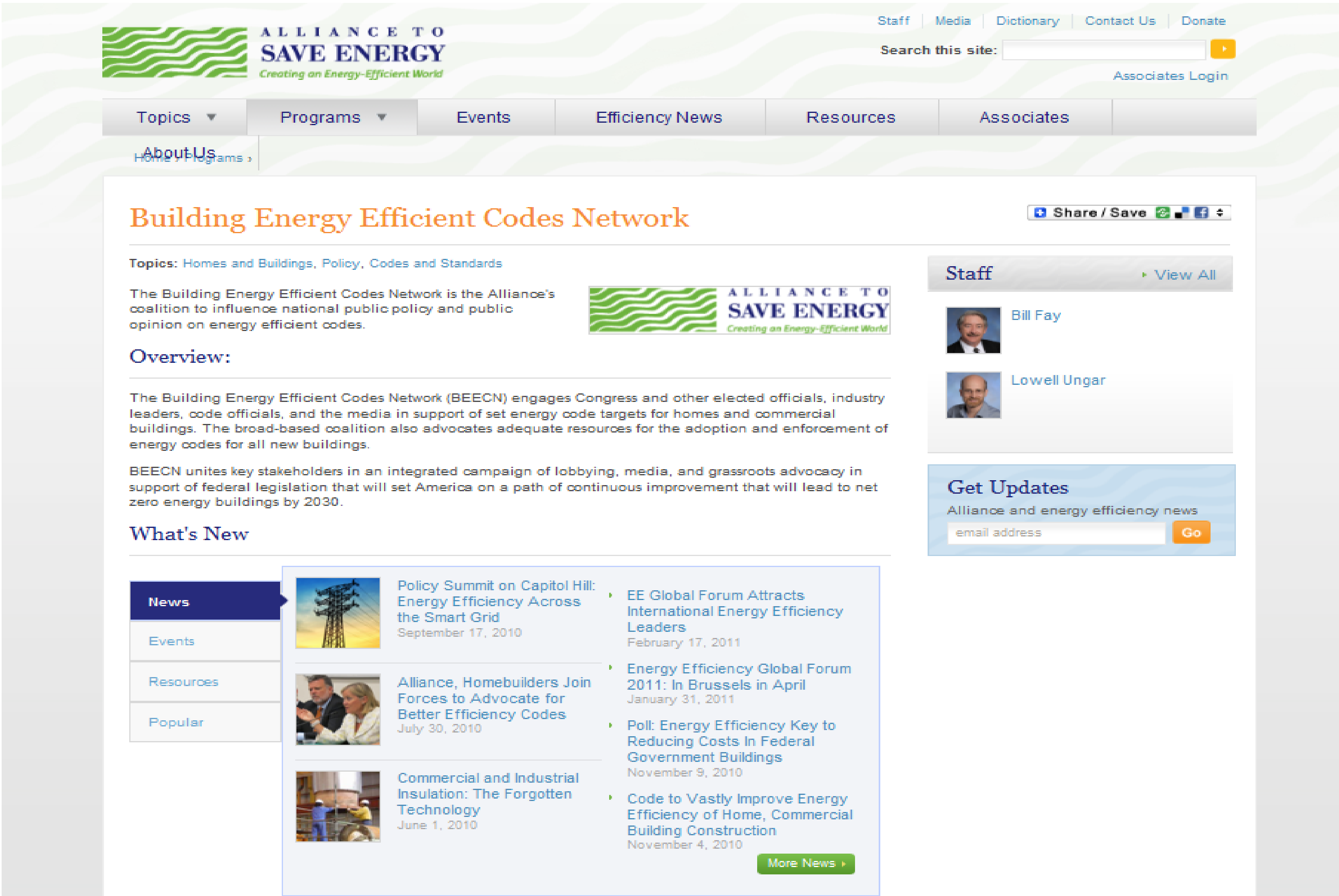
Alliance to Save Energy (ASE)

ALLIANCE TO SAVE ENERGY
Creating an Energy-Efficient World



http://ase.org/ Date visited: 3/15/2011

ASE: Building Energy Efficient Codes Network



ALLIANCE TO SAVE ENERGY
Creating an Energy-Efficient World

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Building Energy Efficient Codes Network

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Topics: Homes and Buildings, Policy, Codes and Standards

The Building Energy Efficient Codes Network is the Alliance's coalition to influence national public policy and public opinion on energy efficient codes.

Overview:

The Building Energy Efficient Codes Network (BEECN) engages Congress and other elected officials, industry leaders, code officials, and the media in support of set energy code targets for homes and commercial buildings. The broad-based coalition also advocates adequate resources for the adoption and enforcement of energy codes for all new buildings.

BEECN unites key stakeholders in an integrated campaign of lobbying, media, and grassroots advocacy in support of federal legislation that will set America on a path of continuous improvement that will lead to net zero energy buildings by 2030.

What's New

News | Events | Resources | Popular

Policy Summit on Capitol Hill: Energy Efficiency Across the Smart Grid
September 17, 2010

Alliance, Homebuilders Join Forces to Advocate for Better Efficiency Codes
July 30, 2010

Commercial and Industrial Insulation: The Forgotten Technology
June 1, 2010

- EE Global Forum Attracts International Energy Efficiency Leaders
  February 17, 2011
- Energy Efficiency Global Forum 2011: In Brussels in April
  January 31, 2011
- Poll: Energy Efficiency Key to Reducing Costs In Federal Government Buildings
  November 9, 2010
- Code to Vastly Improve Energy Efficiency of Home, Commercial Building Construction
  November 4, 2010

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Online Code Training

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MODULES

- Sill Seal Tape
- Egress
- Rigid Foam Insulation
- Wrapping the House
- Building with SIPS
- Fireplace Installation
- Proper Ventilation
- Insulated Vinyl Siding
- Engineered Wood Siding
- Brick Veneer Installation
- Feeney Cable Railings
- Plenum Cable
- Sealed Attic Systems

Welcome to the

Michigan Bureau of Construction Codes
Online Code Training Series

Is your System ready to play a VIDEO >>

As our statewide construction codes are revised and updated we are providing this e-learning programming to educate the industry on building product information, installation details and performance standards guidance to meet the revised codes. Through the kind support of our industry sponsors, Building Media, Inc., (www.buildingmedia.com) is working in partnership with the Bureau of Construction Codes to develop and provide this unique Internet-based training approach for building and design communities to disseminate and communicate these new and revised construction codes.

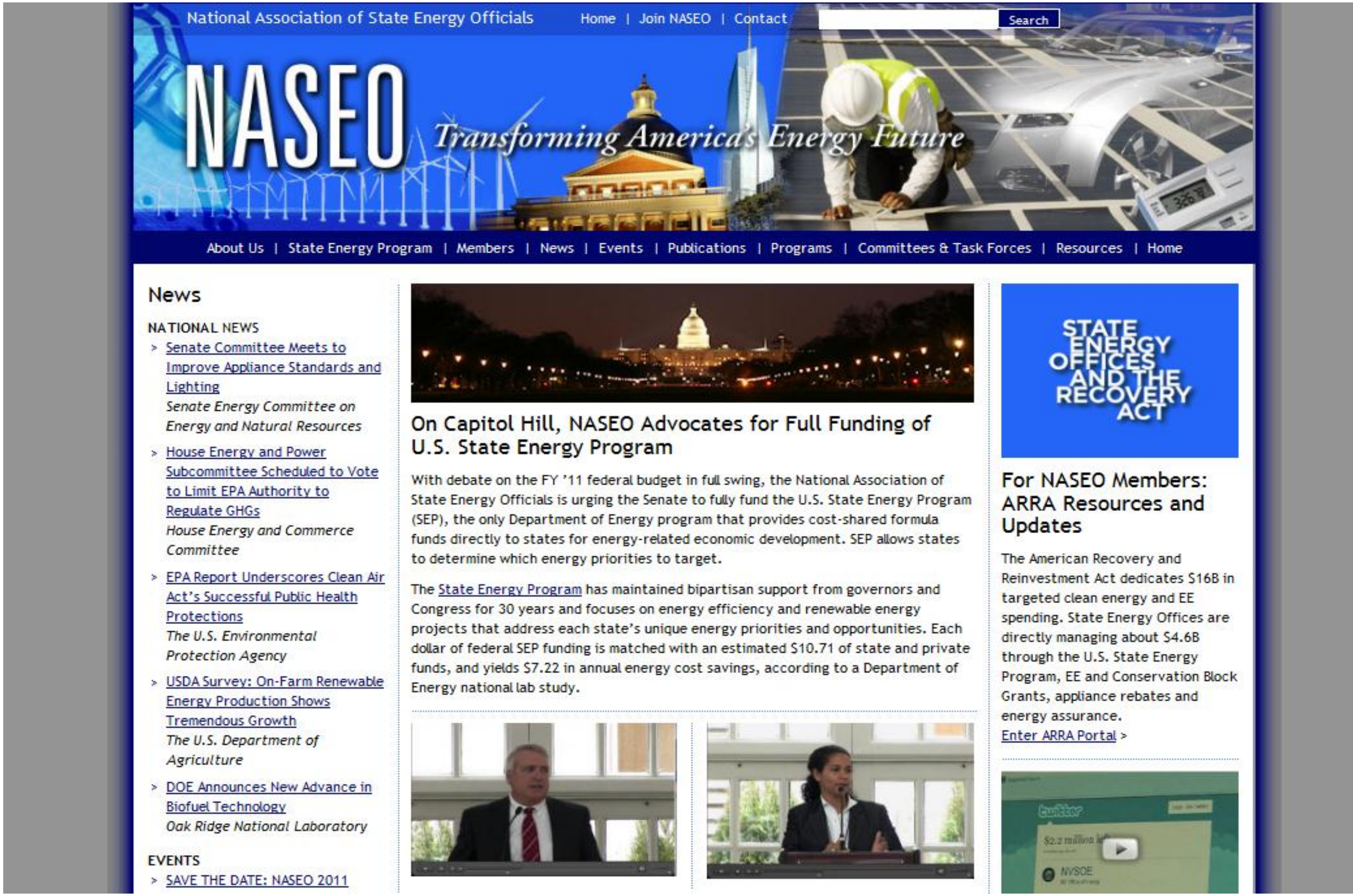
The purpose of this online building academy is to provide readily accessible training to building department personnel, builders and architects. The goal of this training program is to:

1. Educate building department personnel to have a greater knowledge and understanding of the codes so they can effectively enforce and inspect for building code regulations
2. Assist builders to construct better buildings that are in compliance with the new state building codes
3. Instruct architects and engineers on understanding the new codes that will be reflected in their designs and engineering.

Click on the buttons on the left to enter the learning modules.

www.michigancodes.com Date visited: 3/15/2011

National Association of State Energy Officials (NASEO)



www.naseo.org Date visited: 3/15/2011

Home Energy Rating System (HERS)

For More Information:

- Residential Energy Services Network
  http://resnet.us
  - Mission: establish and maintain the standards of quality for evaluating building energy performance and increase the opportunity for ownership of high performance buildings
- Energy Efficient Homes Midwest
  http://www.eehmidwest.com/
  - Midwest agency
  - Certifies most raters in Michigan

Additional Training Resources

U. S. Department of Energy

Building Energy Codes Program

Additional Training Resources:

http://www.energycodes.gov/events/other_resources.stm

- Several additional training resources
- ICC and ASHRAE links
- Professional and trade organizations
- State-specific resources

Interesting Web Links

ASHRAE Building Science Article

http://bookstore.ashrae.biz/journal/journalarticle.php?filename=building_sciences120108.pdf *(requires member login)*

California Title 24: Online Learning

http://www.energy.ca.gov/title24/

City of Seattle, WA: DIY Home Energy Audit

http://www.seattle.gov/dpd/static/DIYweb_LatestReleased_DPDP016083.pdf

Efficient Windows Collaborative

http://www.efficientwindows.org/

EPA Energy Star Program

http://www.energystar.gov/

Michigan Code Watch: Online Code Training

http://www.michigancodes.com/

MIT Open Courseware

http://ocw.mit.edu/index.htm

Montana Weatherization Training Center

http://weatherization.org/

Interesting Web Links

Oak Ridge National Laboratory: Building Envelope Research

http://www.ornl.gov/sci/roofs+walls/insulation/ins_01.html

Southface Learning Center

*www.**southface**.org/learning-center/trainings/*

Southface Online Training

*www.**southface**onlinetraining.org/*

U. S. Energy Information Administration: Key Terms Glossary

http://www.eia.doe.gov/a-z_index/Energya-z_a.html

U. S. Green Building Council (LEED Rating System)

www.usgbc.org

USGBC: Education

http://www.usgbc.org/education

U.S. DOE: Building Energy Codes Program

http://www.energycodes.gov

U.S. DOE: Energy Savers Blog

http://www.eereblogs.energy.gov/energysavers/post/What-Energy-Saving-Gifts-Are-You-Giving-this-Year.aspx

Appendix

MICHIGAN STATE UNIVERSITY

Important Terminology

Heat Flow Terms:

- R-value
- U-value
- C-factor
- F-factor

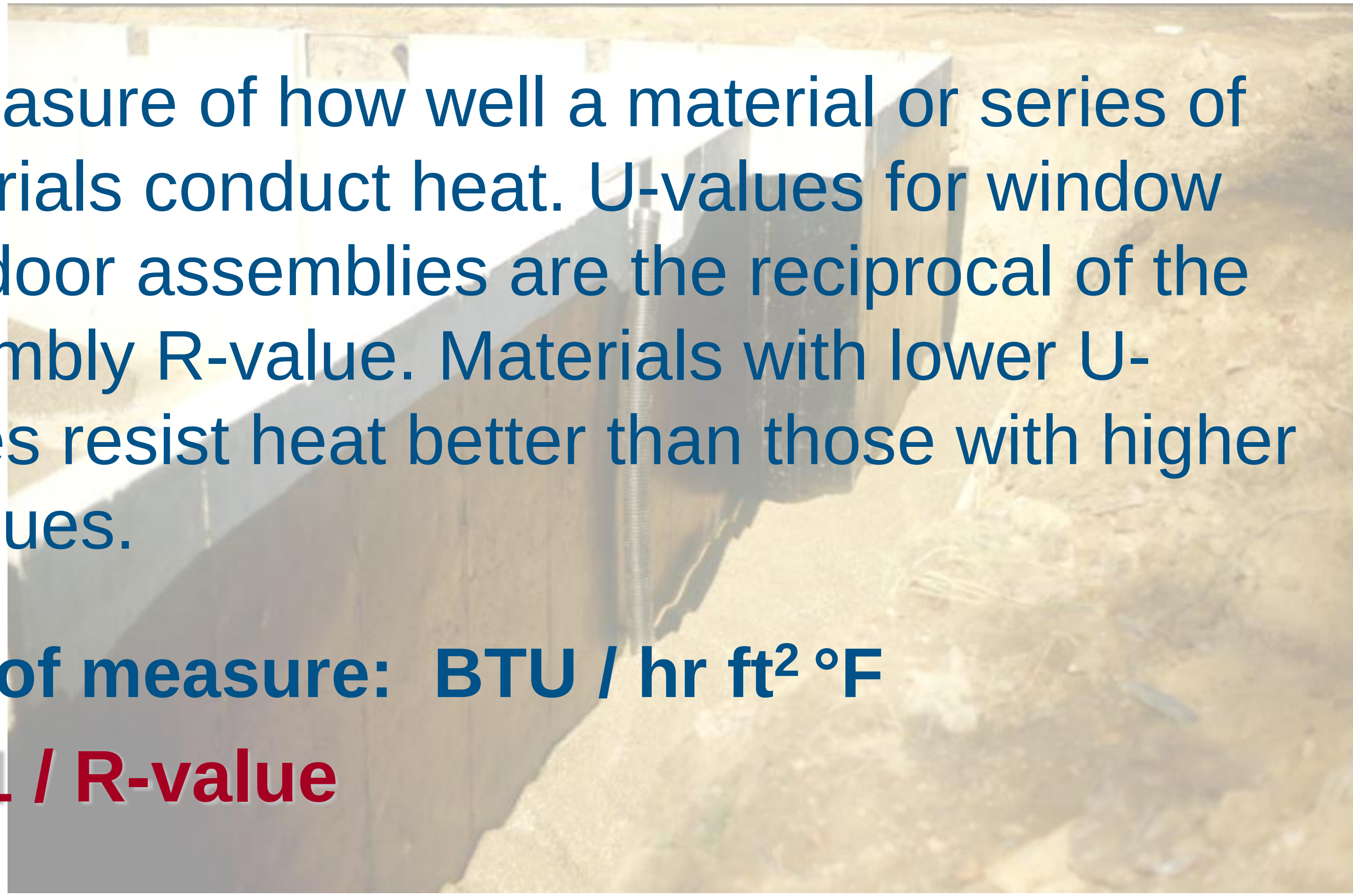
R-value

A measure of thermal resistance, or how well a material or series of materials resist the flow of heat. R-value is the reciprocal of U-value. Materials with higher R-values resist better than those with lower R-values.

Unit of measure: hr ft^2 °F / BTU

R = 1 / U-value

U-value



A measure of how well a material or series of materials conduct heat. U-values for window and door assemblies are the reciprocal of the assembly R-value. Materials with lower U-values resist heat better than those with higher U-values.

Unit of measure: BTU / hr ft^2 °F

U = 1 / R-value

C-factor

C-factor is also a rate of heat flow through a homogenous material, but could be for any given thickness.

Unit: BTU / hr ft^2 ºF

C-factor does not include soil or air films

F-factor

The perimeter heat loss factor for slab-on-grade floors, expressed in **BTU / hr ft. ºF**

Glazing/Fenestration

- Fenestration
- Solar Heat Gain Coefficient
- Shading Coefficient

Fenestration

The terms "fenestration", "window", and "glazing" are often used interchangeably.

However, fenestration refers to the design and position of windows, doors and other structural openings in a building (including frames).

Fenestration

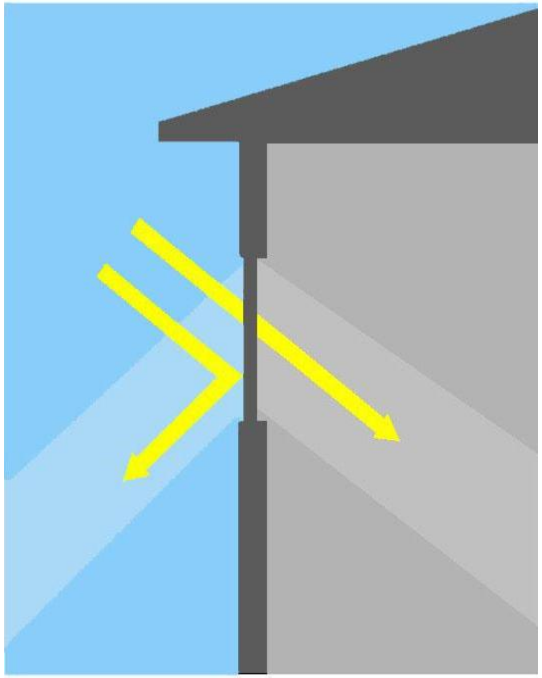
- U-values for windows can be measured at the center of the glass or can be expressed as a whole unit U-value
- National codes such as IECC and IRC require a unit U-value
- Codes have specific requirements for testing and labeling of window U-values

Solar Heat Gain Coefficient (SHGC)

SHGC is the glazing's effectiveness in rejecting solar heat gain. It is a part of a system for rating window performance used by the **National Fenestration Rating Council (NFRC).**

It is the fraction of incident solar radiation admitted through a window, both directly transmitted and absorbed, then subsequently released inward. It is expressed as a number between 0 and 1. **The lower a window's SHGC, the less solar heat it transmits.**

SHGC is gradually replacing the older index, Shading Coefficient (SC), in design standards.



http://resourcecenter.pnl.gov/cocoon/morf/ResourceCenter/dbimages/full/891.jpg

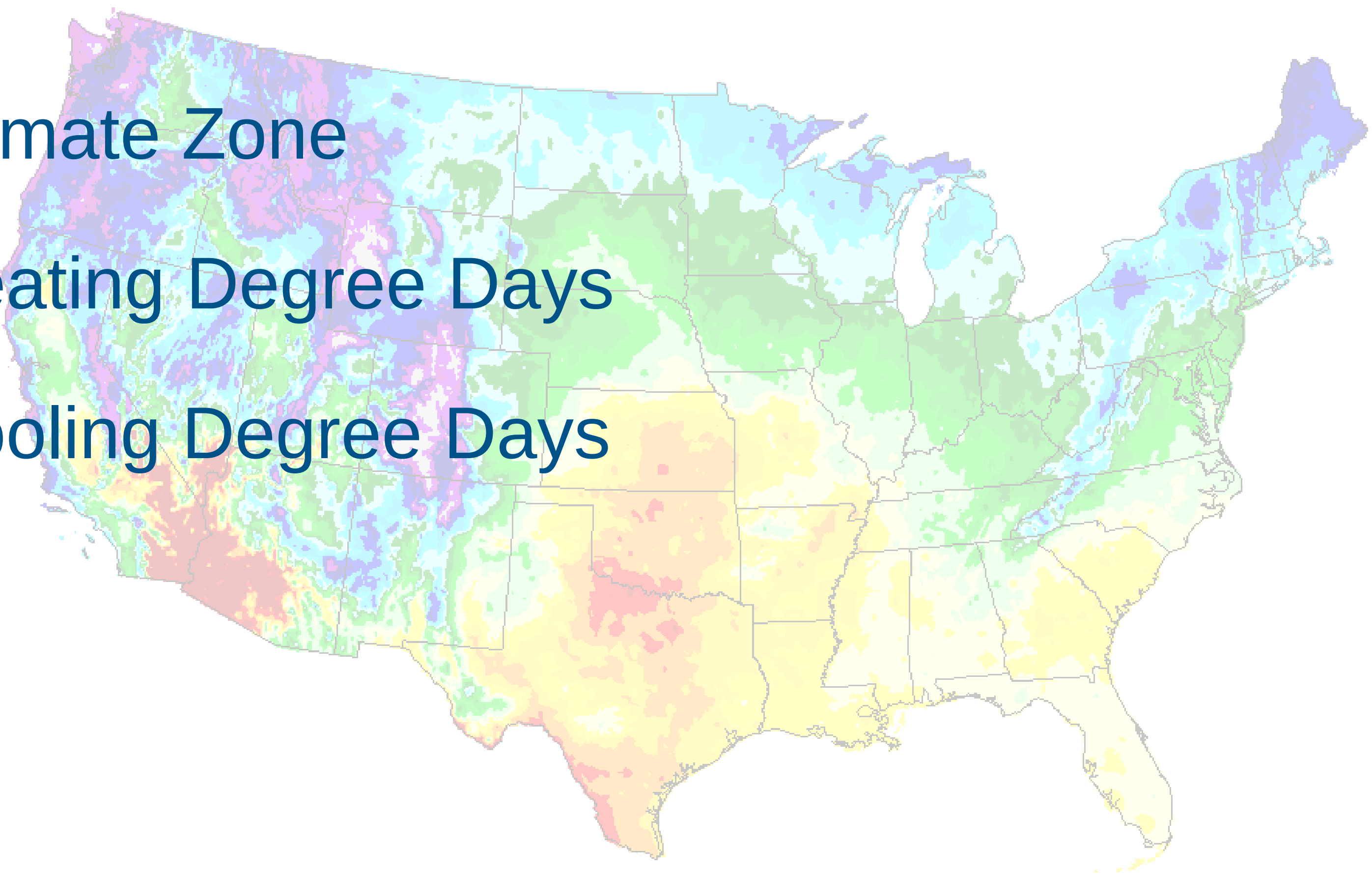
Date Visited: 3/15/2011

Shading Coefficient

The ratio of solar heat gain through fenestration, with or without integral shading devices, to that occurring through un-shaded 1/8-in thick double-strength glass.

If you are using glass whose performance is listed in terms of SC, **you may convert to SHGC by multiplying the SC value by 0.87**

Climate Zone / Degree Days



- Climate Zone
- Heating Degree Days
- Cooling Degree Days

http://www.climatesource.com/us/fact_sheets/excdd_us.gif Date Visited: 3/15/2011

Heating Degree Days

A unit, based upon temperature difference and time, used in estimating fuel consumption and specifying nominal heating load of a building in winter. For any one-day, when the mean temperature is less than 65°F (18.3°C), there exists as many degree-days as there are Fahrenheit degrees difference in temperature between the mean temperature for the day and 65°F (18.3°C).

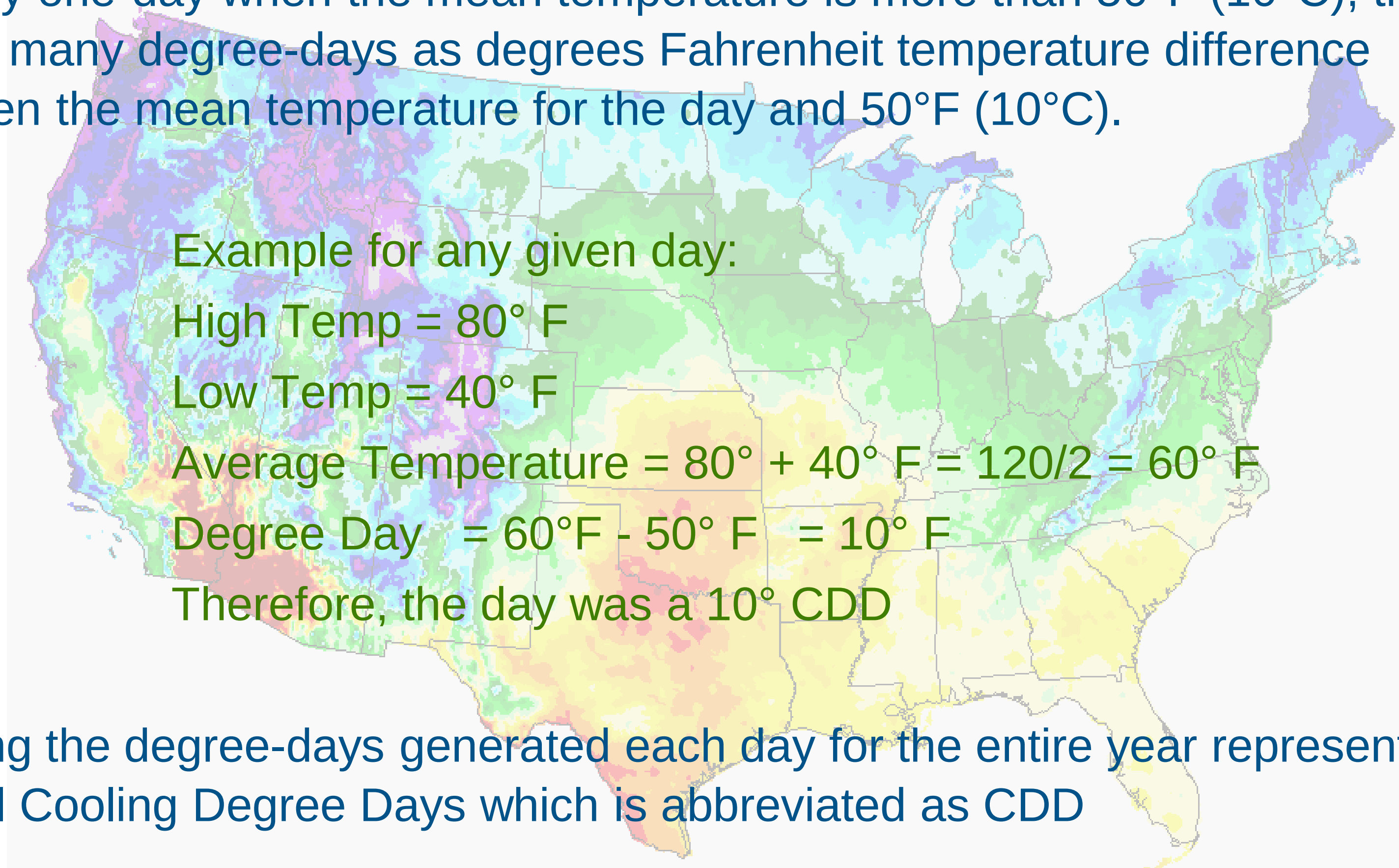
Example for any given day:
High Temp = 50° F
Low Temp = 20° F
Average Temperature = 50° + 20° F = 70/2 = 35° F
Degree Day = 65°F - 35° F = 30° F
Therefore, the day was a 30° HDD

Totaling the degree-days generated each day for the entire year represents the annual Heating Degree Days which is abbreviated as HDD

http://www.climatesource.com/us/fact_sheets/excdd_us.gif Date Visited: 3/15/2011

Cooling Degree Days

For any one-day when the mean temperature is more than 50°F (10°C), there are as many degree-days as degrees Fahrenheit temperature difference between the mean temperature for the day and 50°F (10°C).



Example for any given day:

High Temp = 80° F

Low Temp = 40° F

Average Temperature = 80° + 40° F = 120/2 = 60° F

Degree Day = 60°F - 50° F = 10° F

Therefore, the day was a 10° CDD

Totaling the degree-days generated each day for the entire year represents the annual Cooling Degree Days which is abbreviated as CDD

http://www.climatesource.com/us/fact_sheets/excdd_us.gif Date Visited: 3/15/2011

Other Key Terms

- Air Barrier
- Mass Wall
- Semi-heated Space

Air Barrier

The principal function of the air barrier is to prevent both the infiltration of outdoor air into a building and the ex-filtration of indoor air to the outside.

Air leakage can cause problems such as loss of energy and deposition of moisture in the walls.

Mass Walls

Wall with thermal heat sinking capacity exceeding 7 $BTU/ft^2{}^oF$ or 5 $BTU/ft^2{}^oF$ provided that the wall has material unit weight not greater than 120 lb/ft^3.

It is generally constructed of masonry or heavy wood and serves as a heat sink.

Semi-Heated Space

An enclosed space within a building that is heated by a heating system whose output capacity is greater than or equal to 3.4 BTU/hr.ft^2 of floor area, but is not a conditioned space.

Equipment Efficiency Terms

- Energy Efficiency
- Coefficient of Performance (COP)
- Energy Efficiency Ratio (EER)
- Seasonal Energy Efficiency Ratio (SEER)
- Annual Fuel Utilization Efficiency (AFUE)

Energy Efficiency

Energy Efficiency = Useful Energy OUTPUT / energy INPUT

Example: The IRC requires the heating appliances to be 78% energy efficient or 0.78.

Practically, efficiency cannot be 100% or 1 because energy is always lost in appliances in the form of sound or light energy.

Coefficient of Performance (COP)

The ratio of the rate of heat exchange to the rate of energy input in consistent units for a complete cooling/heating system as tested under a nationally recognized standard or designated operating conditions.

http://www.ferrotec.com.sg/prodimage/fig93.jpg Date visited: 3/15/2011

Energy Efficiency Ratio (EER)

The ratio of net cooling capacity of an equipment item in Watts (1 BTU / hr = 0.29 Watts) to the total rate of power input (in Watts) under designed operating conditions.

EER = Net cooling capacity (in Watts) / Power input (Watts)

Seasonal Energy Efficiency Ratio (SEER)

The ratio of the total cooling output of an air conditioner during its annual usage period of cooling to the energy input during the same period.

SEER = Cooling output / Energy input

- New equipment ranges from about 10 to 16 SEER
- Higher SEER ratings indicate more efficient equipment

Annual Fuel Utilization Efficiency (AFUE)

Annual fuel utilization efficiency is the combustion heating equipment efficiency and is abbreviated as AFUE. AFUE typically ranges from about 78 to 96% AFUE.

Higher AFUE ratings indicate more efficient equipment

Basic Energy Units

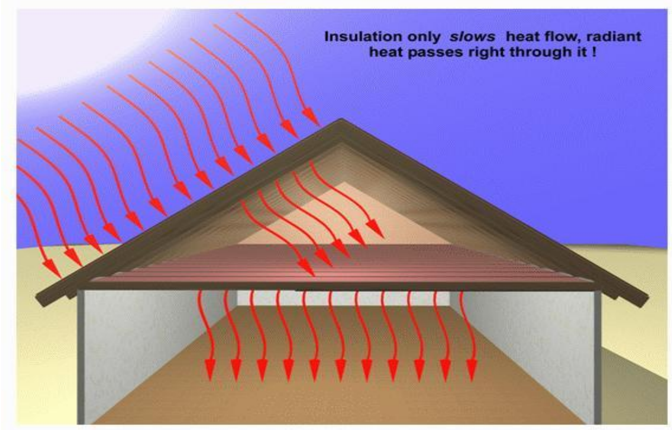
- **British Thermal Unit (BTU):**
  - 1 BTU is the amount of heat energy required to raise the temperature of one pound of water by 1ºF, at sea level (It takes about 2,000 BTUs to make a pot of coffee).
- **Joules:**

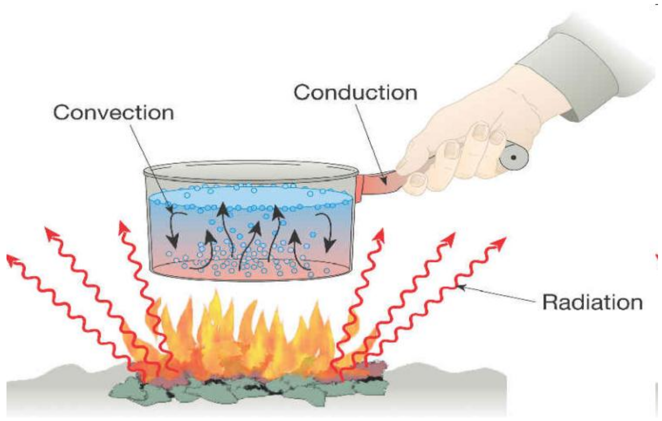
  1,000 joules = 1 Kilojoules = 1 BTU

  So, 2 million joules to make a pot of coffee!!
- Other measures such as CALORIES

Heat Energy and Heat Flow

- Heat is a form of *energy*
- Flows in 3 ways:
  - CONDUCTION
  - CONVECTION
  - RADIATION





http://www.savenrg.com/norbs.jpg

https://www.cresis.ku.edu/iceicebaby/?m=201010

Date visited: 3/15/2011

CONDUCTION

- Higher to lower temperature (higher → lower *energy*)
- Transfer of heat through a substance, resulting from a difference in temperature between different parts
- Rate of heat flow between 2 regions is directly proportional to:
  - The temperature difference between them and
  - Conductivity of the substance
  - Contact area
- *Example*: Heat flowing from inside conditioned space to outside unconditioned space through walls

CONVECTION

- Warmer air rises
- **Convection is the mode of heat transfer in fluids** (air and liquids)
  - Air expands when heated—density decreases
  - Warmer air rises through the surrounding cooler air
  - Cooler air that flows in to replace the rising warmer air gets heated and also rises
  - Thus, a current called a convection current, becomes established in the air
  - The same principle causes land and sea breezes

RADIATION

Radiant energy is energy that comes from a source and travels through space (example: solar radiation)

- The *Sun*: The most common source of radiant energy
- The Sun's light and heat cannot reach us by conduction or convection because space is almost completely empty (VACUUM)

When sunlight hits the earth, its radiant energy is *absorbed* or *reflected*

Energy in Building Science

- A building's energy performance is closely related to other aspects of building science such as:
  - **MOISTURE**
  - **MOLD**
  - **VENTILATION**
- Changes in construction details for one purpose can have unintended effects
- When designing for energy one should consider moisture and ventilation simultaneously
- In some states successful training programs for builders have been developed, which address these interrelationships

Moisture in Buildings

Excessive moisture in buildings, combined with favorable temperature conditions, can foster:

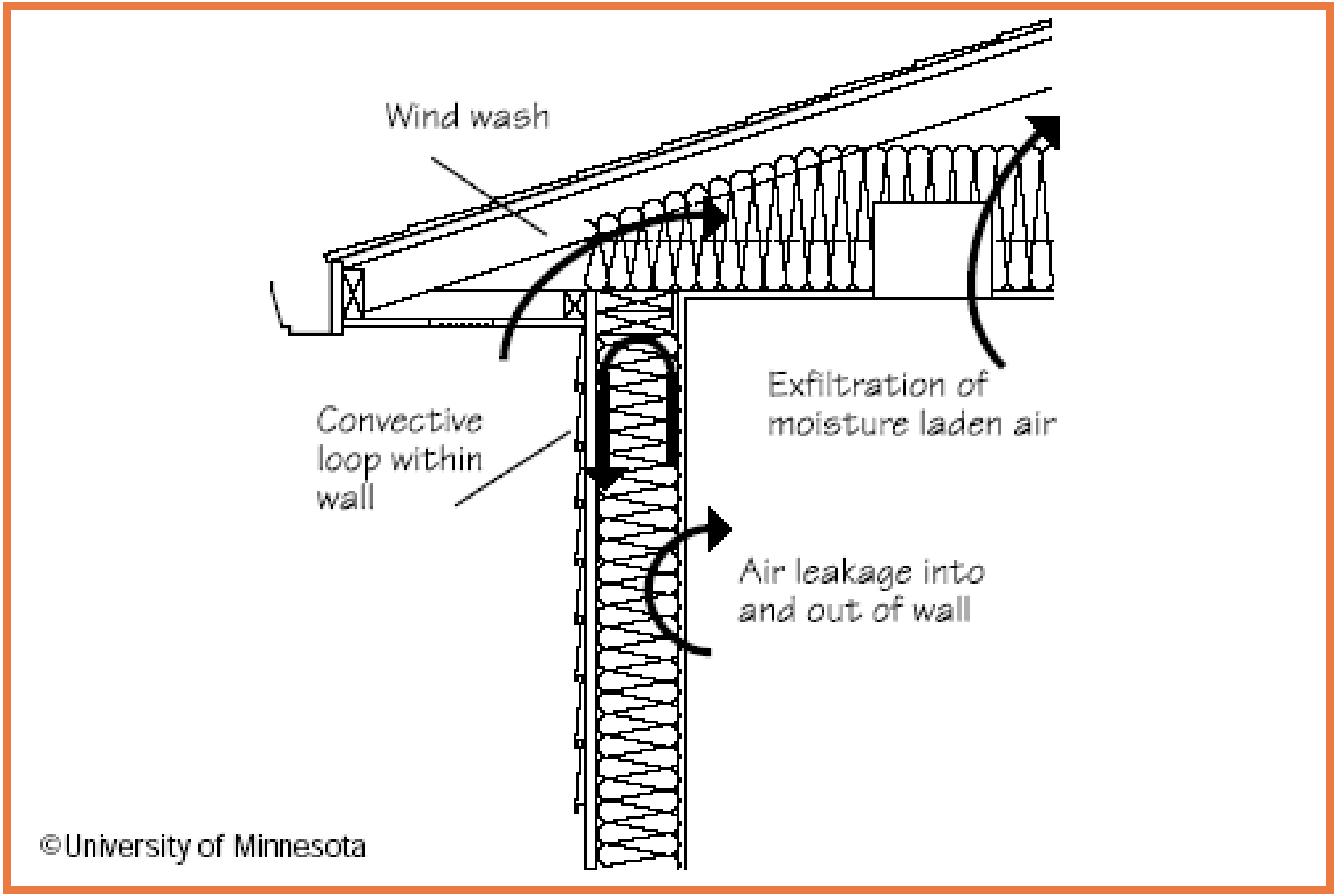
- **Mold growth**
- **Air quality problems**
- **Health problems**
- **Decay of building materials and failure of the envelope**

According to EPA:

The key to mold control is moisture control

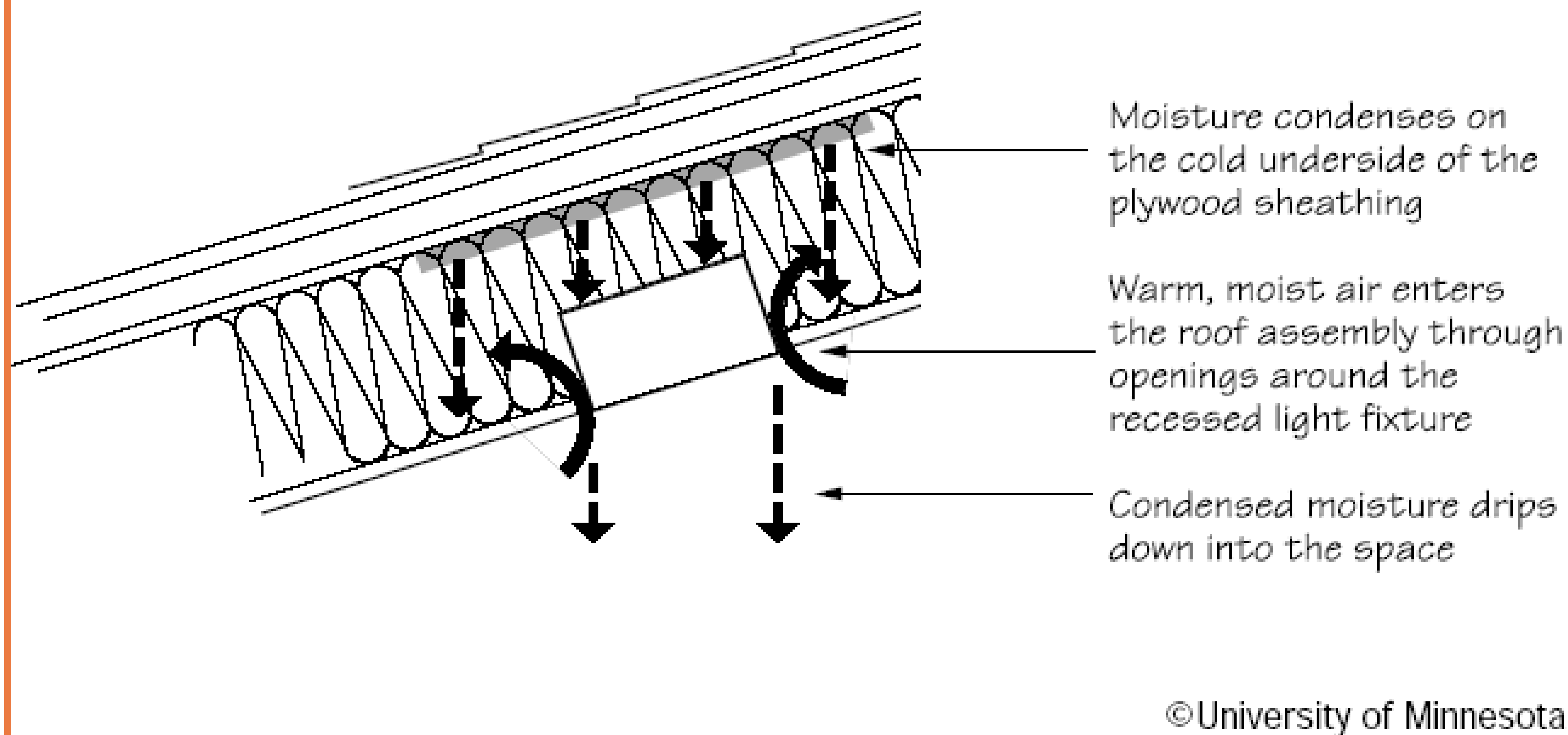
Envelope Air/Moisture Flows

Energy Processes



Source: Building Science Primer by Patrick Huelman, University of Minnesota, July 2004

Envelope Moisture Formation



Source: Building Science Primer by Patrick Huelman, University of Minnesota, July 2004

Moisture Control

KEY COMPONENTS OF A COLD CLIMATE HOUSE

	Energy Saving	Moisture Control	Improving Air Quality
Continuous, warm-side air barrier	Secondary Benefit	Primary Benefit of Measure	Minor Effect
Full-coverage, warm-side vapor retarder	Secondary Benefit	Primary Benefit of Measure	Minor Effect
Full-coverage, optimal thermal insulation	Primary Benefit of Measure	Secondary Benefit	Minor Effect
Continuous, exterior-side weather barrier	Secondary Benefit	Primary Benefit of Measure	Minor Effect
Energy-efficient & condensation-resistant windows	Primary Benefit of Measure	Secondary Benefit	Minor Effect
Effective ground-moisture/soil gas control	Minor Effect	Primary Benefit of Measure	Secondary Benefit
Safe, efficient space heating & cooling	Primary Benefit of Measure	Minor Effect	Primary Benefit of Measure
Managed mechanical ventilation	Minor Effect	Primary Benefit of Measure	Primary Benefit of Measure
Low-toxicity materials, finishes & furnishings	Secondary Benefit	Minor Effect	Primary Benefit of Measure
Efficient & safe appliances & lighting	Primary Benefit of Measure	Minor Effect	Secondary Benefit

Primary Benefit of Measure — Secondary Benefit — Minor Effect

Source: Building Science Primer by Patrick Huelman, University of Minnesota, July 2004

Ventilation

- Outdoor air ventilation addresses most indoor air quality issues:
  - Sick Building Syndrome
  - Moisture and Mold Problems
  - Second-hand Tobacco Smoke
  - Material Out-gassing
  - Multiple Chemical Sensitivity

- Good ventilation dilutes pollutants
- Ventilation can increase energy consumption, which can be mitigated by the use of heat exchangers

Source: 'Ventilation Basics and Beyond', Presentation made by Jeff Tiller at 2004 National State Building Energy Codes Conference

Why Ventilate?

- **Moisture control**
  - Reduce excessive moisture harmful to the building structure
  - Reduce excessive moisture that is a source of mold and mildew growth
- **Eliminate odors and pollutants** that are harmful to human health

Source: 'Ventilation Basics and Beyond', Presentation made by Jeff Tiller at 2004 National State Building Energy Codes Conference

END

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