Energy Efficient Commercial Buildings

Opportunity or Challenge?

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RESNET Conference 2006

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EPAct 2005 Tax Credits for Commercial Buildings

- Summary:
  - Up to $1.80 per square foot tax deduction
  - 50% reduced energy use beyond ASHRAE 90.1-2001
  - 3 Categories
    - HVAC and service hot water
    - Building Envelope
    - Lighting

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EPAct 2005 Tax Credits for Commercial Buildings

- Qualifying Buildings
  - New buildings put into service* between January 1, 2006, and December 31, 2007
  - Buildings may earn $0.60/sqft per system for upgrading one or two systems
  - Existing buildings can take credit if retrofits occur during qualifying period

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EPAct 2005 Tax Credits for Commercial Buildings

- Qualifying Buildings (cont.)
  - Buildings that fall within the scope of ASHRAE 90.1-2001
    - Commercial buildings of all sizes
    - Residential buildings 4 stories or higher

EPAct 2005 Tax Credits for Commercial Buildings

- Lighting Specifics (interior lighting)
  - Must use bi-level controls
  - May qualify for pro-rated deduction for partial performance
    - $0.30/sqft for buildings (or portions of buildings) that achieve 25% lighting savings over 90.1-2001 lighting power density requirements
    - Incentive increases progressively to $0.60/sqft for 40% improvement

EPAct 2005 Tax Credits for Commercial Buildings

- Process
  - Building design, system evaluation, energy modeling, and verification must be conducted by a qualified third-party authority
  - Implementing regulations to be developed by the Treasury Department with input from DOE
  - Minimum requirements: evaluation of plans and final inspection

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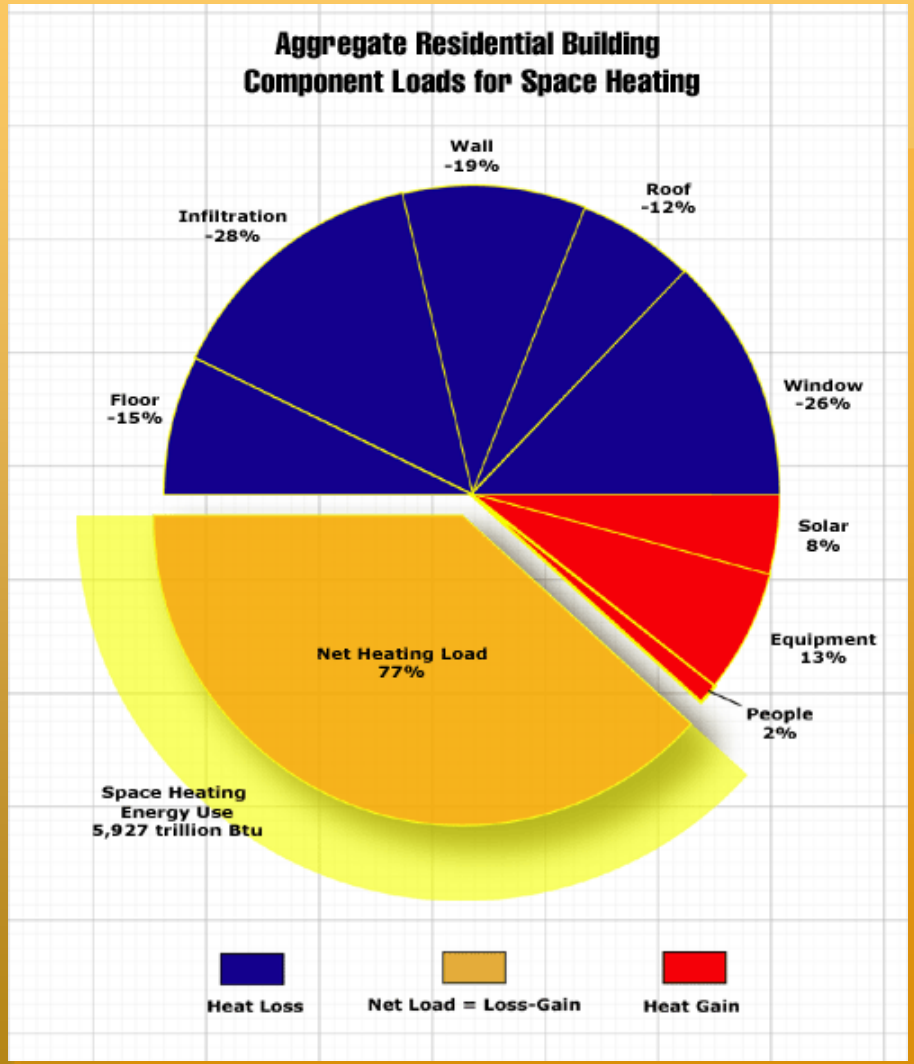
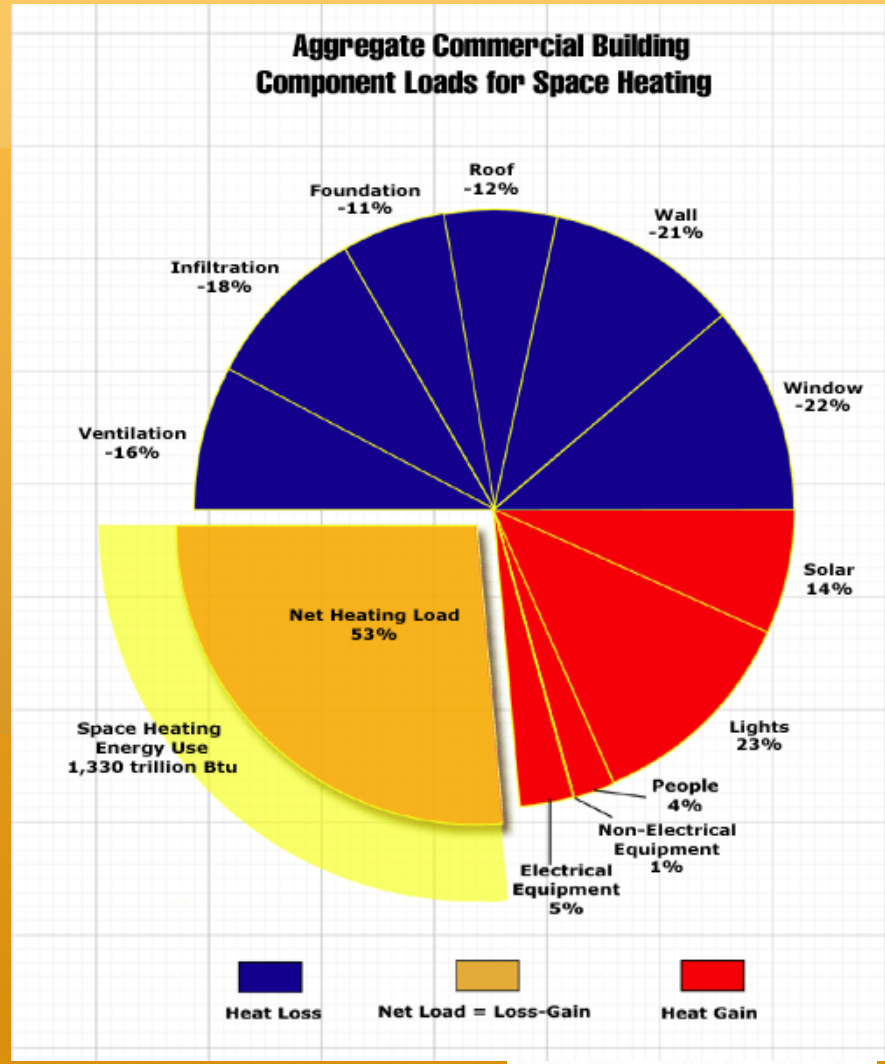
Certification Requirements

- Methods of calculating and verifying energy and power costs
- Use of qualified software
- Inspection and testing procedures
- Qualification of person doing evaluation and inspection (Energy Consultant)

Component Loads: Heating





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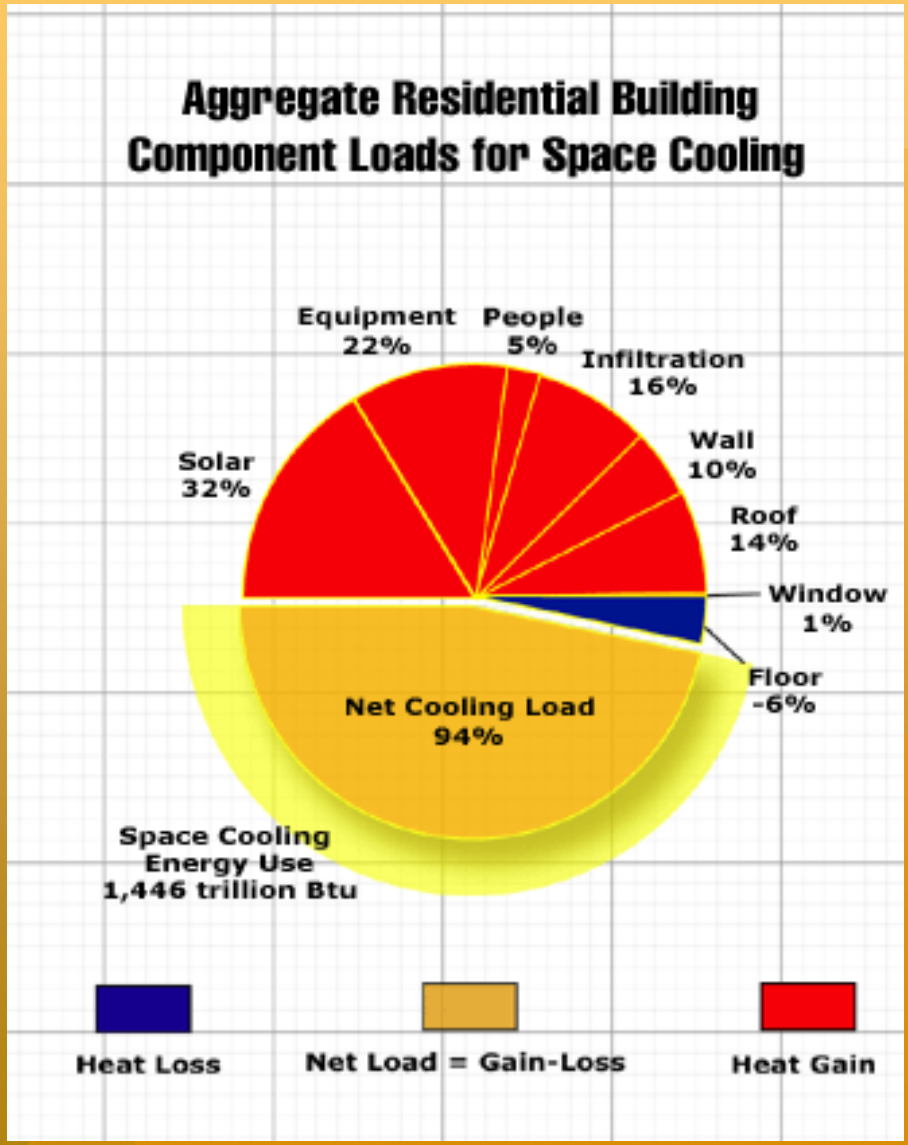
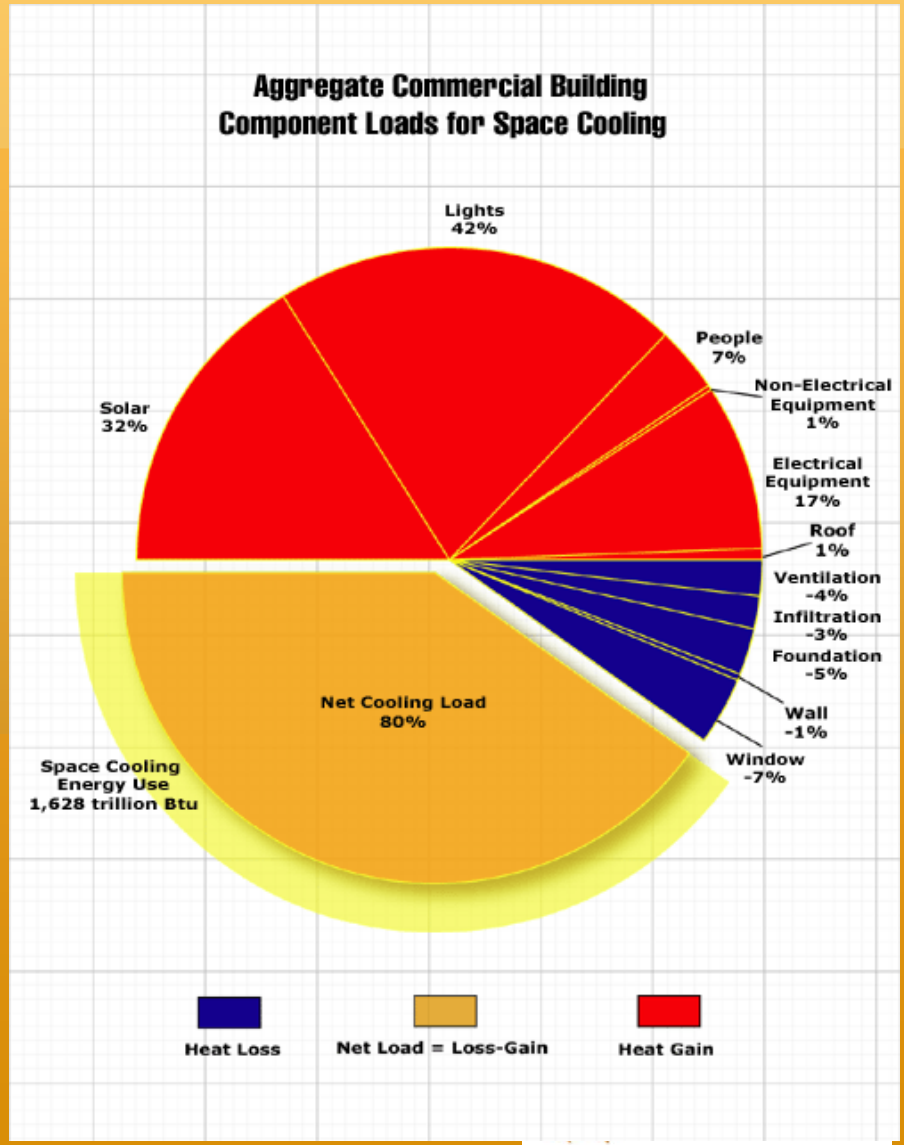
Source: EERE

Component Loads: Cooling





Source: EERE

Can HERS Raters Make the Leap to Commercial?

- Challenges
  - Different construction types
  - Different systems and equipment
  - Different occupancy demands
  - Working with design teams
  - Ownership and decision-making
  - Different codes and standards
  - Different modeling requirements

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Construction Types

- Steel Framed
- Block or block and brick
- Concrete – plank or slab
- Others…

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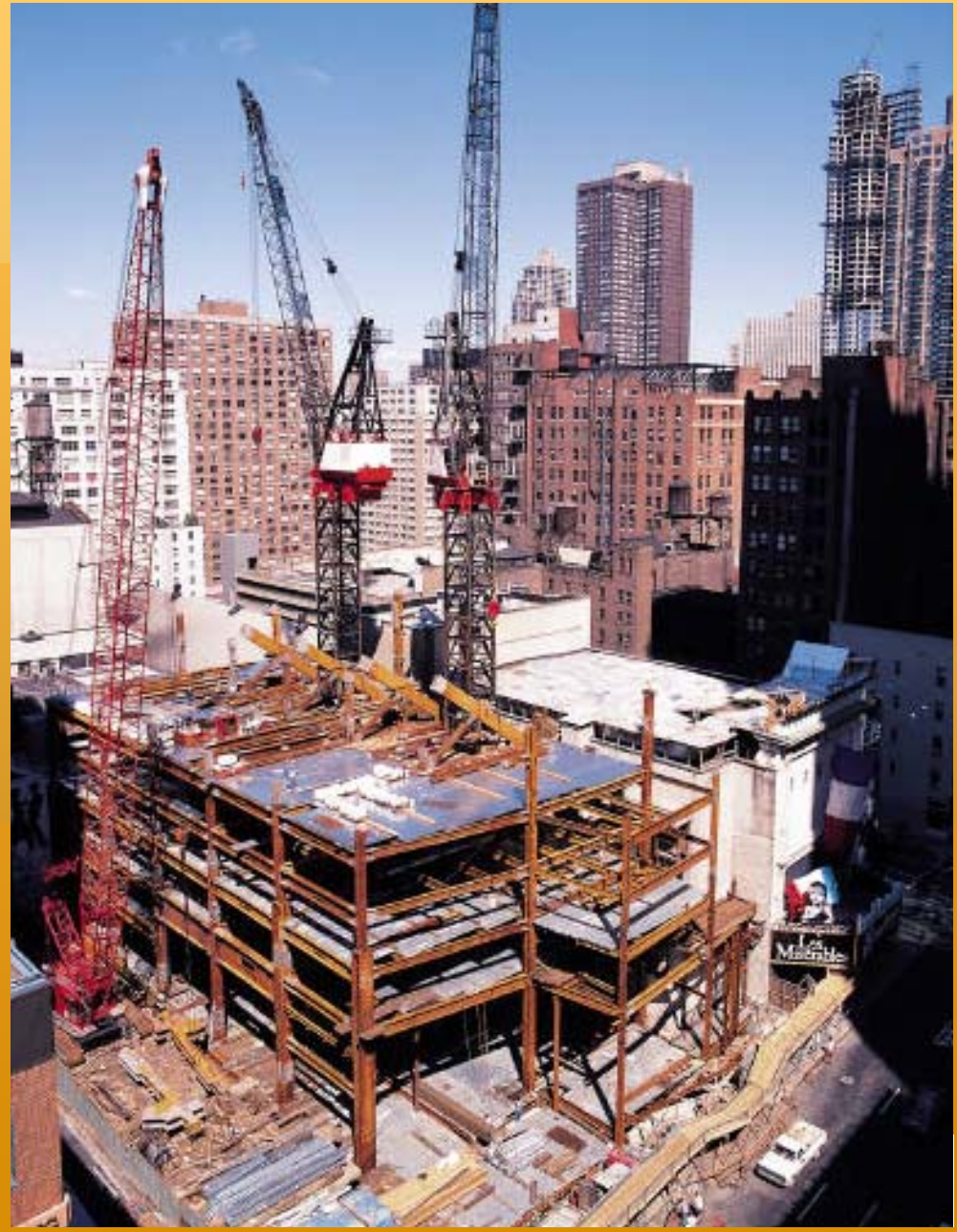
Construction Types

- Impacts on Energy Efficiency:
  - Selection of insulation materials
  - Insulation design and installation details
  - Air sealing methods and materials
- Modifications to envelope specifications requires coordination with design team
  - Aesthetic issues
  - Floor area impacts
  - Wall/window relationship
  - Relationship to heating/cooling loads, HVAC sizing and design

Envelope

- Eligible Measures:
  - Improved insulation
  - Improved windows
  - Air sealing?



Systems and Equipment

- HVAC
  - Heating
    - Central boilers with fan-coil units
    - Unitary heating equipment
  - Cooling
    - Central chillers with fan-coil units
    - Unitary cooling equipment
  - Ventilation
    - Ventilation requirements based on occupancy types
    - Off-cycle timers, dampers,etc.
- Service hot water maker and distribution

Systems and Equipment

- Energy Efficiency Improvements
  - Improved plant efficiency
  - Improved distribution efficiency
  - Improved controls
- Design team issues:
  - Changes to engineering spec's
  - Sizing
  - Distribution design
  - Modified zoning and/or control settings

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Systems and Equipment

- Eligible measures:
  - Cooling equipment
  - Water heating equipment
  - Controls
  - Reduced distribution losses from ducts and fans
  - Reduce or eliminate simultaneous heating and cooling
  - Low pressure duct systems

Lighting

- Lighting
  - IESNA requirements for lumen output based on occupancy type and task
  - Integrated lighting design
    - General vs. task lighting
    - ASHRAE 90.1 LPD requirements
    - Controlling brightness, color, glare
    - Controls (bi-level controls required for tax incentive), additional credit for occupancy sensors, photocells, timers

Lighting

- Eligible Measures
  - Hardwired fixtures
  - Ballasts
  - Lamps
  - Lighting sources
  - Daylighting
  - Controls
- Not Eligible
  - Screw in CFL's
  - Exit Signs

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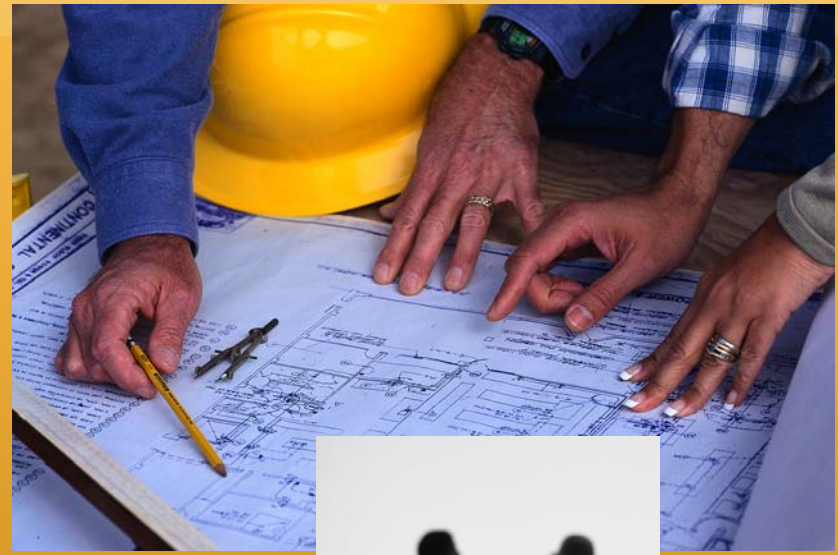
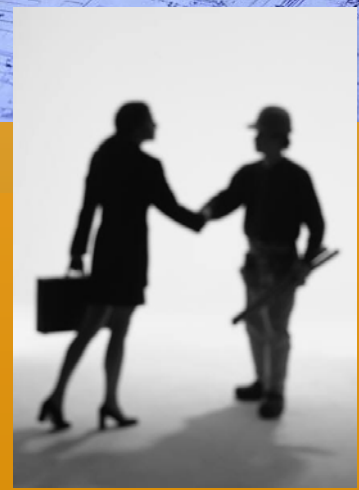
Occupancy

- Occupancy types affect:
  - Lighting requirements
  - Ventilation requirements
  - Scheduling of major comfort systems (HVAC, lighting)

Design Team

- Owner
- Developer
- Architect
- Engineers
- (Sub-contractors)
- Energy Consultant





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Ownership and Decision-making

- Residential
  - Single owner-occupant
  - Owner may also be GC
  - Owner may hire GC
  - Owner is fundamental decision-maker and ultimate occupant
- Commercial
  - Owner may or may not be occupant
  - Developer is probably not owner or occupant
  - Occupant may not be involved in design process at all
  - Decisions are made by owner and/or developer

Design Process

- Energy Consultant works with developer, architect, and engineers to develop design specifications that meet target energy performance (as modeled)
- Energy Consultant verifies that final design meets requirements and necessary details are included in bid specifications

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Design Process

- Architects and engineers need to be on board from the beginning and design spec's monitored throughout process
- The developer will incur "soft costs" associated with this process (meetings, communications, design revisions, etc.)

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Design Process

- Energy Consultant may participate in bidder's meetings
- In process inspections while building is under construction may be critical to ensure final performance
- Energy Consultant is responsible for checking commissioning reports for system performance as designed
- Energy Consultant may also provide some final inspection performance testing where commissioning is not part of the process

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Codes and Standards

- Commercial Code
- ASHRAE 62.1
  (Ventilation for Indoor Air Quality)
- ASHRAE 90.1
  (Energy Efficiency)

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Modeling

- Energy savings of 50% or more must be achieved compared to a reference building meeting the minimum standards of ASHRAE 90.1-2001
- Proposed calculation method:

  2005 California Non-residential Alternative Calculation Method Approval Manual

  http://www.energy.ca.gov/title24/2005standards

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Modeling

- Software
- DOE2 is the only modeling software referenced in the California calculation method
- Possible alternatives:
  - Energy Plus
  - Energy-10
  - Radiance (lighting design)
  - TREAT???

More Challenges

- ASHRAE 90.1 leaves room for interpretation on many baseline component assumptions
  - How will this be handled?
- Supply Issues – will high efficiency equipment be available?

Impact of Calculation Design Method

- Fuel neutral
- Intention is to include technologies not otherwise credited in ASHRAE 90.1 or California Title 24 standards

  (This will require supplemental calculation methods for specific technologies.)

Technologies Not Covered in Calculation Design Method:

- But intended to be allowable measures:
  - Natural ventilation
  - Evaporative cooling
  - Automatic lighting controls (photocells, occupancy sensors, timers)
  - Daylighting
  - Semi-conditioned spaces
  - Improved fan system efficiency, including reduced static pressure

Technologies Not Covered in Calculation Design Method:

- But intended to be allowable measures:
  - Advanced unloading mechanisms for mechanical cooling (e.g. variable speed compressors)
  - On site electrical generation (CHP, fuel cells, solar, etc.)
  - Wiring with lower energy losses than wiring satisfying 90.1 for building power distribution systems
  - Commissioning

Verification

- May require additional expertise beyond HERS Rater:
  - Commissioning of heating and cooling systems
  - Ventilation TAB contractor

What Costs are Eligible?

- Any costs associated with upgrading the building that may be capitalized:
  - Fees for energy consulting
  - Materials
  - Equipment
  - Labor
  - Recycling
  - Commissioning

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Achieving 50% Improvement

- Advanced Energy Design Guide for Small Office Buildings

  (ASHRAE special publication)

Provides guidance for achieving 30% improvement over ASHRAE 90.1-1999

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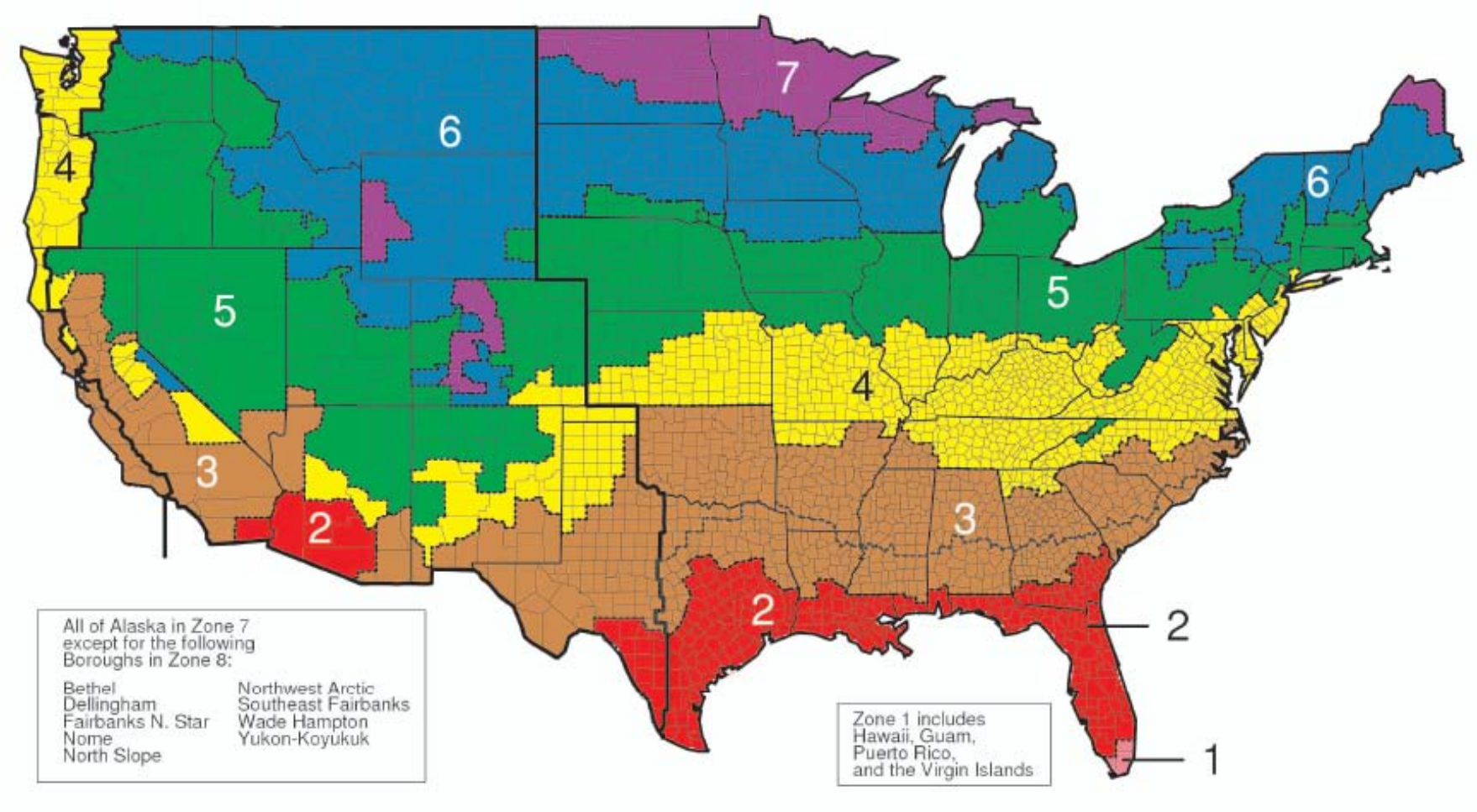
Climate Zones



U.S. DOE Climate Zones

Design Guide Example 1:
Zone 2 (San Antonio)

Component	Recommendation
Roof insulation above deck	R-15 c.i.
Attic	R-38
Mass Walls	R-7.6 c.i.
Frame Walls	R-13
Window to Wall Ratio	20-40%
Windows	U-0.45, SHGC 0.31
Lighting Power Density	0.9 Watts/sqft

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Design Guide Example 1:
Zone 2 (San Antonio)

- Component
  - AC < 5 tons
  - AC > 5 tons
  - Gas Furnace
  - Duct location
  - Duct insulation
  - Gas water heating
- Recommendation
  - 13.0 SEER
  - 11.0 SEER +
  - 80%
  - Interior only
  - R-6
  - .81 EF

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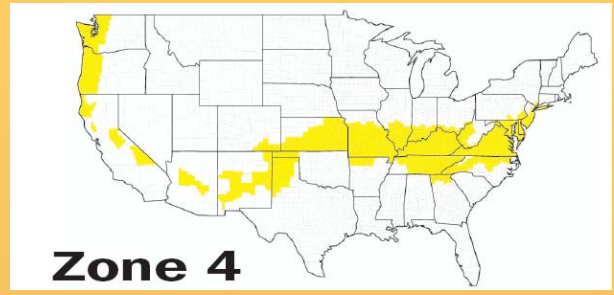
Design Guide Example 2:
Zone 4 (New York City)



Component	Recommendation
Roof insulation above deck	R-20 c.i.
Attic	R-38
Mass Walls	R-11.4 c.i.
Frame Walls	R-13 (+ R-7.5 c.i. for steel frames)
Window to Wall Ratio	20-40%
Windows	U-0.42, SHGC 0.46
Lighting Power Density	0.9 Watts/sqft

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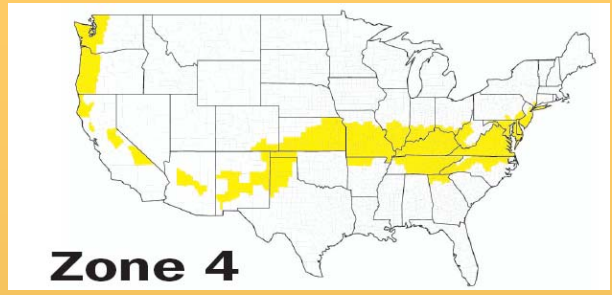
Design Guide Example 2:
Zone 4 (New York)



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  - 10.0 SEER +
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Lighting Power Densities

Building Type	90.1-2001	Aug 2003, add.
Hotel	1.7	1.0
Library	1.5	1.3
Multifamily	1.0	0.7
Office	1.3	1.0
Retail	1.9	1.5
Warehouse	1.2	0.8

MF Energy Star High Rise Pilot (NY)

- Developers receive up to $4/sqft incentive to cover soft costs (design phase) and hard costs (incremental cost of improved measures)
- ASHRAE 90.1-2004, Appendix G modeling method
- Appendix G is a cost-based approach, not Btu-based

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MF Energy Star High Rise Pilot (NY)

- Energy consultant costs: $50,000-100,00 per building
- Initial results: ~15% improved energy performance
- On-site generation will help

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Conclusions

- Many questions still unanswered (software, supplemental calculation methods, etc.)
- Current proposed standards are more rigorous than most HERS rating companies may be equipped to handle
- Who can?
  - Professional engineers
  - LEED compliance consultants
  - A few others

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Conclusions

- There's not enough time for the HERS industry to develop standards for commercial building compliance under current proposed rules
- Teaming arrangements with engineering firms may be feasible

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More information

- www.efficientbuildings.org
- www.energytaxincentives.org
- www.ashrae.org

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