

# Energy Efficient Commercial Buildings

Opportunity or Challenge?

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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

# 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

# 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

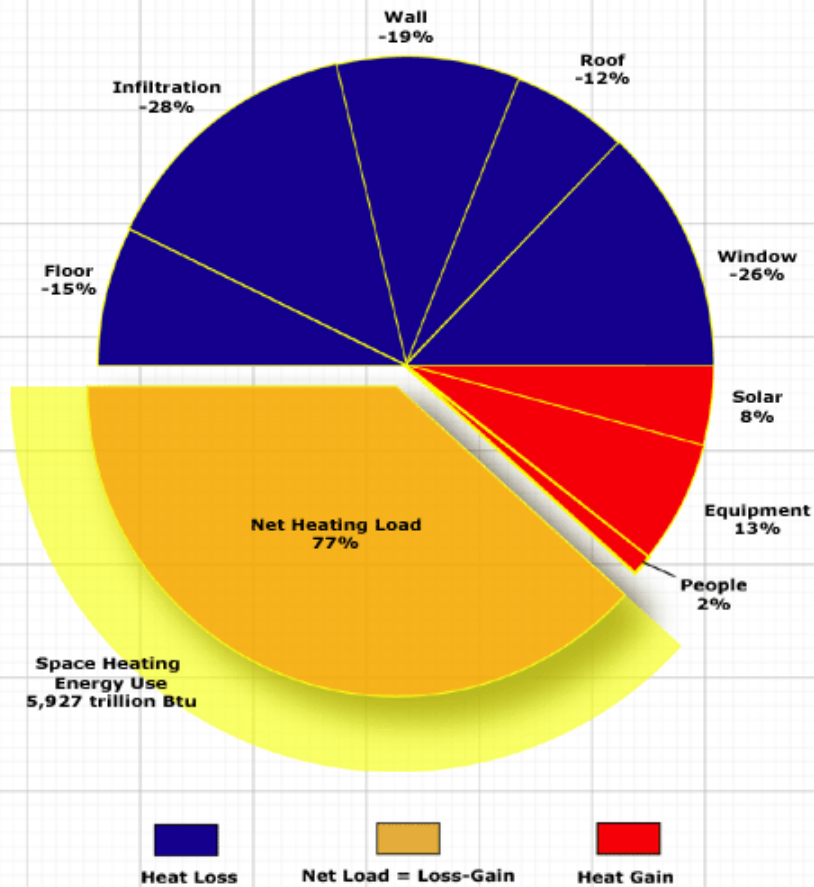
- Process
  - Building design, system evaluation, energy modeling, and verification must be conducted by a qualified third-party authority
  - Implementing regulations to be developed by the Treasury Department with input from DOE
  - Minimum requirements: evaluation of plans and final inspection

# Certification Requirements

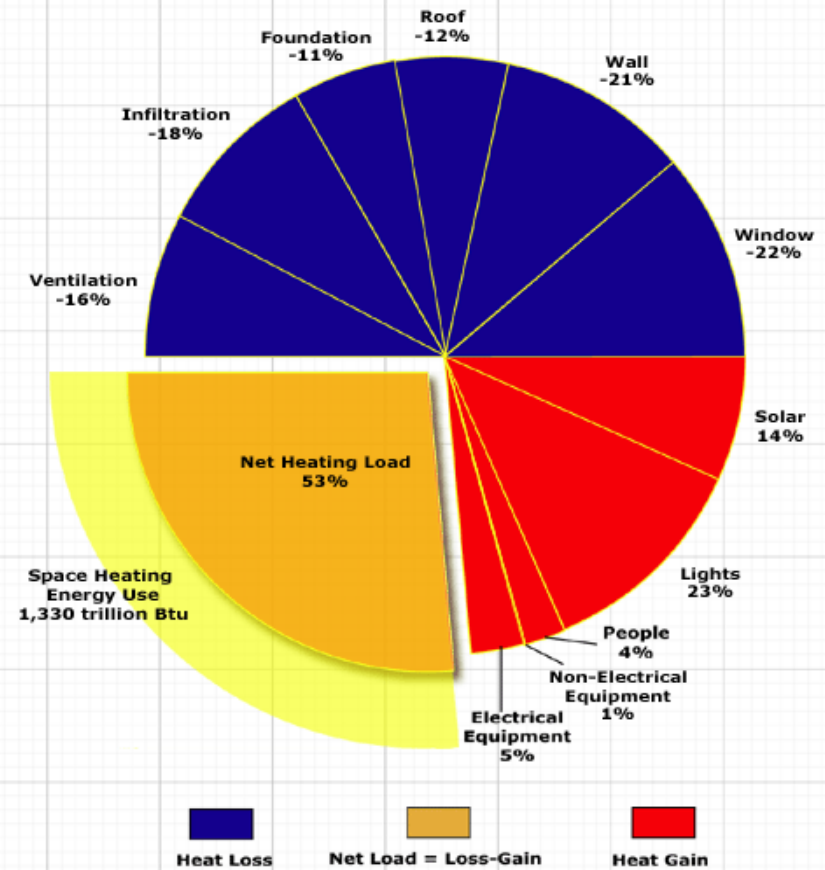
- Methods of calculating and verifying energy and power costs
- Use of qualified software
- Inspection and testing procedures
- Qualification of person doing evaluation and inspection (Energy Consultant)

# Component Loads: Heating

**Aggregate Residential Building Component Loads for Space Heating**

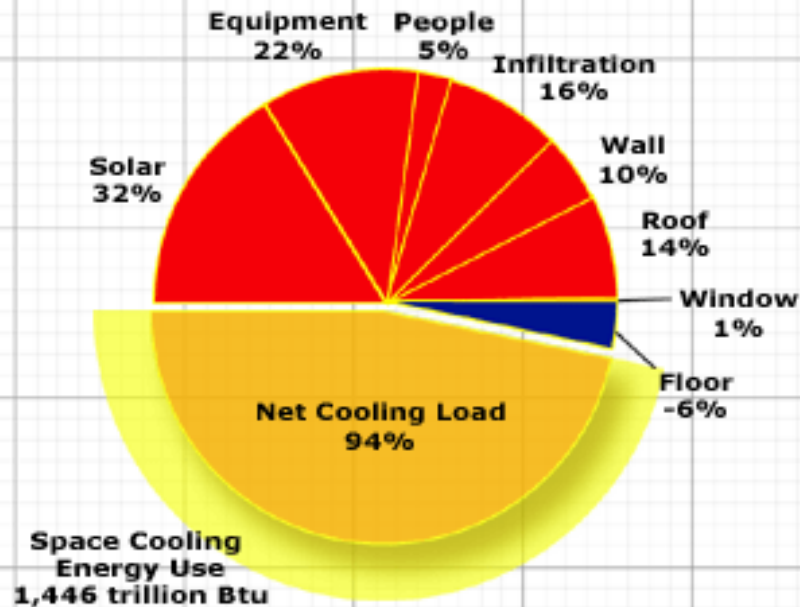


**Aggregate Commercial Building Component Loads for Space Heating**



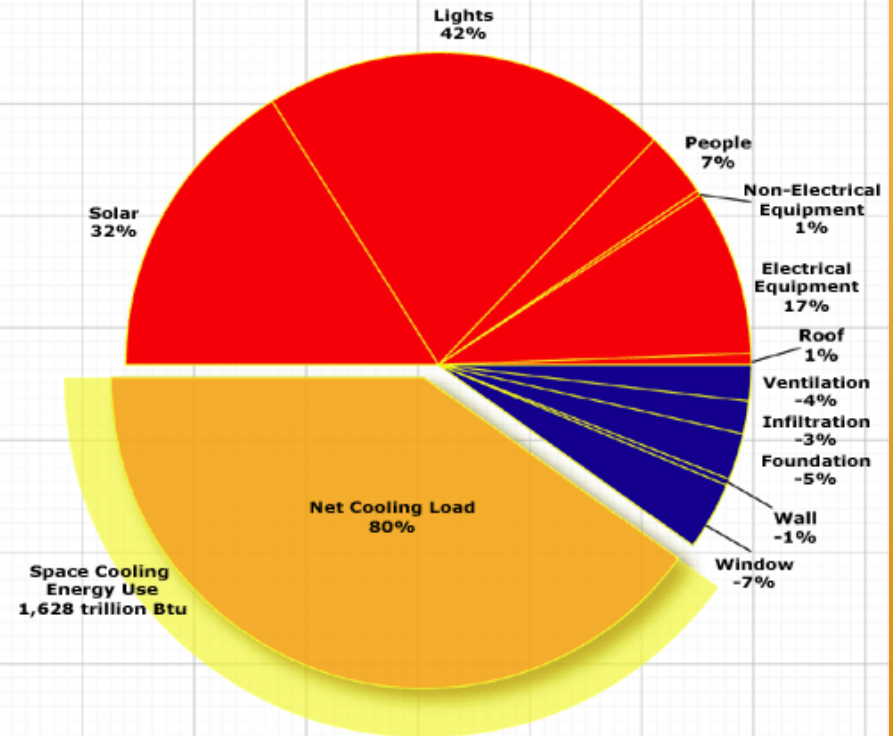
# Component Loads: Cooling

**Aggregate Residential Building Component Loads for Space Cooling**



Heat Loss      Net Load = Gain-Loss      Heat Gain

**Aggregate Commercial Building Component Loads for Space Cooling**



Heat Loss      Net Load = Loss-Gain      Heat Gain

# 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

# Construction Types

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



# 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



# 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



# 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



# 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

# 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.)

# 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

# Codes and Standards

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

# 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>

# 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?

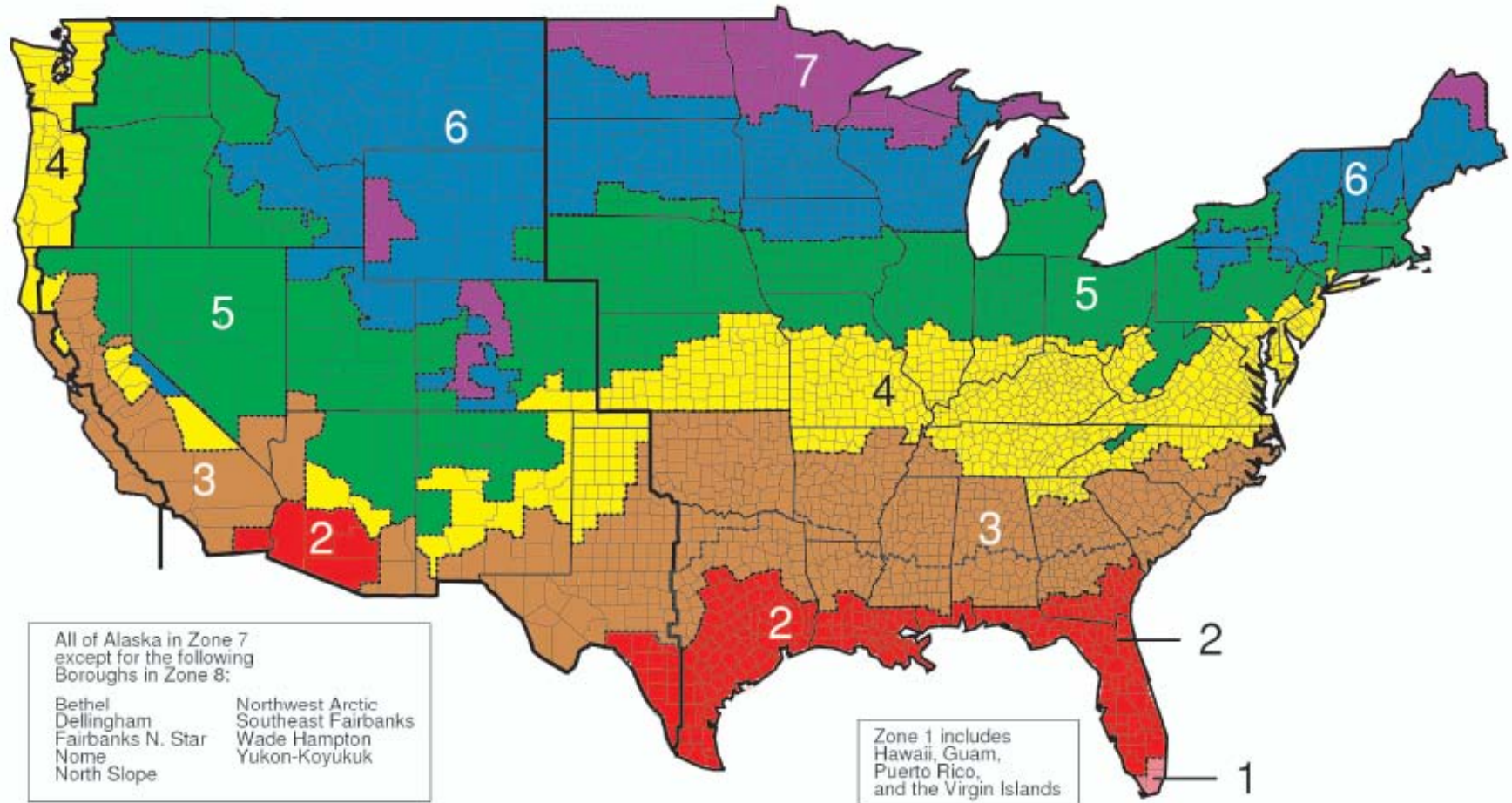
- Any costs associated with upgrading the building that may be capitalized:
  - Fees for energy consulting
  - Materials
  - Equipment
  - Labor
  - Recycling
  - Commissioning

# 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

# 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    |

# Design Guide

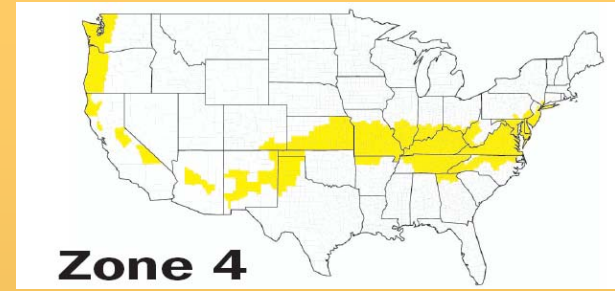
## Example 1: Zone 2 (San Antonio)



- 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

# Design Guide

## Example 2: Zone 4 (New York City)



### ■ Component

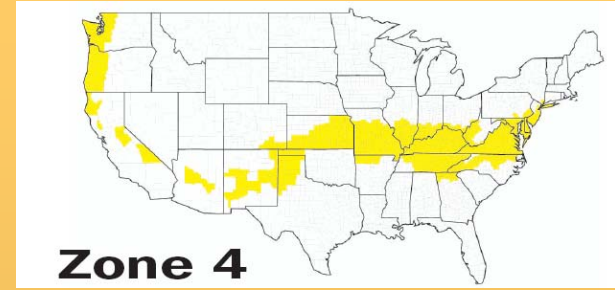
- Roof insulation above deck
- Attic
- Mass Walls
- Frame Walls
  
- Window to Wall Ratio
- Windows
- Lighting Power Density

### ■ Recommendation

- R-20 c.i.
  
- R-38
- R-11.4 c.i.
- R-13 (+ R-7.5 c.i. for steel frames)
  
- 20-40%
- U-0.42, SHGC 0.46
- 0.9 Watts/sqft

# Design Guide

## Example 2: Zone 4 (New York)



### ■ Component

- AC < 5 tons
- AC > 5 tons
- Gas Furnace
- Duct location
- Duct insulation
- Gas water heating

### ■ Recommendation

- 13.0 SEER
- 10.0 SEER +
- 80%
- Interior only
- R-6
- .81 EF

# 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

# 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

# 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

# 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



# More information

- [www.efficientbuildings.org](http://www.efficientbuildings.org)
- [www.energytaxincentives.org](http://www.energytaxincentives.org)
- [www.ashrae.org](http://www.ashrae.org)

**THOSE WHO  
THROW OBJECTS  
AT THE CROCODILES,  
WILL BE ASKED TO  
RETRIEVE THEM**



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