Building Energy Quotient™

ASHRAE's Building Energy Labeling Program

ASHRAE

Presentation to the Montreal Chapter

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Presidential Member

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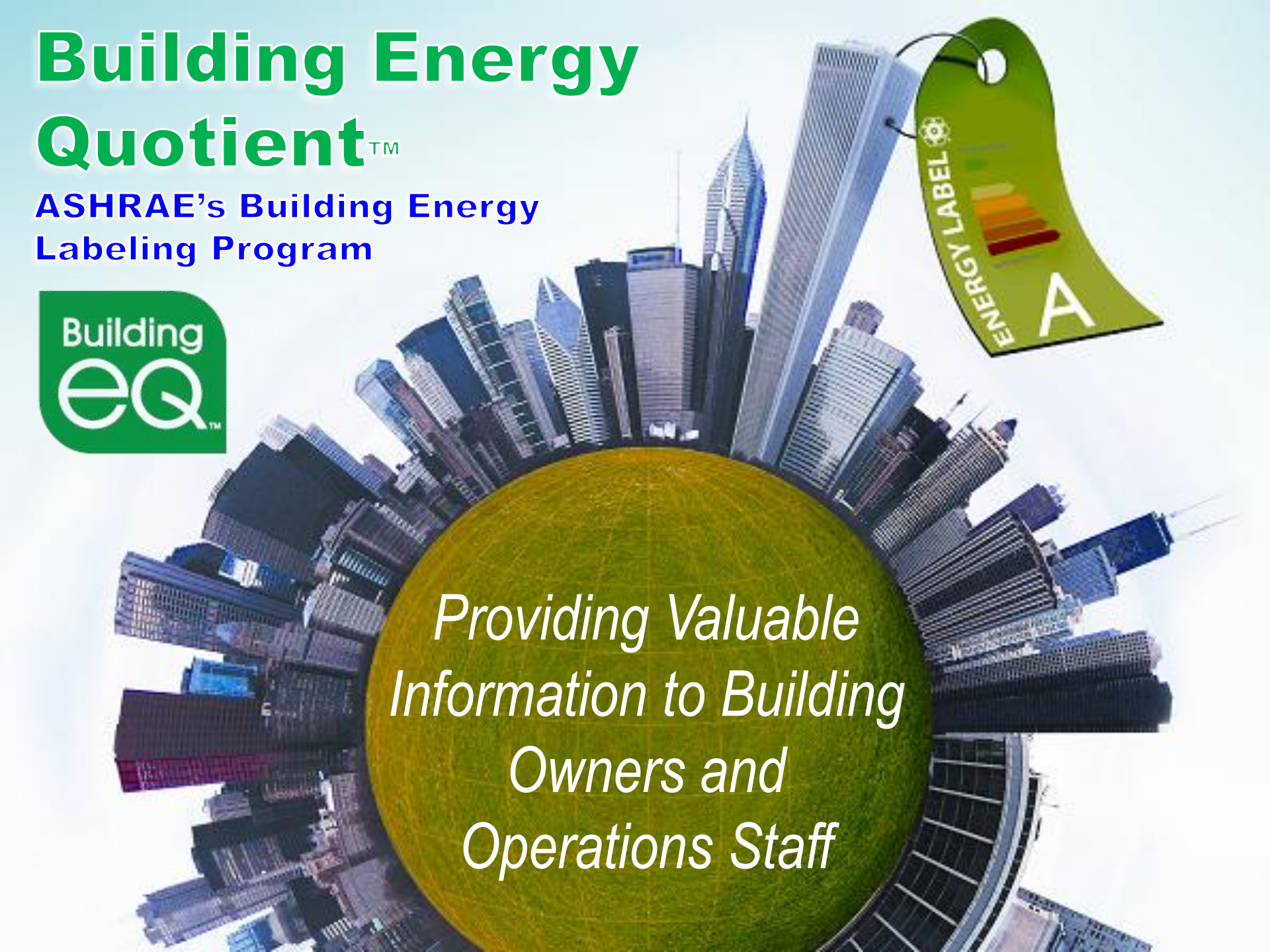
ASHRAE's Building Energy Labeling Program

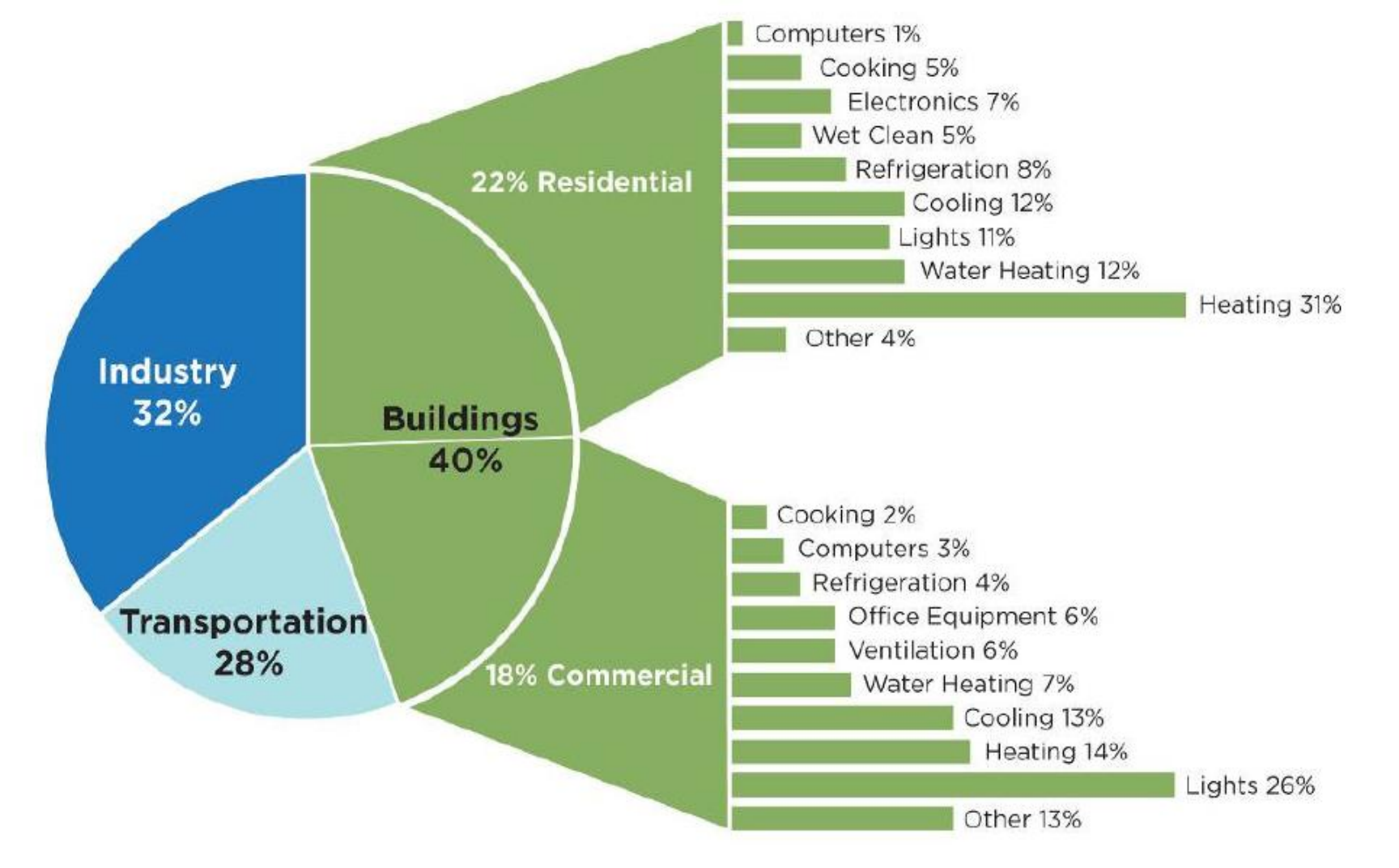


Objectives of the Program

- Promote the value of energy efficiency in the real estate market
- Enhance ability to identify energy efficiency measures to help improve operations
- Drive buildings towards Net Zero Energy
- Provide clear communication to the public
- Ensure widespread use

Building EQ Labels

Figure 1: Energy Consumption



Energy Efficient Buildings
Key Factors for Success

- Raising Public Awareness
- Legislation and Incentive Action
- Technical Issues Design & Construction
- Procedural Issues – Commissioning
- Operation and Maintenance
- Measurement and Verification
- Occupant Behavior – Changing Mindsets and Culture

Energy Codes Development

Standard 90.1			
Year	EUI Btu/Sq.Ft.Yr	Change	Rate per Year
Pre 1973	88,000	-	-
1975	65,000	27%	-
1989	55,900	14%	1%/yr
1999	53,300	4%	0.40%/yr
2004	43,250	19%	3.8%/yr
2010	30,600	30%	5.0%/yr
2016	21,625	30%	5.0%/yr
2020	17,300	20%	5.0%/yr
	Excludes Plug and Process Loads		

Energy Reduction Projections for ASHRAE Standards & AEDGs

Our Path Forward

How Hard is it to Achieve a 30% Reduction?

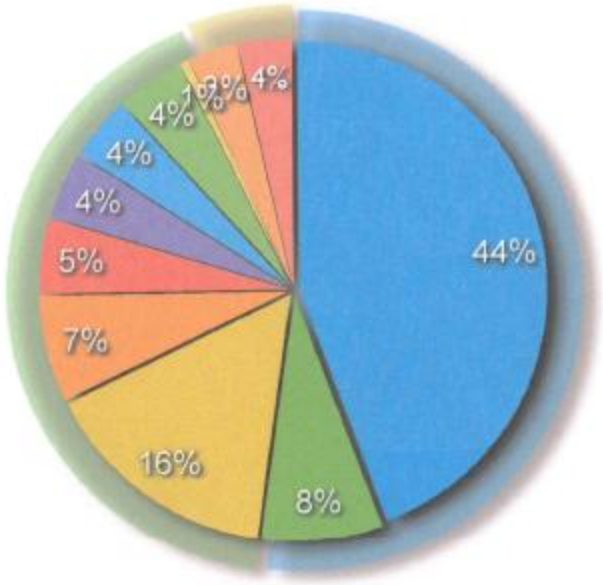
How About a 50% Reduction

It is all about Regulated and Unregulated Loads

It is all about Raising Awareness and Understanding

Residential Building Energy

- 2006 U.S. Buildings Site Energy End-Use Splits



- Heating 44%
- Cooling 8%
- Water Heating 16%

68% Regulated

- Lighting 7%
- Electronics 5%
- Refrigeration 4%
- Wet Clean 4%
- Cooking 4%
- Computers 1%
- Other 2%
- Adjust to SEDS 4%

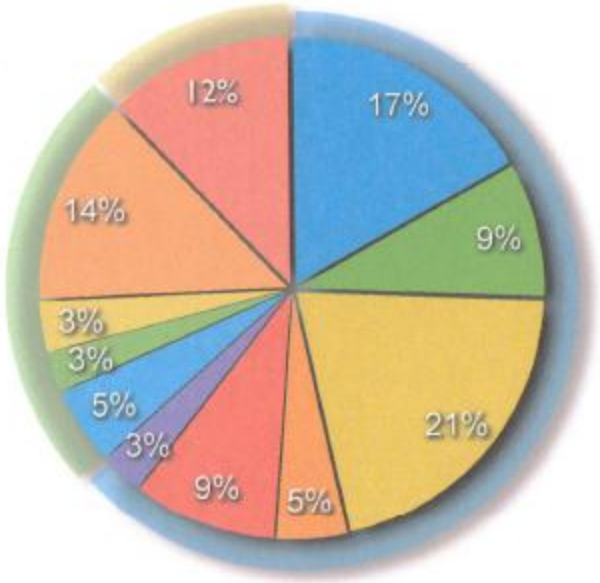
28% Unregulated

A 30% total reduction would require a 44% reduction in regulated loads
A 50% total reduction would require a 74% reduction in regulated loads

Source: *Buildings Energy Data Book 2009*, http://buildingsdatabook.eere.energy.gov/Default.aspx Table 2.1.5

Commercial Building Energy

- 2006 U.S. Buildings Site Energy End-Use Splits



- Lighting 17%
- Cooling 9%
- Heating 21%
- Ventilation 5%
- Water Heating 9%
- Refrigeration 3%

64% Regulated

- Electronics 5%
- Computers 3%
- Cooking 3%
- Other 14%

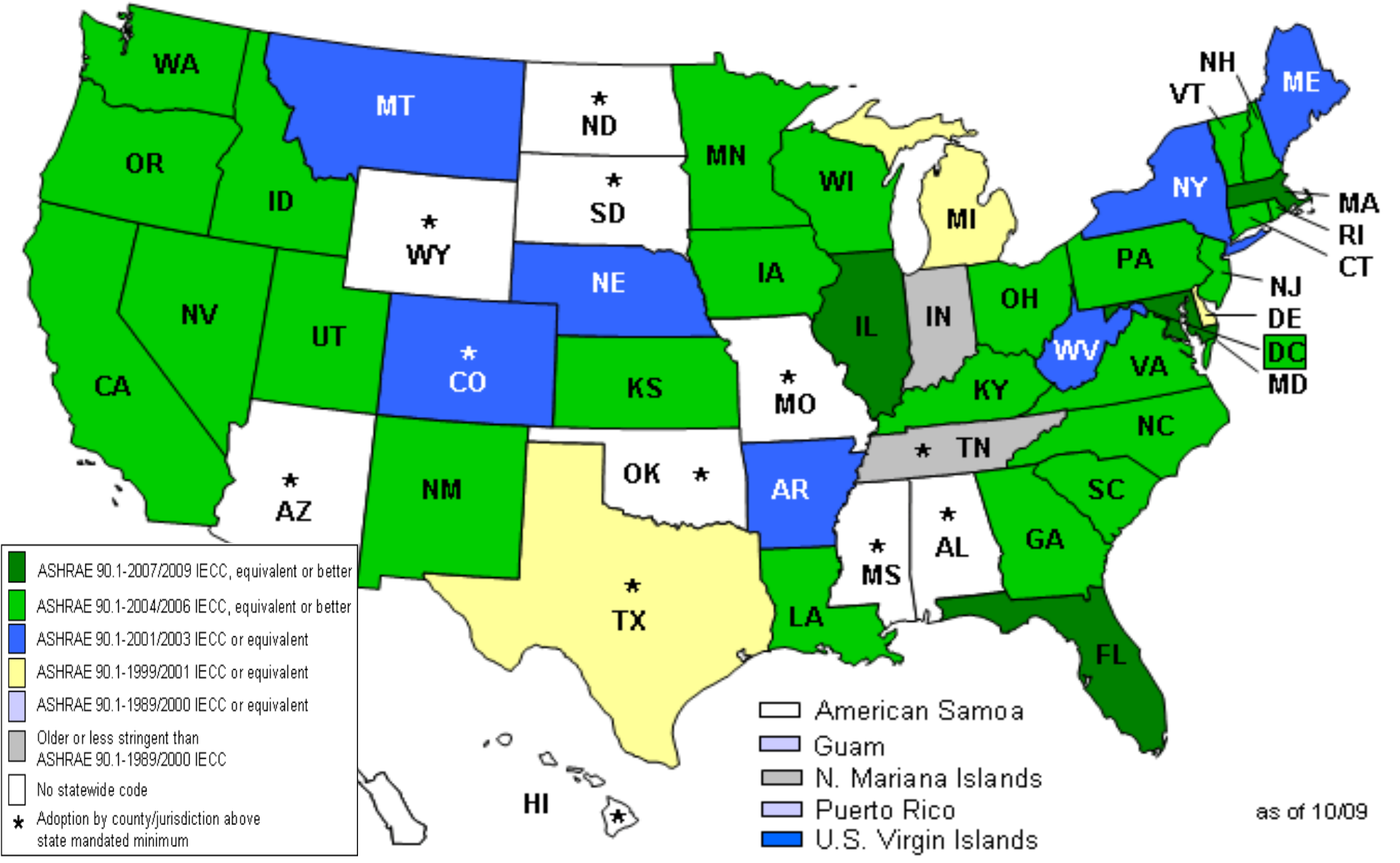
25% Unregulated

- Adjust to SEDS 12%

A 30% total site reduction would require a 47% reduction in regulated loads
A 50% total site reduction would require a 78% reduction in regulated loads

Source: *Buildings Energy Data Book 2009*, http://buildingsdatabook.eere.energy.gov/Default.aspx Table 3.1.4

Current State Adoptions of Standard 90.1



What Do We Need:-

- More Stringent Building Codes - Uniformly Applied and Enforced
- Move towards Performance Based and Outcome Based Energy Codes.
- Higher Energy Costs Including Peak Load Shaving and Demand Control
- Possible Carbon Tax

Increasingly the Issues will not be Technical nor will they be Political or even Economic!

We need to change Occupant Behavior, Mindsets and Culture

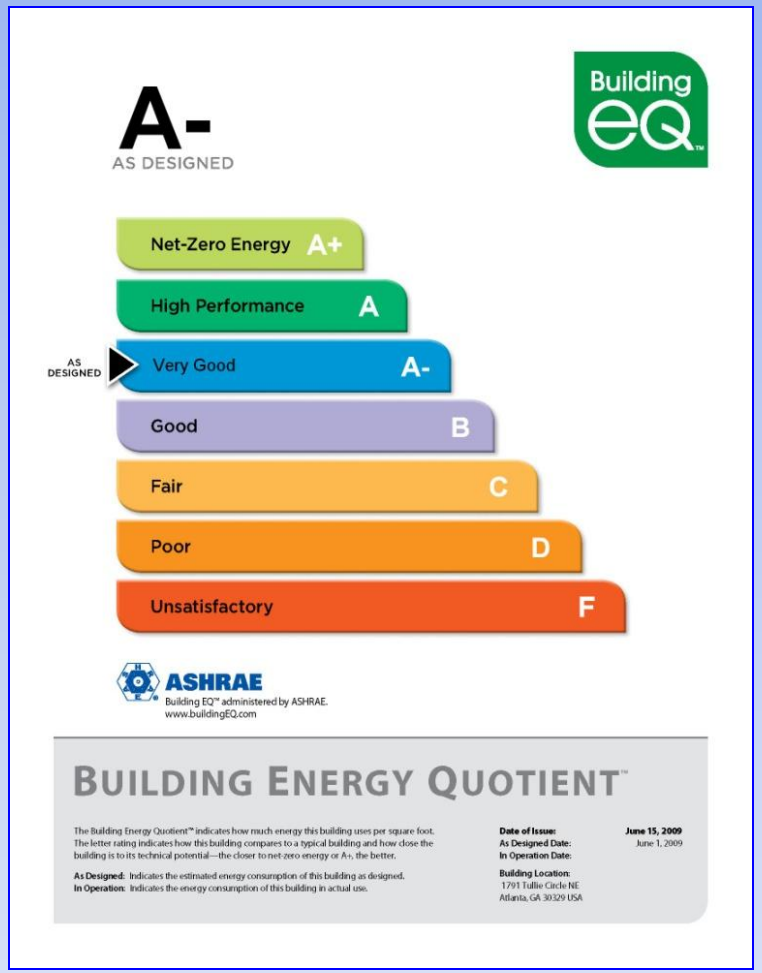
- Plug and Process Loads in Buildings
- Lighting
- Thermal Comfort

- Raising Awareness
- Energy Costs and Availability
- Environmental Awareness
- Legislation and Code change
- Culture of Sustainability

Measurement and Verification

- Information is Key to Success
- Metering and Sub Metering
- Graphical Displays
- Building Energy Labeling

Building Energy Labels Provide. . .

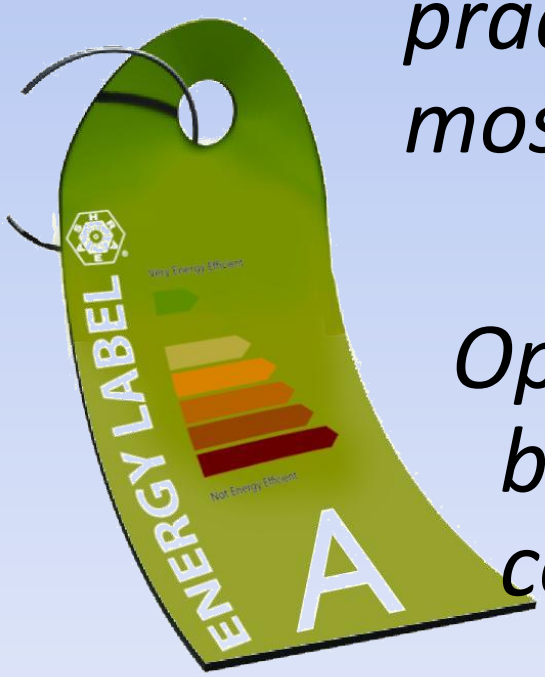


- Information on the potential and actual energy use of buildings
- Feedback to building owners and operators on how their building is performing
- Insight into the value and potential long-term costs of a building
- Differentiation in the marketplace

Building Energy Labels Provide. . .

Market-based forces to influence energy efficiency investment opportunities

Flexibility in the technology and practice investments that make the most sense for your building

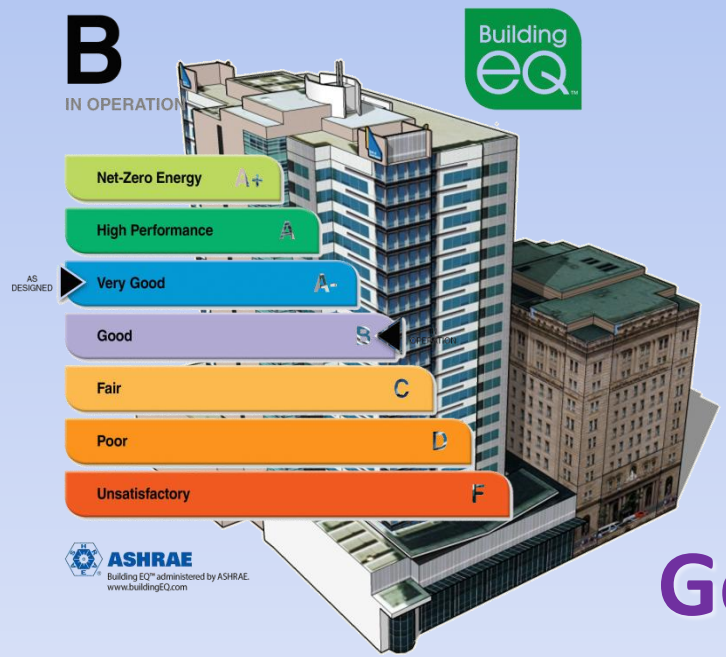


Opportunities to differentiate your building in a technically sound and consistent manner

Why Now?

As the nation looks to reduce its energy use, reliable and consistent information is the critical first step in making the necessary choices and changes

These Buildings are "Green"
How Efficiently Do They Use Energy?



This Building has a Good Energy Quotient

Why Now?

- Mandatory labeling requirements already in place:
  - European Union, Japan and Australia
  - California
  - Washington, DC
  - Austin, TX

Building owners need a technically sound label and certificate that can serve as a consistent model for such mandatory programs.

Building EQ Information Provided

- Label - Two part Label – Asset and Operational
- Certificate
- Documentation

Providing Relevant Information to the Audience

- The **Label**:
  - Most visible component of the program
  - Simple to understand and targeted at the **general public**
  - Suitable for display in building lobbies and marketing materials
  - Would satisfy public disclosure requirements at the state and local level

Providing Relevant Information to the Audience

- The **Certificate**:
  - Technical information explaining the score on the label
  - Provide information useful to **building owners**, **potential owners and tenants**, **utilities**, and **operations and maintenance personnel**
  - Includes many value added features – **Energy Use, Load Demand Characteristics, Indoor Air Quality**

Providing Relevant Information to the Audience

- The **Documentation**:
  - Background technical information reflecting the information contained on the label and certificate
  - Useful information for **engineers**, **architects**, and technically savvy building owners or prospective owners in determining the current state of the building and opportunities for improving its energy use

What types of Ratings can Buildings Receive?

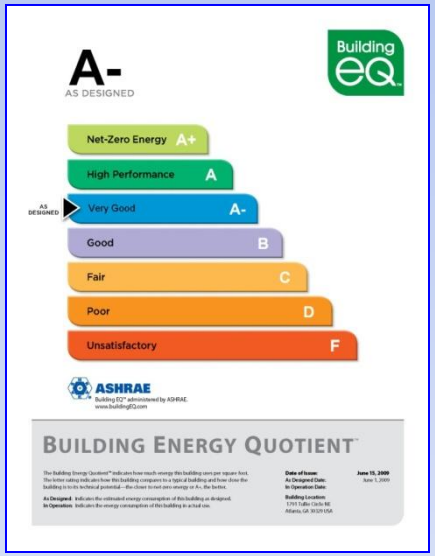
- The ***As Designed Rating*** (asset) provides an assessment of the building based on the components specified in the design—including mechanical systems, building envelope, orientation, and daylighting. The asset rating will be based on the results of a building energy model.
  - Applicable to both new and existing buildings
  - Can be utilized to make choices between potential building designs

What types of Ratings can Buildings Receive?

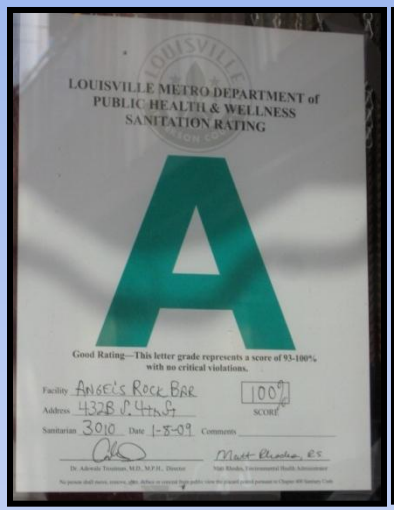
- The ***In Operation Rating*** (operational) provides information on the measured energy use of a building and is based on a combination of the structure of the building and how it is operated.
  - Applicable for existing buildings and after 12-18 months of operation for new buildings with full metered energy data
    - Site Visits Required to Verify Energy Use and IEQ
    - Provides Information on Potential Energy Improvements

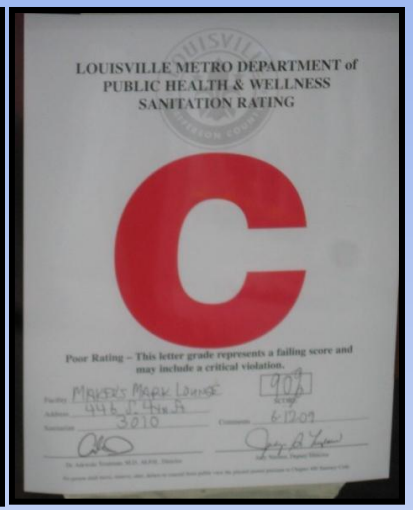
Operational Rating How it works

- Dimensionless Scale
  - Top at 0 for Net Zero Energy
  - Median score set to median EUI of CBECS buildings
- Assessor Workbook
  - Building Characteristics
  - Energy Calculations
  - IEQ Certification
  - System Energy Breakdown



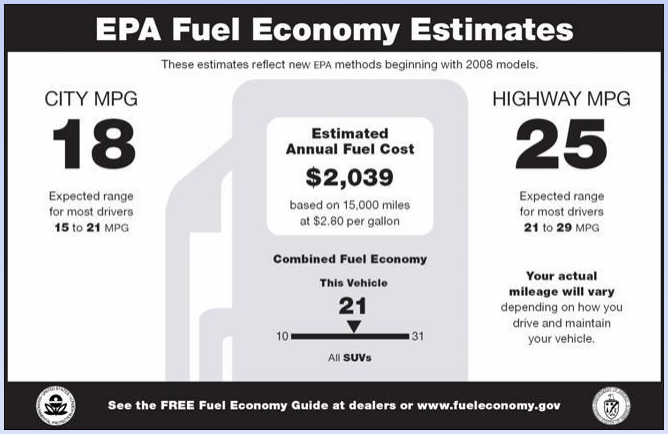
Informing Consumers to Allow Educated Choices is Not New





Louisville, KY Restaurant Sanitation Ratings

Car Fuel Economy Estimates



Nutrition Facts Label

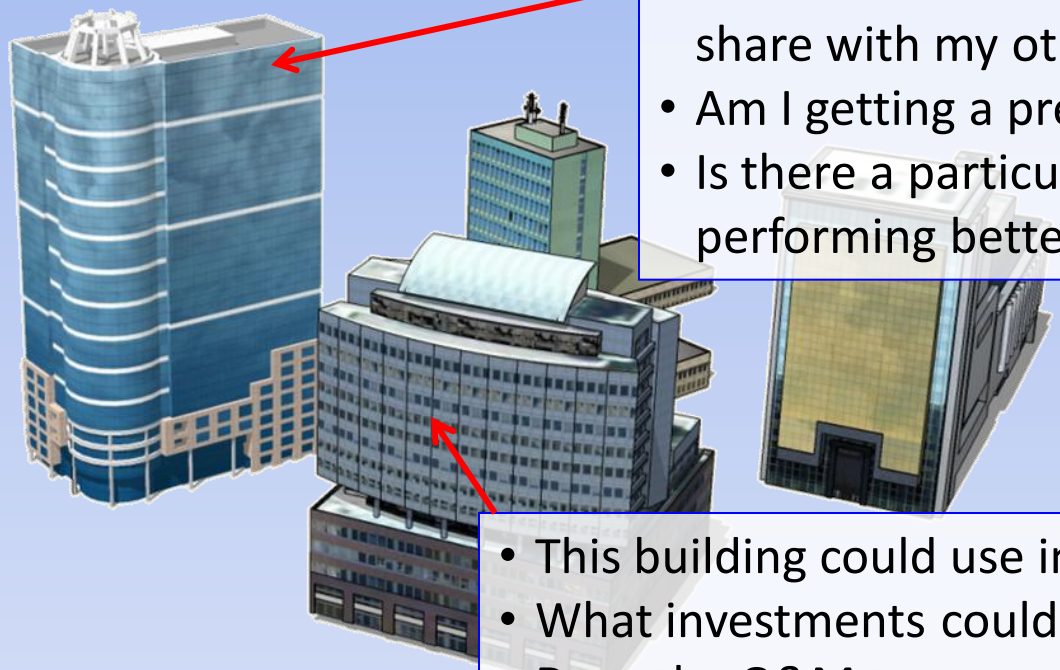
2003 CBECS[1] Weighted Mean Energy Use Intensities[2] by Subsector and Climate Zone[3,4]: IP Units kBtu/ft^2.yr

Subsectors	Climate Zones														
	All	1A	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	6A	6B	7
All	90	74	72	114	89	70	62	95	108	99	104	87	89	97	71
Office/professional	93	42	82	72	88	70	58	97	143	95	107	66	110	114	68
Nonrefrigerated warehouse	42	22	16		22	21	20	39	29	37	79	60	37	58	33
Education	83	52	73	160	82	74	105	102	38	58	87	79	90	90	84
Retail (except malls)	74	61	93	129	60	50	31	65	100		88	80	93	97	102
Public assembly	94	75	60		112	48	45	110	44	249	103	97	88	102	97
Service	77	60	53		49	61	27	82	83		80	101	88	99	65
Religious worship	44		31		28	31		47	56		52	39	53	34	
Lodging	94	81	91		98	57		92	264	545	89	65	108	93	68
Food services	258	393	208		423	393	82	234		260	258	228	203	236	192
Inpatient health care	249	200	246	360	205	257	204	248	163		294	245	240	235	256
Public order and safety	116		91		160	79		129			108	94	126	148	
Food sales	200		166		212	183	120	242			203	147	242		199
Outpatient health care	95	19	77		55	106		70	190		111	120	112	91	166
Vacant	21		4	47	4	6	0	40	3	60	21	93	22		55
Other	79		48		100	175		71	26		94	92	69	85	57
Skilled nursing	125		71		84	85		148			148	153	118	134	
Laboratory	305				242	170		600			370		268	115	
Refrigerated warehouse	99							120			68	51	62		

Why Should Owners be Interested?

Manage portfolios and identify investment opportunities

Existing Building Portfolios (*In Operation Rating*):



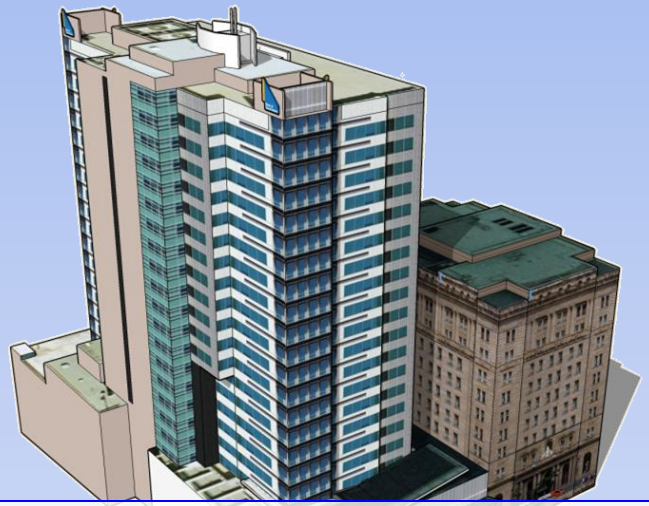
- What can the staff managing this building share with my other building managers?
- Am I getting a premium for this building?
- Is there a particular reason this building is performing better?

- This building could use improvement.
- What investments could improve energy use?
- Does the O&M team need additional training?
- Can re-commissioning or retro-commissioning address poor performance?

Why Should Owners be Interested?

Make educated decisions on new building design

Design Options for a New Building (*As Designed Rating*):



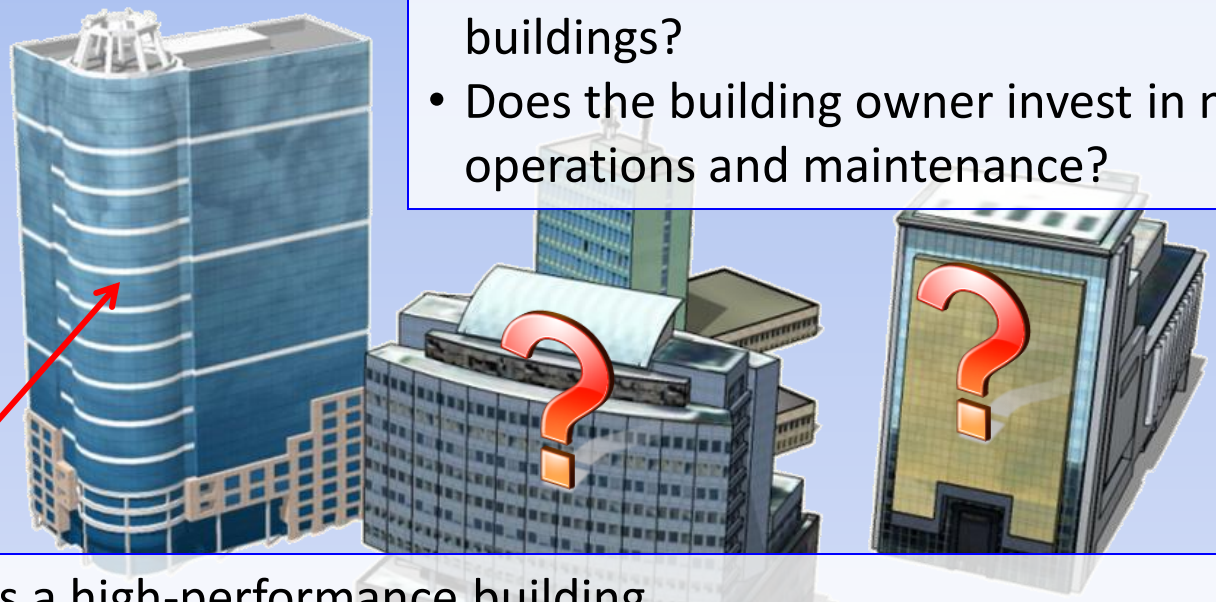
- Which design will be most marketable?
- What can I expect in future energy costs?
- Does the design meet my initial energy use expectations?
- What will I need to do to assure the building performs to its potential?

Why Should Owners be Interested?

Tenants are looking to understand energy use and cost

Potential Leases:

- Is this a bad building or just not measured?
- What will my energy bills be?
- How do I compare energy use for different buildings?
- Does the building owner invest in necessary operations and maintenance?



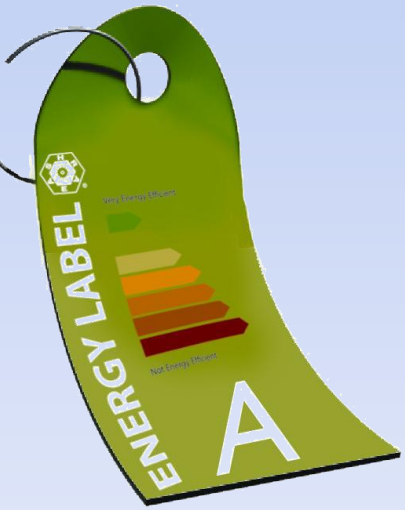
- This is a high-performance building.
- My energy costs will be manageable.
- The building owner pays attention to operations and maintenance.
- I can afford to put more money towards rent.

Initial Voluntary Program
How Can Energy Disclosure Requirements be Implemented?

- Require all new buildings to obtain an asset rating before issuing building permits
- Require disclosure of past operational energy use and/or asset rating upon sale or lease of existing buildings
- Require existing buildings to report operational energy use with schedule for implementation based on square footage

How is the Building EQ Program Different from Existing "Green" Programs like LEED or Green Globes?

- It focuses solely on a building's **actual energy** performance and use to allow greater concentration on understanding energy use and **identifying opportunities** for improvement
  - Could be used to improve/verify energy component of green building rating systems
  - Identifies specific energy indoor air quality and other performance data



How is the Building EQ Program Different from Energy Star?

- Building EQ provides greater differentiation for higher performing buildings **of the same type and in the same climate zone,** thus allowing and encouraging greater emphasis on the top performers
- An expansion of the type and amount of information provided
  - Mechanism for labeling building types outside Energy Star system
  - **Numerical and Qualitative** scores easily comparable across similar buildings

What will bEQ do for me?
Certificate will provide -

- Potential side-by-side comparison of *As Designed* (asset) and *In Operation* (operational) Ratings
- Peak demand reduction and demand management opportunities
- Energy use from on-site renewables
- Measurement-based Indoor Environmental Quality (IEQ) indicators to assure levels of service are maintained
- List of operational features including commissioning activities, energy efficiency improvements
- Provides information on how building performance can be improved

What will bEQ do for me?

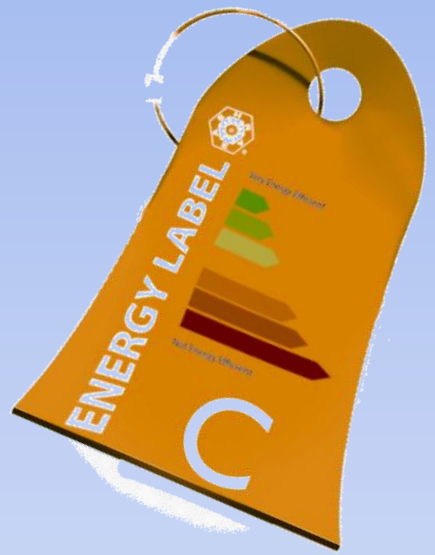
- Use to verify effectiveness of Energy Saving Performance Contracts (ESPCs)
- Reduce potential long-term risks due to rising energy costs or climate change concerns
- Differentiate your building from its peers to attract tenants or potential buyers
- Inform operations and maintenance staff (and the CFO) on how buildings are using energy
- Potential utilization outside of North America for areas without existing labeling programs

Developing the Program

- An international team of experts representing a variety of fields critical to producing a technically sound and widely applicable program.
  - Members familiar with the Energy Star Program and the European Union labeling programs, building energy modeling experts, and representatives from the utility, government, and advocacy community.
  - Following development of the initial program, ASHRAE will make use of its broad technical resource network to validate and enhance the program.

Supporting the Program

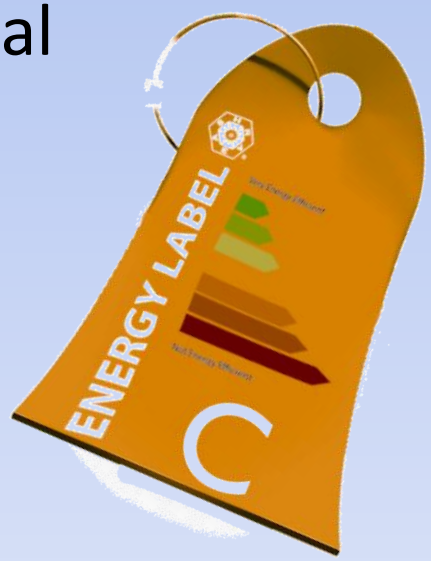
- Developing the tools and resources to support utilization
  - Educational Programs
  - Instruction Manuals
  - Technical Guidance
  - Advocacy Materials
  - Marketing Materials
  - User-friendly Internet-based Interface



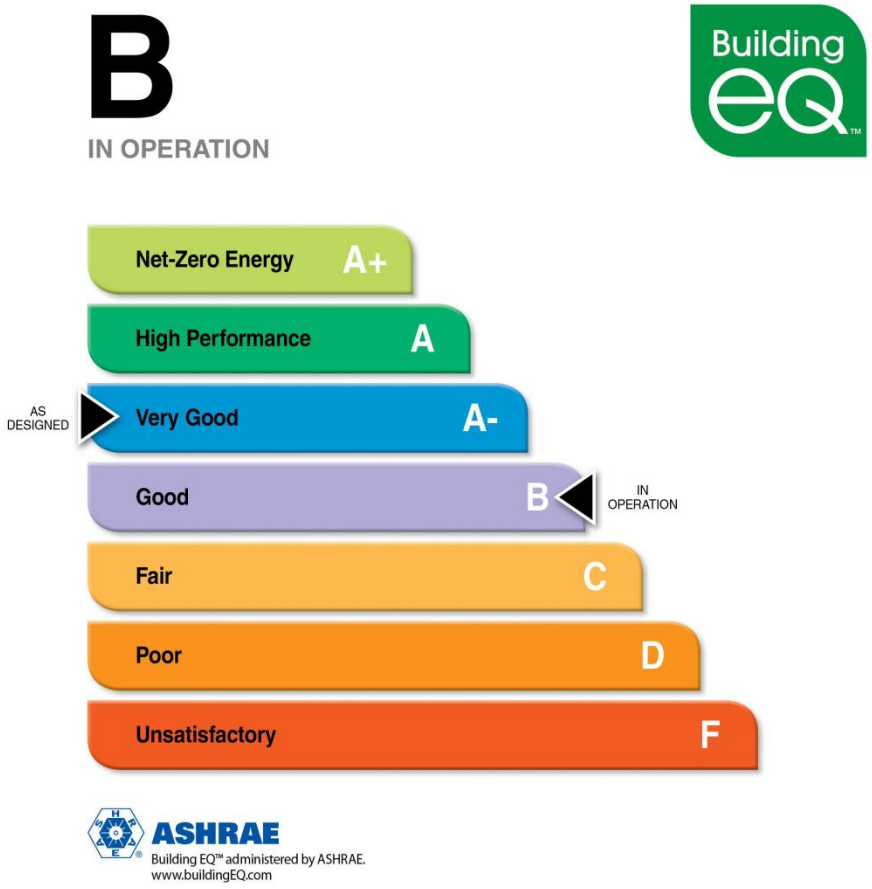
Supporting the Program

- Developing the tools and resources to support utilization
  - Certification Programs:

1. Building Energy Modeling Professional
   First Available in Orlando. Now available upon request
2. Certified Energy Assessor
   First Available in Las Vegas



Building EQ Labels

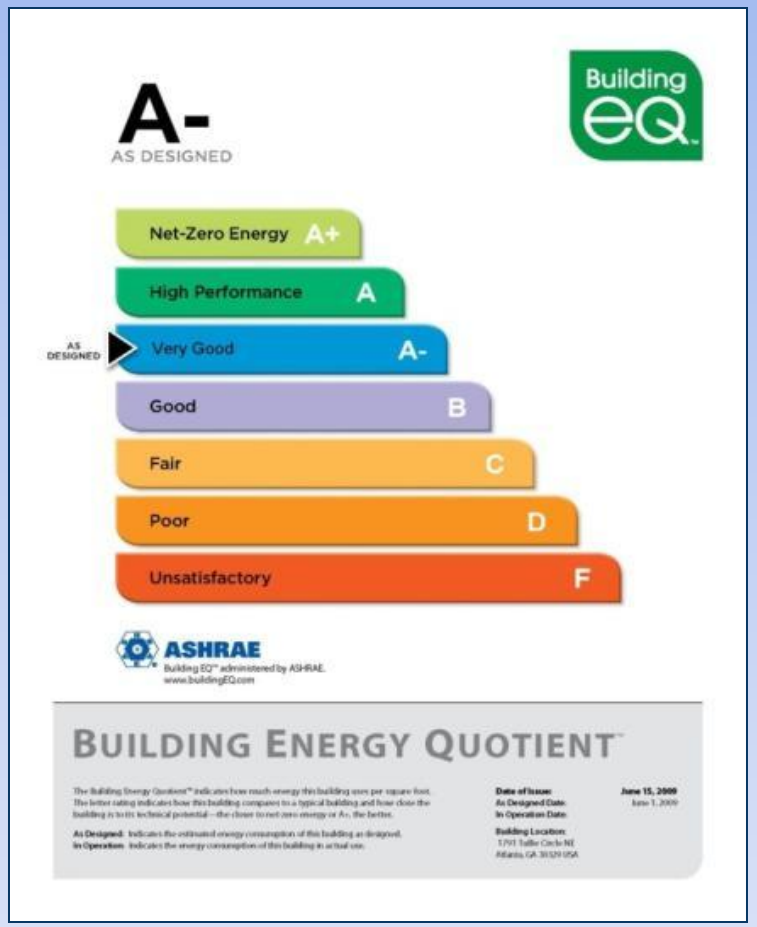


Availability and Cost

- The ***In Operation*** rating began its pilot phase in late 2009 with a widespread launch in 2010
- The ***As Designed*** rating will begin its pilot in early 2011 with a widespread launch in mid-2011
- The actual cost for obtaining the label has not been determined, but we are cognizant of limited budgets and the anticipated annual renewal for operational ratings

About the Pilot Program Happening NOW

- In Operation Pilot completed in June 2010
- 23 buildings from 10 owners/operators
- 17 Provisional Assessors
- Assessments include:
  - Building characteristics
  - Building Energy Quotient
  - IEQ Assessment
- As Designed rating to follow in second half of 2011



www.buildingeq.com

About the Pilot

Participation of Prominent Building Owners/Developers

Participants:

BNIM

WRIGHT RUNSTAD & COMPANY

RUSSELL DEVELOPMENT COMPANY, INC.

The Durst Organization

Ashforth Pacific, Inc.

DETROIT-WAYNE JOINT BUILDING AUTHORITY

ASHRAE

Hines

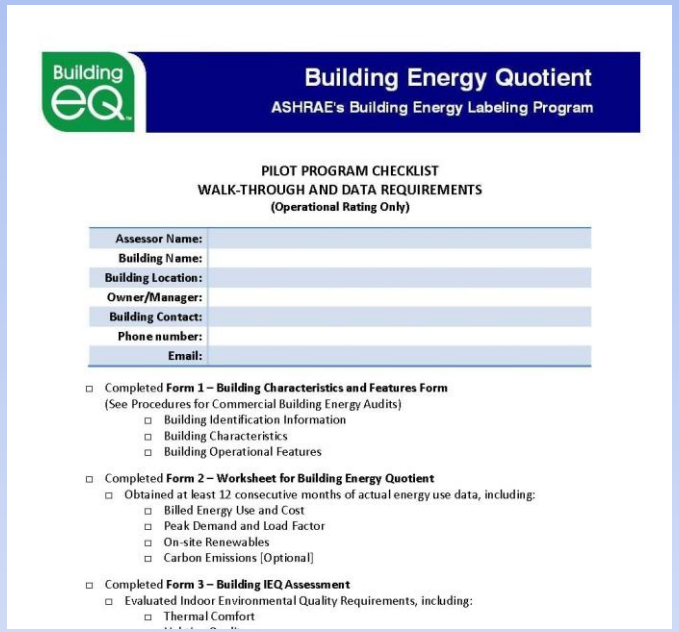
GSA

DEPARTMENT of MANAGEMENT and BUDGET Since 1948 DMB

Assessor Pilot Procedures

Walk-through Procedures and Checklist

- Overall process for the assessment
- Contact Information
- Checklist to verify that all forms have been completed



Building eQ

Building Energy Quotient

ASHRAE's Building Energy Labeling Program

PILOT PROGRAM CHECKLIST
WALK-THROUGH AND DATA REQUIREMENTS
(Operational Rating Only)

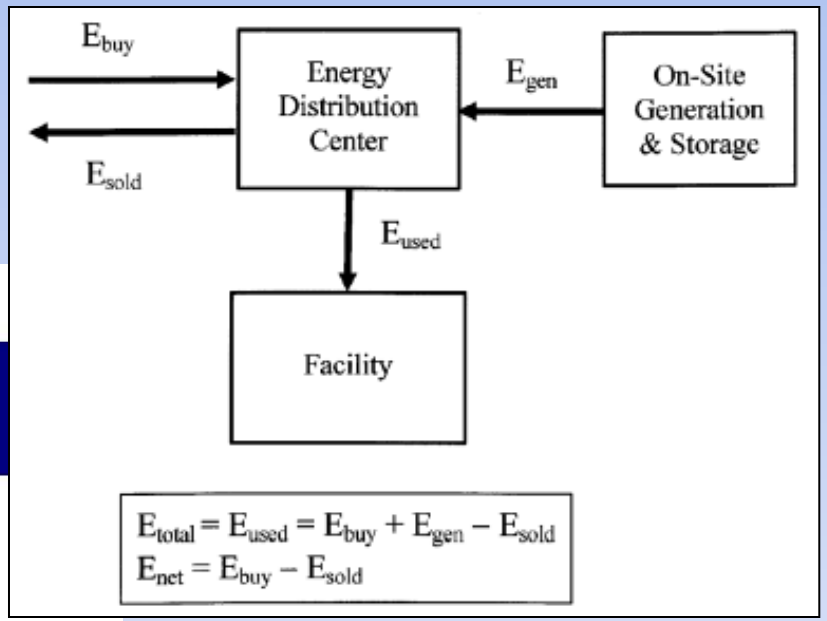
Assessor Name:	
Building Name:	
Building Location:	
Owner/Manager:	
Building Contact:	
Phone number:	
Email:	

- ☐ Completed **Form 1 – Building Characteristics and Features Form**
  (See Procedures for Commercial Building Energy Audits)
  - ☐ Building Identification Information
  - ☐ Building Characteristics
  - ☐ Building Operational Features
- ☐ Completed **Form 2 – Worksheet for Building Energy Quotient**
  - ☐ Obtained at least 12 consecutive months of actual energy use data, including:
    - ☐ Billed Energy Use and Cost
    - ☐ Peak Demand and Load Factor
    - ☐ On-site Renewables
    - ☐ Carbon Emissions [Optional]
- ☐ Completed **Form 3 – Building IEQ Assessment**
  - ☐ Evaluated Indoor Environmental Quality Requirements, including:
    - ☐ Thermal Comfort

Assessor Pilot Procedures

Definitions

- Adapted from ASHRAE Standard 105
- Key terms



Building eQ

Building Energy Quotient

ASHRAE's Building Energy Labeling Program

PILOT PROGRAM DEFINITIONS

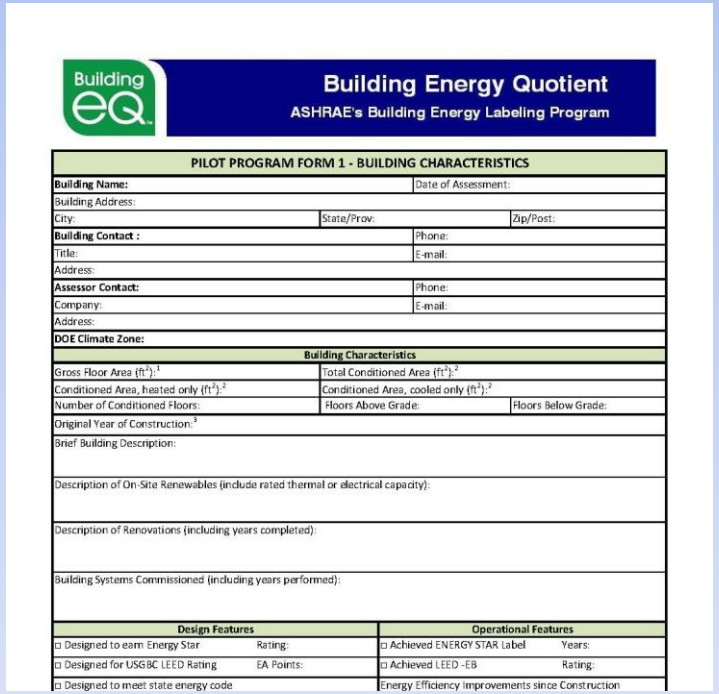
The following definitions are adapted from *ANSI/ASHRAE Standard 105-2007, Standard Methods of Measuring, Expressing and Comparing Building Energy Performance.*

conditioned: heated and/or cooled. In this application, *conditioned* means provided with a heat supply to maintain air temperature of 50°F (10°C) or higher, and/or provided with a cooling supply to maintain air temperature of 86°F (30°C) or lower.

Assessor Pilot Procedures

Workbook Form Instructions
Form 1: Building Characteristics

- Contact Information
- Climate Zone
- Building Characteristics
- Design and Operational Features



Building eQ — Building Energy Quotient
ASHRAE's Building Energy Labeling Program

PILOT PROGRAM FORM 1 - BUILDING CHARACTERISTICS

Building Name:		Date of Assessment:
Building Address:		
City:	State/Prov:	Zip/Post:
Building Contact :		Phone:
Title:		E-mail:
Address:		
Assessor Contact:		Phone:
Company:		E-mail:
Address:		
DOE Climate Zone:		

Building Characteristics

Gross Floor Area (ft^2):[1]	Total Conditioned Area (ft^2):[2]	
Conditioned Area, heated only (ft^2):[2]	Conditioned Area, cooled only (ft^2):[2]	
Number of Conditioned Floors:	Floors Above Grade:	Floors Below Grade:
Original Year of Construction:[3]		
Brief Building Description:		
Description of On-Site Renewables (include rated thermal or electrical capacity):		
Description of Renovations (including years completed):		
Building Systems Commissioned (including years performed):		

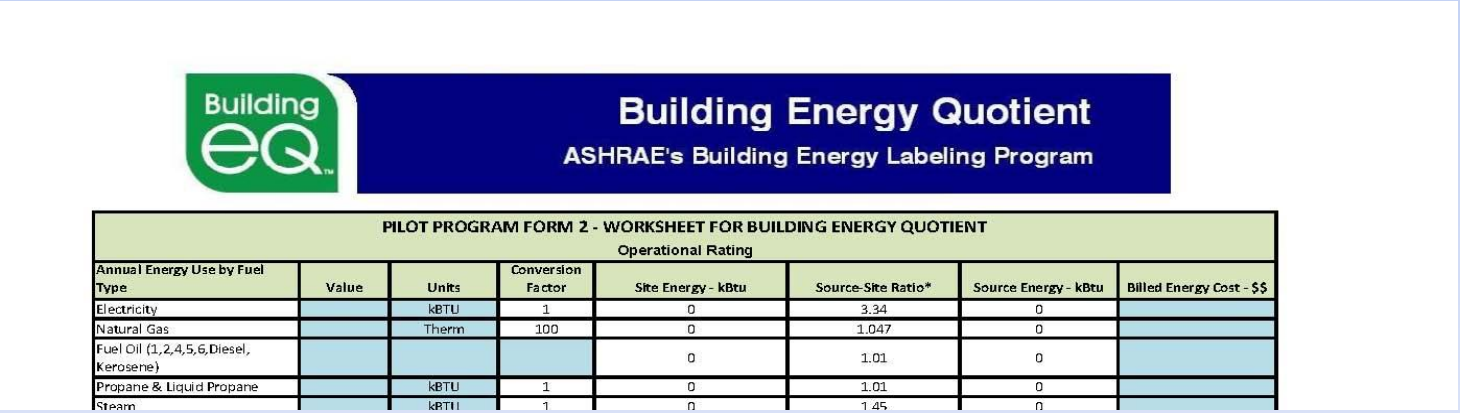
Design Features		Operational Features	
☐ Designed to earn Energy Star	Rating:	☐ Achieved ENERGY STAR Label	Years:
☐ Designed for USGBC LEED Rating	EA Points:	☐ Achieved LEED -EB	Rating:
☐ Designed to meet state energy code		Energy Efficiency Improvements since Construction	

Assessor Pilot Procedures

Workbook Form Instructions

Form 2: Energy Calculations

- Annual Energy Use by Fuel Type
- Worksheet for Calculation of bEQ Score
- Fill-in Information and Drop-down menus



Building eQ

Building Energy Quotient

ASHRAE's Building Energy Labeling Program

PILOT PROGRAM FORM 2 - WORKSHEET FOR BUILDING ENERGY QUOTIENT

Operational Rating

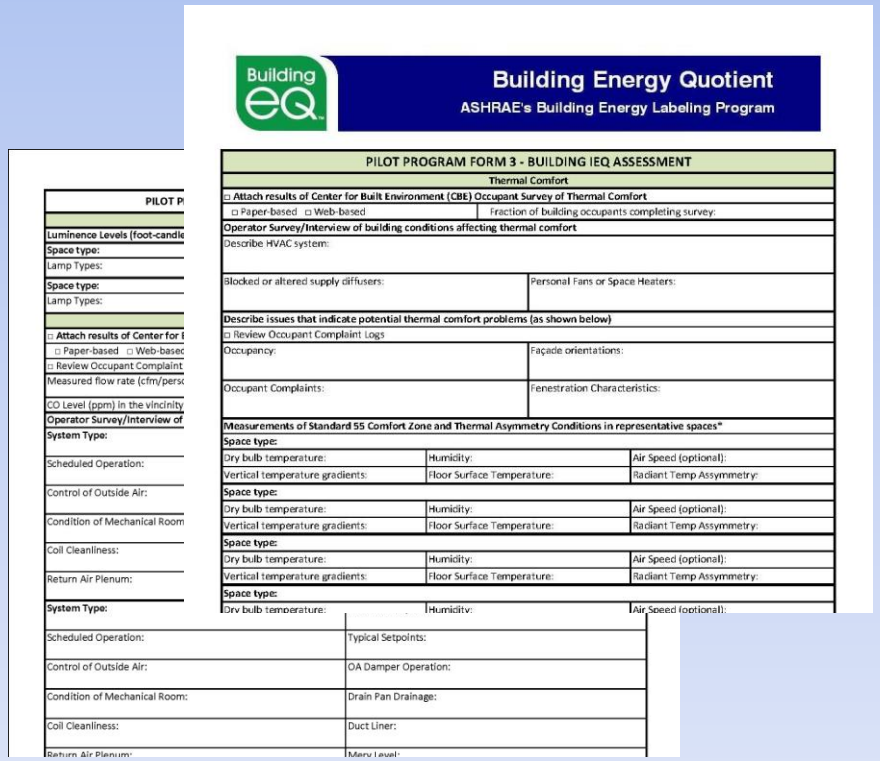
Annual Energy Use by Fuel Type	Value	Units	Conversion Factor	Site Energy - kBtu	Source-Site Ratio*	Source Energy - kBtu	Billed Energy Cost - $$
Electricity		kBTU	1	0	3.34	0	
Natural Gas		Therm	100	0	1.047	0	
Fuel Oil (1,2,4,5,6,Diesel, Kerosene)				0	1.01	0	
Propane & Liquid Propane		kBTU	1	0	1.01	0	
Steam		kBTU	1	0	1.45	0	

Assessor Pilot Procedures

Workbook Form Instructions

Form 3: IEQ Certification

- Thermal Comfort
- Lighting Quality
- Indoor Air Quality
- Surveys
- Measurement



Building eQ

Building Energy Quotient

ASHRAE's Building Energy Labeling Program

PILOT PROGRAM FORM 3 - BUILDING IEQ ASSESSMENT

Thermal Comfort

□ Attach results of Center for Built Environment (CBE) Occupant Survey of Thermal Comfort

□ Paper-based □ Web-based | Fraction of building occupants completing survey:

Operator Survey/Interview of building conditions affecting thermal comfort

Describe HVAC system:

Blocked or altered supply diffusers: | Personal Fans or Space Heaters:

Describe issues that indicate potential thermal comfort problems (as shown below)

□ Review Occupant Complaint Logs

Occupancy: | Façade orientations:

Occupant Complaints: | Fenestration Characteristics:

Measurements of Standard 55 Comfort Zone and Thermal Asymmetry Conditions in representative spaces*

Space type:

Dry bulb temperature: | Humidity: | Air Speed (optional):

Vertical temperature gradients: | Floor Surface Temperature: | Radiant Temp Assymmetry:

Space type:

Dry bulb temperature: | Humidity: | Air Speed (optional):

Vertical temperature gradients: | Floor Surface Temperature: | Radiant Temp Assymmetry:

Space type:

Dry bulb temperature: | Humidity: | Air Speed (optional):

Vertical temperature gradients: | Floor Surface Temperature: | Radiant Temp Assymmetry:

Space type:

Dry bulb temperature: | Humidity: | Air Speed (optional):

Scheduled Operation: | Typical Setpoints:

Control of Outside Air: | OA Damper Operation:

Condition of Mechanical Room: | Drain Pan Drainage:

Coil Cleanliness: | Duct Liner:

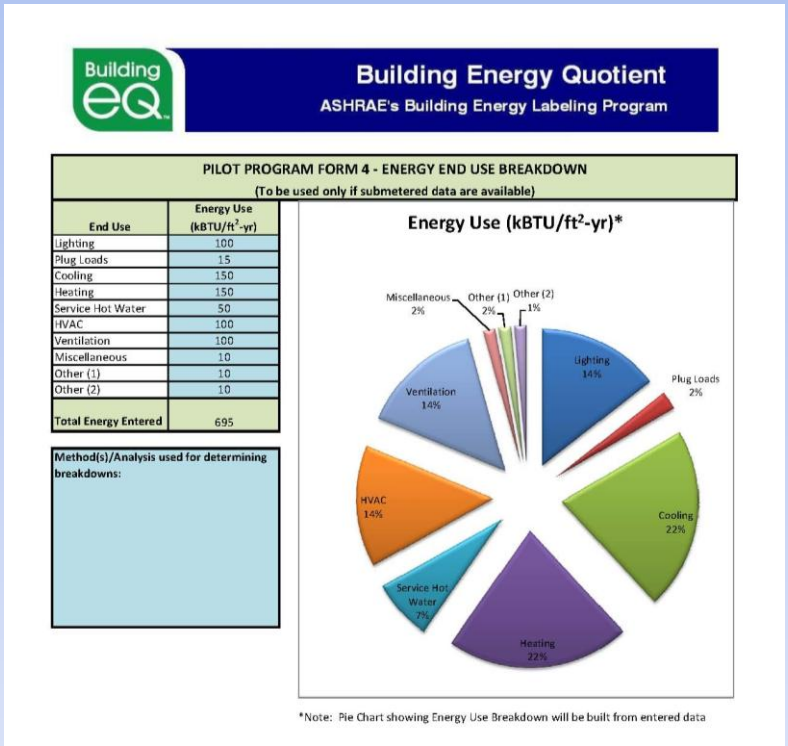
Return Air Plenum: | Mercy Level:

Assessor Pilot Procedures

Workbook Form Instructions

Form 4: Systems Energy Breakdown

- Only if Sub-metered Data is available
- Creates Pie Chart of Energy Usage by System type



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Frequently **A**sked **Q**uestions

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Any Questions?

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