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Development of ASHRAE's Building Energy Quotient Labeling Program

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Today's Topics



- Need for ASHRAE to take action on labeling
- Development Background
- Types of Ratings Covered by bEQ
- Key Features in Rating Process
- Pilot Testing Program

Building Energy Labels Provide. . .

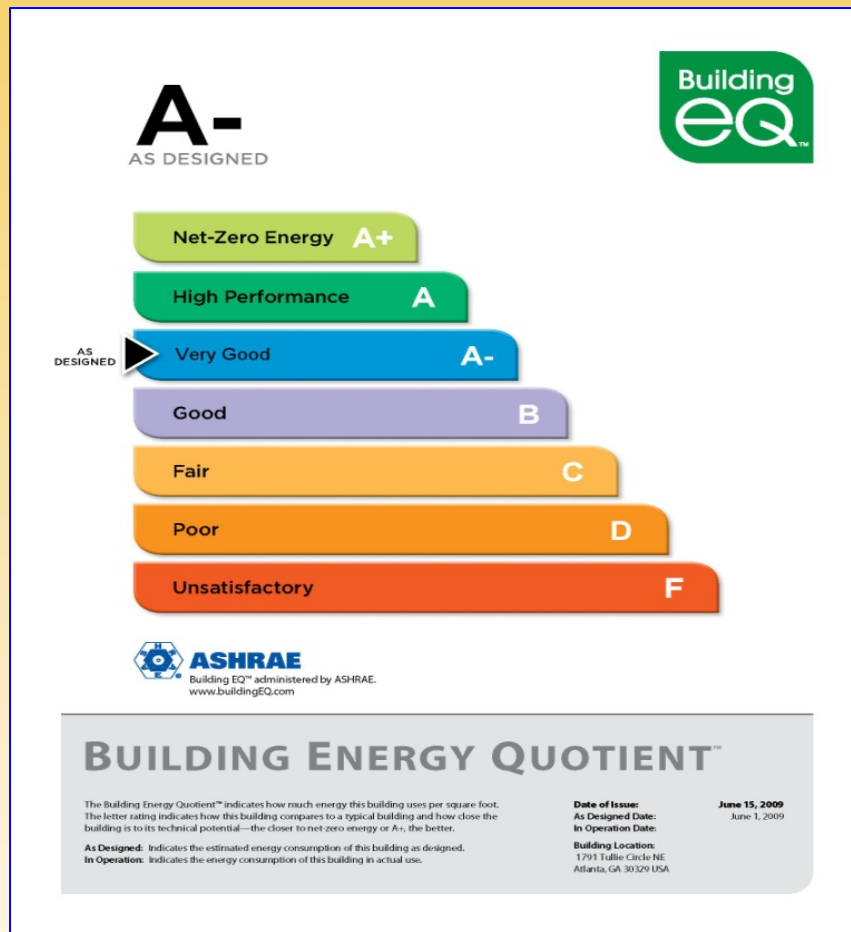
Market-based forces to influence energy efficiency investment opportunities

Owners flexibility through investment in the technologies and practices that make the most sense for their building

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



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 compared to their peers
- Insight into the value and potential long-term costs of a building
- Differentiation in the marketplace

Why Now?

Potential utilization outside of North America
for areas without existing labeling programs

Mandatory labeling requirements
already in place:

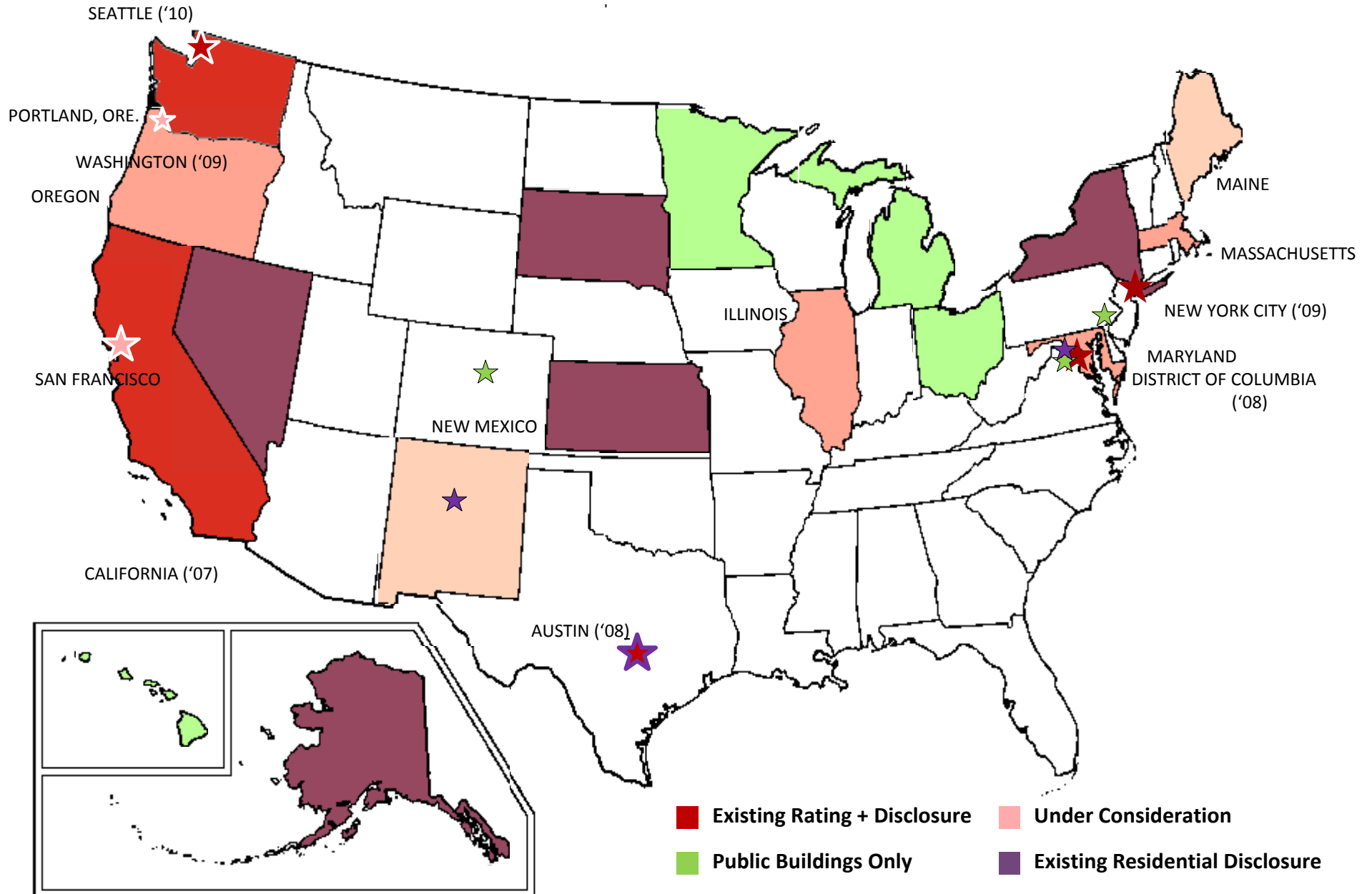
- European Union
- California
- Washington, DC
- Austin, TX



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

US Commercial Energy Disclosure and Rating Mandates

Source: Institute for Market Transformation



Developing the bEQ Program

- Technically sound and widely applicable program
- Committee with international team of experts
- Members familiar with the Energy Star and EU labeling programs
- Building energy modeling experts
- Representatives from Utilities, Government, and Advocacy community.
- Following initial roll-out, validate and enhance the program using ASHRAE's broad technical resource network

Phase 2 Improvements to the Initial ASHRAE ABEL Program Concept

- Development of an ASHRAE bEQ certificate for building documentation and a label for public display of the rating
- Development of an ASHRAE Building Energy Certificate for compliance with regulatory energy use disclosure requirements
- Addition of building energy performance ratings using the bEQ rating scale consistent with labeling and rating programs in other countries
- Expansion of the energy efficiency features documented with the Certificate
- Technical instructions on conducting bEQ ratings

The bEQ Value-Added Features:

- 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, plus information on how performance can be improved

Energy Consumption in Buildings

- Function Of Regulated Variables Such As Envelope Thermal Characteristics, Equipment Efficiencies, Control Algorithms (Temperature Reset), Lighting Power, Etc.
- Function Of Unregulated Variables, Such As Occupant Density, Office Equipment And Appliances, Process Equipment, Operating Hours, Special Ventilation.

What is an Asset Rating

- The ABEL Asset Rating Is Intended To Be A Measure Of The Energy Efficiency Quality Of The As-built Fixed Physical Components Of A Building (Regulated Parameters)
- The Asset Rating Normalizes the Effect of Tenant Variables on Building Energy Consumption (Unregulated Parameters)
- Ideally, the Validity of the Asset Rating Survives a Change in Tenancy

What types of bEQ Ratings?

As Designed Rating (asset)

- Assessment of the building based on design components: mechanical, envelope, orientation, and daylighting.
- 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

Current US Asset Rating Methodologies

- ASHRAE 90.1 Appendix G
- LEED Energy and Atmosphere Credit 1
- Green Globes
- Building Energy Performance Standard (historical)

What are Problems with Existing Asset Rating Methodologies

- Results Are Not Comparable Among Buildings of the Same Type
- Some Physical Variables Normalized
 - Building Massing
 - Percentage of Glazing Below 40%
- Occupancy Parameters Not Normalized
- Calculation Procedures Insufficiently Rigorous
- Discrepancies Between Asset Ratings and Operational Results Misunderstood

Asset Comparator Strategies

- Based on Actual Building Data
 - Energy Star TargetFinder 50% EUI (ASHRAE HQ)
 - Comparing Simulations with Poorly Qualified Metered Data
- Based on Pre-Calculated EUI's for Building Type and Climate Zone
 - Simplest Procedure, But Not Compatible with Custom Non-Regulated Loads
- Based on Custom Simulations
 - Reference Building Descriptions for Each Building Type (DOE?, but Not ASHRAE 90.1-2007 Appendix G)
 - Some Non-Regulated Inputs Standardized
 - Other Non-Regulated Inputs Not Standardized

Normalization Methodologies

- **Normalize the Candidate Building Simulation**
 - Standardize All non-Regulated Inputs for Candidate Building Simulation, including internal loads
 - Re-size Equipment for Candidate Building
- **Normalize the Comparator Simulation**
 - Set All non-regulated Inputs in Comparator Building Equal to As-Operated for Candidate Building
- **Mixed Normalization**
 - Standardize Only Those non-Regulated Inputs that Do Not Impact Installed Characteristics of Equipment

Asset Comparator EUI

- Specific to Building Characteristics
 - Building Type
 - Climate
 - Building Size?
- Unregulated (Plug Loads) and Occupant Density
 - Cannot be Standardized without Resizing Candidate Building Equipment or Affecting Part Load Operation
- Flexible Application for Mixed Use and Exceptional Buildings
 - Proration for Mixed Use Candidate Buildings
 - Unusual Ratio of Regulated to Non-Regulated Loads

Asset Rating Strategy

- Utilize a modified ASHRAE 90.1 Appendix G approach to set up baseline case and candidate building simulations
- Define base case building using reference building rather than modified candidate building
- Use Comnet parameter to list define values
- Define base building as 1990's era building

COMNET - National Energy Protocol Specification (NEPS)

- Modeling Rules
 - Thermal Blocks
 - HVAC Zones
 - Equipment Sizing (Comparator Building)
- Modeling Assumptions
 - Schedules
 - Operational Variable
- Software Requirements
 - ASHRAE Standard 140-2007 Testing
 - Simulation Capabilities

What is the Methodology of the bEQ Asset Rating Method

- Simulate the Building Using ASHRAE Standard 90.1-2007 Acceptable Simulation Tools and Standard Weather Data
- Assume Standard Schedules and Operational Variables for the Specific Building Type
- Assume Occupancy and Non-Regulated Equipment Loadings for As-Designed Candidate Building
- Perform Simulations for Both Buildings
- Score is Ratio of Candidate EUI to Comparator EUI

Characteristics of the ASSET Rating

- Designed to Isolate Impact of Permanent Aspects of the Property (Insulation, Glass, HVAC equipment, etc)
- Based on Energy Simulation with Inputs to Normalize for Operational Variables.
- Methodology Will Utilize Standardized Schedules and Non-Regulated Load Values.
- Ratings are the Ratio of Project EUI to EUI of Target Building Type (Location Normalized). Details still in development.
- Does not predict actual energy consumption of building in use because operational and occupancy parameters aren't customized to candidate building

What types of bEQ Ratings?

In Operation Rating (operational)

- Measured energy use of a building
- Based on a combination of the structure of the building and how it is operated
- Applicable for existing buildings
- Applicable for new buildings after 12-18 months of operation.

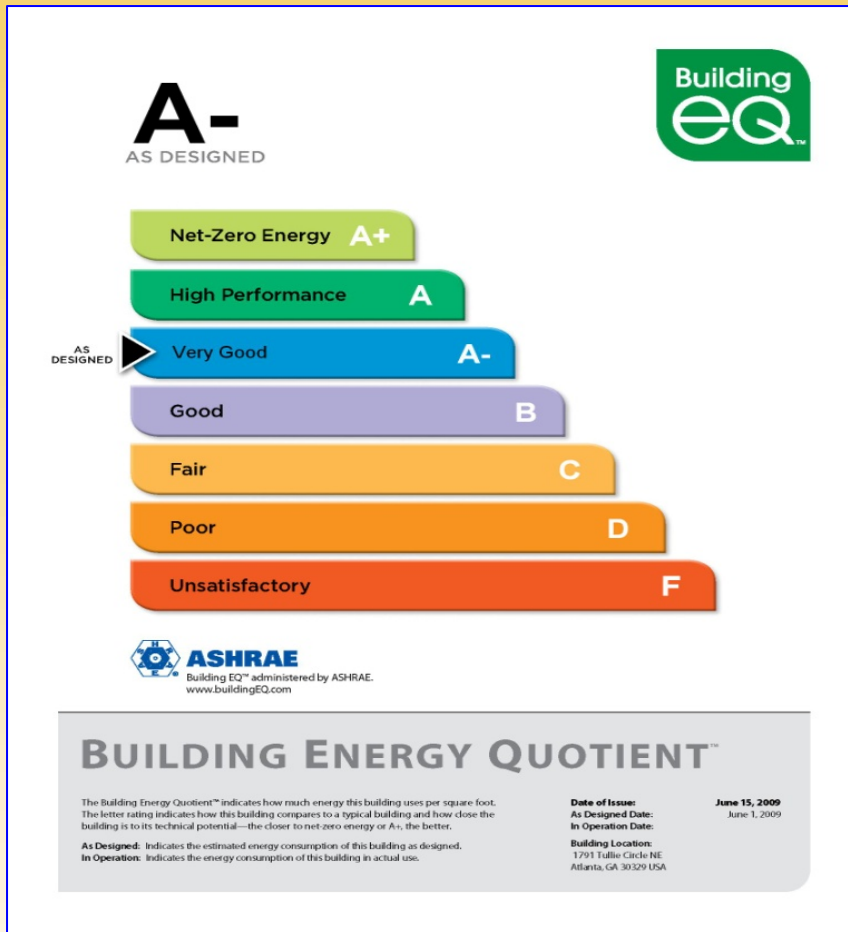
bEQ Operational Rating “In Operation”

- Site visit required to verify energy performance and IEQ
- Documentation of key energy efficiency operational features
- ENERGY STAR labels or LEED-EB earned in specific years
- Building systems commissioning completed
- Lists energy efficiency retrofits completed
- Optional information on potential for energy efficiency improvements (e.g. energy audit report)

Comparing the Asset Rating and the Operational Rating

- Asset Rating is Based on Simulated Energy Usage.
Operational Rating is Based on Actual Energy Usage.
- Asset Rating is independent of operational and occupancy variables.
Operational Rating is influenced by operational and occupancy variables.
- Asset rating can only be improved by upgrading building fabric.
Operational Rating can be improved through upgrade of either operating procedures or building fabric

The bEQ Rating Scale



- The bEQ scale is dimensionless; “100” to “Zero”
- Top of scale (100) set to median EUI of CBECS building types and subtypes (51 subtypes + 14 with Target Finder (Operational Rating))
- Bottom of scale (zero) set to “net zero energy”
- Can go below zero for net energy producing buildings
- Intended for high performance buildings

The bEQ Rating Scale

Scale Range	Rating	Description
≤ 0	A+	Net Zero Energy
1-25	A	High Performance
26-50	A-	Very Good
51-75	B	Good
76-100	C	Fair
101-125	D	Poor
>125	F	Unsatisfactory

Supporting the Program

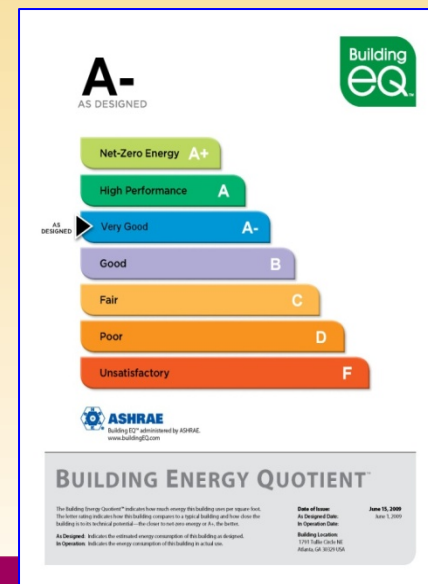
- Developing the tools and resources to support utilization
 - Educational Programs
 - Instruction Manuals
 - Technical Guidance
 - Advocacy Materials
 - Marketing Materials
 - User-friendly Internet-based Interface
 - Personnel Certification Program on Energy Modeling
 - Criteria for a Qualified Energy Assessor



Providing Relevant Information

The **bEQ** Label:

- Most visible component of the program
- Simple to understand – targets **general public**
- at the state and local level
- Suitable for display in building lobbies and marketing materials
- Satisfies public disclosure requirements at the state and local level



Providing Relevant Information

The **bEQ Certificate**:

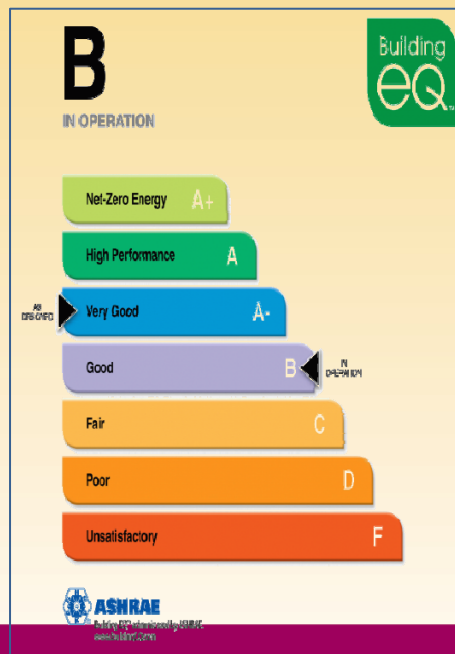
- Technical information explains the rating score
- Information useful to **building owners, tenants, utilities, and operations and maintenance personnel**

Additional **Documentation**:

- Background technical information
- Useful for **engineers, architects**, and technically savvy building owners
- Useful for determining the current state of the building and opportunities for improving its energy use

How is bEQ Program Different from “Green” Programs like LEED or GreenGlobes?

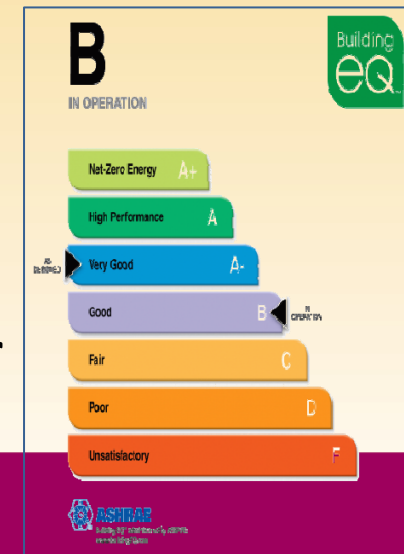
- Focuses solely on a building’s **energy** use



- Greater concentration on understanding energy use and **identifying opportunities** for improvement
- Could be used to improve/verify energy component of green building rating systems

How is bEQ Different from Energy Star?

- Greater differentiation for high performing buildings
- Greater emphasis on top performers and net zero energy
- Able to label building types outside of Energy Star
- Validation via required site visit
- Field-verified IEQ
- Expanded information provided
- Easily comparable scores across similar buildings



About the Pilot

Participation of Prominent Building Owners/Developers

Participants:



RUSSELL DEVELOPMENT COMPANY, INC.



Ashforth Pacific, Inc.



The Durst Organization



Hines



Pilot Program How it works

- Assessor Pilot Procedures
 - Walk-through procedures and checklist
 - Definitions
 - Workbook form instructions
- Assessor Workbook
 - Building Characteristics
 - Energy Calculations
 - IEQ Certification
 - System Energy Breakdown

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: ¹			
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	
<input type="checkbox"/> Designed to earn Energy Star	Rating:	<input type="checkbox"/> Achieved ENERGY STAR Label	Years:
<input type="checkbox"/> Designed for USGBC LEED Rating	EA Points:	<input type="checkbox"/> Achieved LEED-EB	Rating:
<input type="checkbox"/> 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 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

The image shows a screenshot of the 'Building Energy Quotient' (BEQ) Form 3 - Building IEQ Assessment. The form is titled 'Building Energy Quotient ASHRAE's Building Energy Labeling Program' and 'PILOT PROGRAM FORM 3 - BUILDING IEQ ASSESSMENT'. It contains sections for Thermal Comfort, Occupant Survey, and various measurements like CO Level, Humidity, and Air Speed.

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 Asymmetry:

Space type:

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

Vertical temperature gradients: Floor Surface Temperature: Radiant Temp Asymmetry:

Space type:

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

Vertical temperature gradients: Floor Surface Temperature: Radiant Temp Asymmetry:

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: MERV Level:

Assessor Pilot Procedures

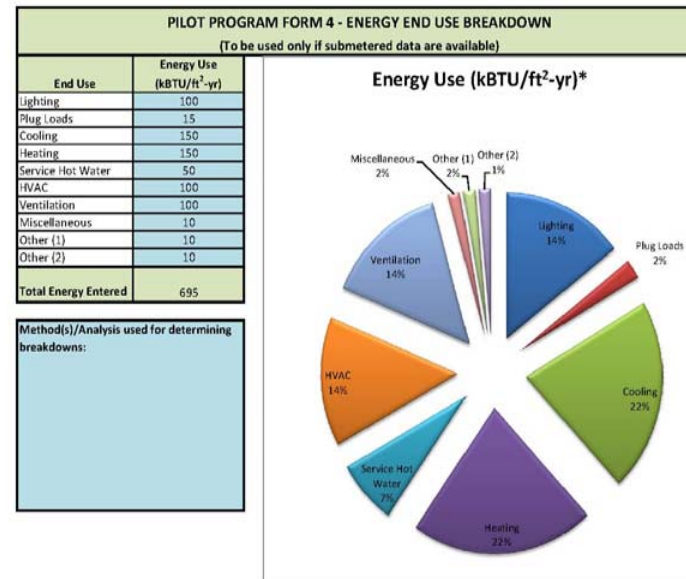
Workbook Form Instructions

Form 4: Systems Energy Breakdown

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



Building Energy Quotient
ASHRAE's Building Energy Labeling Program



*Note: Pie Chart showing Energy Use Breakdown will be built from entered data

Next Steps on Availability and Cost

- Pilot for *In Operation* rating concludes soon
- Pilot for *As Designed* rating begins early 2011
- Widespread launch anticipated in mid 2011
- Annual renewal for operational ratings
- Cost to obtain label is not yet determined
- Aware of limited budgets
- Roll-out issues addressed in bEQ business plan

For More Information...

- Visit the ASHRAE bEQ web site:

<http://www.buildingeq.com/>

- Contact ASHRAE staff:

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