Building Energy Quotient: ASHRAE’s Building Energy Labeling Program
As the world looks to reduce energy consumption... information is the critical first step toward change
Information for Consumers to Allow Educated Choices is Not New

Restaurant Sanitation Ratings

Nutrition Fact Label

Car Fuel Economy Estimates
Cost of Owning a Building

“Most buildings will lose up to 30% of their efficiency in the first three years of operation.”

– Bill Harrison,
ASHRAE Presidential Member
(Data based on Texas A&M Study)
Building Energy Labels:

- Promote energy efficiency in real estate
- Differentiate efficient buildings in the marketplace (for tenants/buyers)
- Provide feedback on a building’s designed and measured energy use
- Identify energy efficiency measures and value in reducing long-term energy costs
- Add to building performance databases
Current Labeling Efforts

• Building certification is becoming widespread
• International efforts:
  – European Union, Singapore and Canada
• U.S. efforts:
  – EPA ENERGY STAR – Portfolio Manager benchmarking
  – DOE Commercial Building Energy Score (pilot phase)
  – USGBC LEED Rating – Broader sustainability rating
  – GBI Green Globes – Broader sustainability rating
  – BOMA 360 – Six O&M focused criteria (incl. energy)
  – State and municipal Building Energy Reporting and Disclosure Ordinances (BERDO)
Why ASHRAE? Why now?

- Over 100 years of experience in the building sciences and technology
- Strong technical expertise across all aspects of building design and operation
- Historic focus on developing consensus-based, non-commercial documents
- Respect and credibility within the building community
- Opportunity to support consistent mandatory programs worldwide
ASHRAE’s Building EQ

- Voluntary labeling program that draws on successful features of other building labeling & certification programs
- Complements other green building and energy rating/labeling programs
- Provides a way to benchmark performance
- Stimulates adoption of high performance building techniques
- Allows for comparison of As Designed (asset) and In Operation (operational) ratings
bEQ Different from other Benchmark Programs

- Includes 49 building types PLUS multiple use buildings or campuses
- Median EUI values provided by climate zone and normalized for weather and operating hours.
- Identifies opportunities for improved energy performance (In Operation)
- Consistent process to assess energy performance
- Unified system for assessing assets and operations
- Greater differentiation for high performing buildings and emphasis on zero net energy
Benefits of bEQ

- Consistent analysis of a building’s designed (as built) and actual energy performance
- Actionable recommendations for reducing energy use with rough costs and paybacks
- Ability to track and show effectiveness of improvements
- Demonstration of corporate responsibility
- Relationship with an ASHRAE certified professional or licensed PE
“The bEQ workbook serves as a good model for information to gather during a Level 1 audit, and also provides a standardized way to present the information.”
bEQ In Operation (operational) rating

• Assessment of building’s structure and systems and how operated
• Compares actual metered energy use of candidate building to median/baseline EUI
• Includes an ASHRAE Level 1 Energy Audit
• Applicable for buildings after at least 12-18 months of operation
• Requires Building Energy Assessment Professional (BEAP) or PE licensed in jurisdiction of project
bEQ As Designed (asset) rating

- Assessment of the building’s physical characteristics and systems
- Independent of a building’s occupancy and operating conditions
- Based on results of a standardized energy model as compared to a baseline
- Applicable to both new and existing buildings
- Requires Building Energy Modeling Professional (BEMP) or PE licensed in the jurisdiction of project
Comparing bEQ Ratings

**In Operation Rating:**
- Actual metered energy consumption
- Influenced by operational and occupancy variables
- Improved by upgrading building fabric or operating procedures

**As Designed Rating:**
- Simulated standardized energy use
- Independent of operational and occupancy variables
- Improved only by upgrading building fabric or systems
The bEQ Rating Scale

- Letter grade based on a score from a dimensionless rating scale
- Zero point on scale set to “zero net energy”
- Median value (100) set to U.S. median energy use intensity (EUI) for existing buildings of that building type, with adjustments
- Score can go below zero for net energy producing buildings
  - exceeds 100 for “inefficient” and “unsatisfactory” buildings with high energy usage
**bEQ In Operation Score**

\[
\left( \frac{\text{EUI}_{\text{measured}}}{\text{EUI}_{\text{median}}} \right) \times 100
\]

- Compares actual metered energy use of candidate building to baseline EUI.
- Baseline EUI is based on CBEC\textsuperscript{*} median for the building type, corrected for location and hours of operation.
  - Tables of median EUI and corrections from ASHRAE Standard 100 as prepared by ORNL.
  - Separate corrections for local HDD/CDD.
- EUIs calculated for source energy using U.S. national site-to-source factors.
bEQ As Designed Score

\[
\left( \frac{\text{EUI}_{\text{standardized}}}{\text{EUI}_{\text{baseline}}} \right) \times 100
\]

- Compares simulated energy use to baseline EUI
- Baseline EUI is based on CBECs median for the building type, corrected for location
  - Tables of median EUI and corrections from ASHRAE Standard 100 as prepared by ORNL
- Uses standardized modeling inputs of building operating parameters (COMNET*)
  - Occupancy, plug and process loads, schedules, setpoints
  - Depends on building and space type
- EUIs calculated for source energy using US national site-to-source factors
Building Certification Requires Qualified Professionals

• bEQ program requires an ASHRAE certified professional or a PE licensed in the jurisdiction where the project is located
Certifies ability to:

• Evaluate, choose, use, calibrate, and interpret results of energy modeling software when applied to building and systems energy performance and economics.

• Competence to model new and existing buildings and systems with their full range of physics.
Building Energy Assessment Professional (BEAP)

Certifies ability to:

- Audit and analyze buildings
- Determine project scope and collect data
- Analyze building performance and interpret results
- Evaluate alternatives and recommend energy conservation measures (ECMs)
- Assist with ECM implementation
Getting Started with a bEQ *In Operation* Rating

www.buildingenergyquotient.org
In Operation Features

• Includes an ASHRAE Level 1 Energy Audit
• Recommends actions to reduce energy use
• Recognizes energy use from on-site renewables
• Includes measurement-based IEQ indicators to assure levels of service are maintained
• Illustrates benefits of equipment and system investments
• Leads to informed energy management decisions
Level 1 Energy Audit

- Preliminary energy-use analysis (PEA) with review of utility bills, rate classes, and peak energy demand
- Space function analysis and energy end use summary
- Identification of low-cost/no-cost energy improvement measures with estimated costs and savings
- Recommended capital improvements with estimated costs and savings
- Identifies peak demand reduction and energy management opportunities
bEQ User Feedback

“We were also able to identify several operational issues ... that will provide large savings with a very quick payback, and will by themselves pay for several times the cost of the evaluation.”
In Operation Procedures

- Identify building type(s) and construction characteristics
- Assemble building utility bills for continuous 12 month period
- Site visit with ASHRAE Level 1 Energy Audit
- Assess adequacy of indoor air quality, thermal comfort, lighting levels
  - Interview with operators/occupants to identify problems
  - Representative measurements to confirm acceptable levels
- Complete workbooks
• Form 1 Building Characteristics
• Form 2 Energy Calculations for Rating
• Form 3 IEQ Screening Information
• Form 4 Energy Savings Suggestions
• Form 5 Energy End-Use Breakdown
• Form 6 Water Use (Optional)
In Operation Workbook
Getting Started with a bEQ As *Designed* Rating

www.buildingenergyquotient.org
• Identify building type and physical characteristics
  – Confirm as-built documentation as available
• Identify energy modeling software to comply with ASHRAE Standard 90.1, Appendix G
• Develop energy model of candidate building and its assets, using standardized neutral variable inputs for building type from COMNET
  – Occupancy, plug and process loads, schedules, setpoints
• Complete workbook
As Designed Workbooks

- Form 1 Building Characteristics
- Form 2 Energy Calculations for Rating
- Form 3 Candidate Building Modeling Inputs
- Form 4 Energy End Use Breakdown
### Building Energy Quotient

**ASHRAE’s Building Energy Labeling Program**

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**FORM 1 - BUILDING CHARACTERISTICS FOR IN OPERATION RATING**

<table>
<thead>
<tr>
<th>Building Name:</th>
<th>Assessment Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address</td>
<td>City: State/Province</td>
</tr>
<tr>
<td>Building Owner:</td>
<td>Phone:</td>
</tr>
<tr>
<td>Building Contact/Title:</td>
<td>Email:</td>
</tr>
<tr>
<td>Address:</td>
<td>City: State/Province</td>
</tr>
<tr>
<td>Assessment/Company:</td>
<td>Phone:</td>
</tr>
</tbody>
</table>

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**FORM 2 - ENERGY CALCULATIONS FOR AS DESIGNED RATING**

**Model Standardized Energy Use Information and Rating Calculation**

<table>
<thead>
<tr>
<th>Description of On-Site Renewable Energy Systems</th>
<th>Value</th>
<th>Units</th>
<th>Conversion Factor</th>
<th>Site Energy - kBtu</th>
<th>Source Site Ratio</th>
<th>Source Energy (kBtu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>3,143</td>
<td>kWh</td>
<td>3.413</td>
<td>0</td>
<td>1,047</td>
<td>0</td>
</tr>
<tr>
<td>Natural gas</td>
<td>0</td>
<td>therm</td>
<td>100</td>
<td>0</td>
<td>1,047</td>
<td>0</td>
</tr>
<tr>
<td>Fuel cell (LP, LP, LPG, Diesel, etc.)</td>
<td>12</td>
<td>kBtu</td>
<td>1</td>
<td>0</td>
<td>1,047</td>
<td>0</td>
</tr>
<tr>
<td>Steam</td>
<td>1</td>
<td>kBtu</td>
<td>1.21</td>
<td>0</td>
<td>1,047</td>
<td>0</td>
</tr>
<tr>
<td>Hot Water</td>
<td>1</td>
<td>kBtu</td>
<td>1.24</td>
<td>0</td>
<td>1,047</td>
<td>0</td>
</tr>
<tr>
<td>Chilled Water</td>
<td>1</td>
<td>kBtu</td>
<td>1.05</td>
<td>0</td>
<td>1,047</td>
<td>0</td>
</tr>
<tr>
<td>Wood / Biomass</td>
<td>1</td>
<td>kBtu</td>
<td>1.0</td>
<td>0</td>
<td>1,047</td>
<td>0</td>
</tr>
<tr>
<td>Coal / Coke</td>
<td>1</td>
<td>kBtu</td>
<td>1.0</td>
<td>0</td>
<td>1,047</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>kBtu</td>
<td>1.0</td>
<td>0</td>
<td>1,047</td>
<td>0</td>
</tr>
</tbody>
</table>

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**STANDARDIZED MODELING INPUTS TABLE**

<table>
<thead>
<tr>
<th>Heat Loss Factor</th>
<th>Minimum Ventilation (cfm/ft²)</th>
<th>Maximum Infiltration (cfm/ft²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensible Heat</td>
<td>Latent Heat</td>
<td>Off</td>
</tr>
<tr>
<td>246</td>
<td>170</td>
<td>0.00</td>
</tr>
<tr>
<td>246</td>
<td>171</td>
<td>0.00</td>
</tr>
</tbody>
</table>

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**Notes**

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**BuildingEQ Rating**

(Source/Median)*100:
bEQ Documentation

bEQ Workbook
• Documents Rating Calculation
• Provides Supplemental Information

bEQ Certificate
• Contains Key Building Information
• Satisfies Disclosure Requirements
• Provides Info for Tenants & Governments

bEQ Dashboard
• Illustrates Level of Performance

bEQ Plaque
• Public Display of Building’s Rating
bEQ Dashboard

Building Energy Quotient Dashboard

EXAMPLE BUILDING
000 MAIN STREET
ANYTOWN, NY 00000

RATED BUILDING TYPE:
BUILDING GROSS SQUARE FOOTAGE:
ORIGINAL CONSTRUCTION DATE:
LATEST MAJOR RENOVATION DATE:

As Designed

Previous Rating Scores Dates
Total Modeled Bldg Energy Use (kBtu)
Modeled Renewable Energy kBtu and %
Total Modeled Net Bldg Energy Use (kBtu)
Modeled Site EUI (kBtu/ft²-yr)
Modeled Source EUI (kBtu/ft²-yr)
ENERGY STAR Target Finder
Other Ratings Awarded

As Designed

In Operation

In Operation Rating Date:
Previous Rating
Scores Dates
Total Measured Bldg Energy Use (kBtu)
Measured Renewable Energy kBtu and %
Total Measured Net Bldg Energy Use (kBtu)
Measured Site EUI (kBtu/ft²-yr)
Measured Source EUI (kBtu/ft²-yr)
Measured ECI ($/ft²-yr)
ENERGY STAR Portfolio Manager
Other Ratings Awarded

As Designed 80

BEST

In Operation 67

Net Zero Energy

Typical

Worst

Medium

175+
bEQ Status

• *In Operation* Rating Available for 49 building types & multiple use applications
  – Workbook updated Aug 2015

• *As Designed* Rating Available for select building types
  – Workbook update coming Sep 2015

• Website: [www.buildingenergyquotient.org](http://www.buildingenergyquotient.org)
  – Download forms & instructions
  – Access brochures & resources
  – Find a certified professional
  – Frequently asked questions
For More Information on bEQ:
www.buildingenergyquotient.org

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