Building EQ: Benchmarking and Disclosure Strategies

New York Chapter of ASHRAE
Goals

- Overview of the Building EQ program
- Building EQ energy management tools
- Building a long-term relationship
Building EQ

- Building energy rating and labeling program
- A tool to differentiate between asset and operational improvements
- Powered by ASHRAE to achieve building energy goals
Building EQ

- Most comprehensive energy assessment program for today’s commercial buildings
  - Actionable recommendations for improving energy performance

Powered by ASHRAE
Current Labeling Efforts

- Widespread acceptance internationally

Austria

England & Wales

Greece

Italy
Current Labeling Efforts

- **U.S. efforts:**
  - EPA ENERGY STAR – Portfolio Manager benchmarking
  - DOE Commercial Building Energy Asset Score
  - 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)
Current Labeling Efforts
Why is Building EQ Different?

• Based solely on energy use
• Focused on understanding energy use
• Identifies opportunities for improved energy performance (In Operation)
Why is Building EQ Different?

• Allows for comparison between buildings with different operating variables (As Designed)
• Consistent energy rating method for both Existing Building and New Construction programs
Why is Building EQ Different?

- Greater differentiation for high performing buildings and emphasis on zero net energy
- Consistent process to assess energy performance
- Unified system for assessing assets and operations
Why is Building EQ Different?

• Builds a relationship with a PE, energy auditor and/or building owner
Rating Types

**In Operation** (operational) rating

- Assessment of energy performance with the existing characteristics *and* how it is operated
- Based on actual metered energy use of a building and on-site audit
- Confirmation that indoor environmental quality is not compromised for energy savings
- Actionable recommendations for improving energy performance
- Applicable after at least 12 months of operation
Rating Types

**As Designed (asset) rating**

- Assessment of energy performance potential, based on building’s physical characteristics and systems
- Independent of building occupancy and operating conditions
- Based on results of a standardized energy model as compared to a baseline
- Applicable to both new and existing buildings
Comparing Ratings

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

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

DESIGNED TO WORK TOGETHER
In Operation Score

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

- Compares actual metered energy use of candidate building to baseline EUI
- Baseline EUI is based on CBECs\(^*\) median for the building type, corrected for location and hours of operation
- EUIs calculated for source energy using U.S. national site-to-source factors

As Designed Score

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

- Compares simulated energy use of candidate building to baseline EUI.
- Baseline EUI is based on CBECOS median for the building type, corrected for location.
- 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.

* COMNET Commercial Buildings Energy Modeling Guidelines and Procedures
## Letter Grades From Rating Scale

<table>
<thead>
<tr>
<th>Score Range</th>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 0</td>
<td>A+</td>
<td>Zero Net Energy</td>
</tr>
<tr>
<td>1-25</td>
<td>A</td>
<td>High Performance</td>
</tr>
<tr>
<td>26-55</td>
<td>A-</td>
<td>Very Good</td>
</tr>
<tr>
<td>56-85</td>
<td>B</td>
<td>Efficient</td>
</tr>
<tr>
<td>86-115</td>
<td>C</td>
<td>Average</td>
</tr>
<tr>
<td>116-145</td>
<td>D</td>
<td>Inefficient</td>
</tr>
<tr>
<td>&gt;145</td>
<td>F</td>
<td>Unsatisfactory</td>
</tr>
</tbody>
</table>
The 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
- Score exceeds 100 for “inefficient” and “unsatisfactory” buildings with high energy usage
Dashboard: Supporting Data

Building Energy Quotient Dashboard

As Designed vs. In Operation

- As Designed Rating Date:
- 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
- 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 EC1 (5-ft²-yr)
- ENERGY STAR Portfolio Manager
- Other Ratings Awarded

Example Building:
- 008 MAIN STREET
- ANYTOWN, ST 00000

Rated Building Type:
- Building Gross Square Footage:
- Original Construction Date:
- Latest Major Renovation Date:

Evaluations:
- Best: Net Zero Energy
- In Operation: 67
Qualifications for Submission

• Rating requires an ASHRAE certified professional or a PE licensed in the jurisdiction of the project
  – Building Energy Assessment Professional (BEAP) for the In Operation rating. www.ashrae.org/BEAP
  – Building Energy Modeling Professional (BEMP) for As Designed Rating www.ashrae.org/BEMP
Looking Ahead

• Aligning baseline EUIs with EPA for projects eligible for ENERGY STAR® scores
• Developing web portal for online entry and automated data exchange
• Collaborations, e.g., EPA, LEED® EBOM, NYSERDA, New Jersey P4P, global jurisdictions
• Developing university course for delivery through student branches and local chapters
• Research project underway to relate design standards and ratings (e.g., 90.1, 189.1, LEED) with operational ratings (e.g., Portfolio Manager)
Building EQ: The Business Case

- Why use Building EQ?
A Shared Problem

• Buildings don’t work as:
  – Intended
  – Designed
  – Constructed
A Shared Problem

• Most buildings will lose up to 30% of their energy efficiency in the first three years of operation

Source: Bill Harrison, Past President of ASHRAE
Based upon a Texas A & M study
A Shared Problem

• So many buildings have been designed using CATNAP
A Shared Problem

• Who is to blame for the problem?
A Shared Problem

- Historical solutions to the problem
A Shared Problem

• Problem has always been viewed as a “people” problem instead of a “situational” problem
Fundamental Truth

• This is a people-based industry
  – Long-term clients a must
  – Profitability is linked to meeting expectations
Meeting Owner’s Expectations

• J. P. Kotter & J. L. Heskett, ‘Corporate Culture and Performance’, research sponsored by Harvard Business School

Businesses that focus obsessively on meeting the needs of clients:

• Revenues increase 4 times faster
• Job creation is 7 times faster
• Owner equity grows 12 times faster
• Profit performance is 750% higher
Meeting Owner Expectations

• How does Building EQ help build relationships?
Meeting Owner Expectations

• Accurate, reliable method of measuring energy use
• Actionable recommendations to improve energy performance
  – No cost/Low cost Energy Efficiency Measures (EEMs)
• Prepare for the future
Meeting Owner Expectations

• Make building performance a situational problem
  – Holistic approach that involves the owner
  – Motivates continuous improvement
  – Removes obstacles to long-term relationships
Meeting Owner Expectations

- An accurate, reliable method of measuring energy use
- A method of quantifying expectations
- Clear understanding of expectations
Meeting Owner Expectations

- Using ASHRAE Level 1 Energy Audit for ‘In Operation’
  - Preliminary Energy Assessment (PEA)
  - Space Function Analysis
  - Pre-assessment interview
  - Site visit
  - Exit interview
### Meeting Client Expectations

- Preliminary Energy Assessment
- Space Function Analysis

#### Energy Consumption

<table>
<thead>
<tr>
<th>Name of Space</th>
<th>Space Use Type*</th>
<th>Gross Floor Area</th>
<th>Weekly Operating Hours</th>
<th>Weeks/Year</th>
<th># Occupants</th>
<th># PCs</th>
<th>Principal Lighting Type</th>
<th>Principal HVAC Type</th>
<th>% of Spaces Heated</th>
<th>% of Spaces Cooled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basement</td>
<td>Utility</td>
<td>375</td>
<td>16/7/365</td>
<td>52</td>
<td>0</td>
<td>0</td>
<td>Fluorescent</td>
<td>VAV</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Electrical</td>
<td>Utility</td>
<td>2720</td>
<td>16/7/365</td>
<td>52</td>
<td>0</td>
<td>0</td>
<td>Fluorescent</td>
<td>VAV</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Mechanical</td>
<td>Utility</td>
<td>125</td>
<td>16/7/365</td>
<td>52</td>
<td>0</td>
<td>0</td>
<td>Fluorescent</td>
<td>VAV</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Elevator Equipment</td>
<td>Utility</td>
<td>275</td>
<td>16/7/365</td>
<td>52</td>
<td>0</td>
<td>0</td>
<td>Fluorescent</td>
<td>VAV</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Other</td>
<td>Utility</td>
<td>275</td>
<td>16/7/365</td>
<td>52</td>
<td>0</td>
<td>0</td>
<td>Fluorescent</td>
<td>VAV</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>First Floor</td>
<td>Vestibule</td>
<td>220</td>
<td>16/7/365</td>
<td>52</td>
<td>Variable</td>
<td>0</td>
<td>Fluorescent</td>
<td>VAV</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>102</td>
<td>Office</td>
<td>175</td>
<td>16/7/365</td>
<td>52</td>
<td>1</td>
<td>1</td>
<td>Fluorescent</td>
<td>VAV</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>103</td>
<td>Office</td>
<td>120</td>
<td>16/7/365</td>
<td>52</td>
<td>1</td>
<td>1</td>
<td>Fluorescent</td>
<td>VAV</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>
Meeting Client Expectations

• Building a relationship with the O & M staff
  – Pre-assessment interview
  – Site visit
  – Post-assessment interview
Meeting Client Expectations

- Interview topics
  - Equipment condition
  - Maintenance protocols
  - O & M issues
  - Planned improvements
  - Maintenance obstacles
  - Indoor Air Quality problems
  - Persistent comfort problems
  - Excessive maintenance items
  - Planned upgrades
Meeting Client Expectations

• Low Cost – No Cost Energy Efficiency Methods (EEMs)
  – Easy solutions with a quick payback
  – Problems the owner wasn’t aware of
  – Potential areas of risk in relationship building
Meeting Client Expectations

• EEMs provide direct, immediate benefit
  – Piping not insulated
  – Holes in ductwork
  – Equipment not balanced
  – Dampers not working
  – Improper set points
### Suggested Energy Savings Measures by Category:

<table>
<thead>
<tr>
<th>Envelope Suggestions</th>
<th>Cost Range</th>
<th>Payback</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A. Building envelope commissioning every 3 years</td>
<td>$1,000 - $5,000</td>
<td>1-4yrs</td>
</tr>
<tr>
<td>2A. Consider installing high albedo roof when roof needs to be replaced (differential cost)</td>
<td>$25,000</td>
<td>5-10yrs</td>
</tr>
<tr>
<td>3A.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lighting/Daylighting Suggestions</th>
<th>Cost Range</th>
<th>Payback</th>
</tr>
</thead>
<tbody>
<tr>
<td>1B. Replace light bulbs in can lights with LED's</td>
<td>$500 - $1,000</td>
<td>1-4yrs</td>
</tr>
<tr>
<td>2B. Change light controller from manual switches to occupancy sensors where applicable</td>
<td>$1,000 - $5,000</td>
<td>1-4yrs</td>
</tr>
<tr>
<td>3B. Upgrade all exit lights to LED</td>
<td>$1,000 - $1,500</td>
<td>1-4yrs</td>
</tr>
<tr>
<td>4B. Install lighting controls so individuals can vary light levels within their space</td>
<td>$2,000 - $5,000</td>
<td>5-10yrs</td>
</tr>
<tr>
<td>5B. Consider installing daylighting controls on offices on exterior walls</td>
<td>$2,000 - $5,000</td>
<td>1-4yrs</td>
</tr>
<tr>
<td>6B.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Meeting Client Expectations

• Addressing IAQ and human comfort issues
  – Increased productivity
  – Decrease in absenteeism
  – Greater job satisfaction
Increasing Motivation

• How does Building EQ motivate energy conservation?
Increasing Motivation

- You are given $50 and must decide between two options:
  - Option #1 – All or nothing gamble – 40% chance you keep $50 and 60% chance you will lose everything
  - Option #2 – You keep $20

- You are given $50 and must decide between two options:
  - Option #1 – All or nothing gamble – 40% chance you keep $50 and 60% chance you will lose everything
  - Option #2 – You lose $30

Experiment conducted by Bernedetto de Martino
Increasing Motivation

• Humans are wired to “herd” together
Increasing Motivation
Increasing Motivation

• Using Building EQ to motivate energy conservation
Conclusion

- Building EQ is a powerful energy management tool