Building Energy Quotient ASHRAE's Building Energy Labeling Program

Triangle Chapter
May 14. 2014

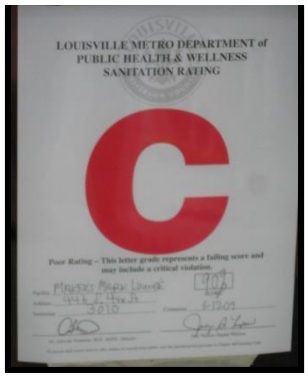
Thomas H. Phoenix, P.E., FASHRAE
ASHRAE President-Elect

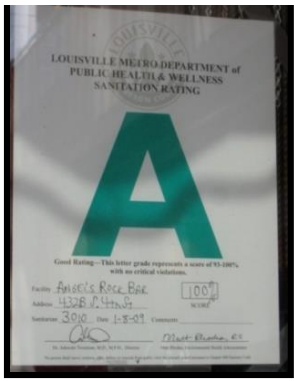
What is Building Energy Labeling?

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

Information for Consumers to Allow Educated Choices is Not New

Restaurant Sanitation Ratings





Nutrition Fact Label

Nutrition Facts

Serving Size 1 cup (140 g)

Servings Per Container *

Amount Per Serving

Calories 80 Calories from Fat 0

	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Cholesterol 0mg	0%
Sodium 0mg	0%
Total Carbohydrate 19g	6%
Dietary Fiber 5g	20%
Sugars 1g	
Protein 1g	

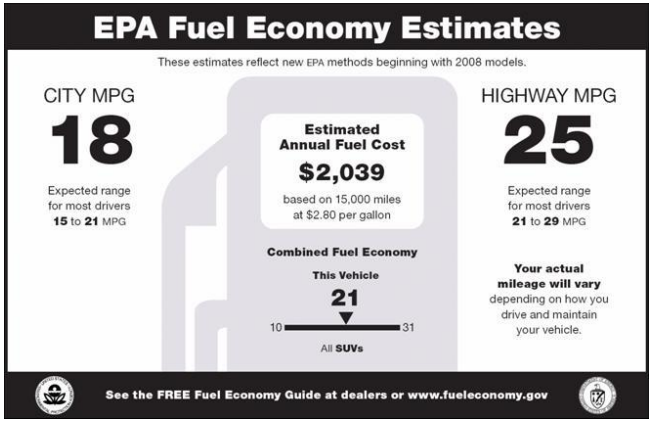
Vitamin A 0% • Vitamin C 15%

Calcium 0% • Iron 0%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories	2,000	2,500
Total Fat	Less Than	65g	80g
Sat Fat	Less Than	20g	25g
Cholesterol	Less Than	300mg	300mg
Sodium	Less Than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Car Fuel Economy Estimates



Building Energy Labels:

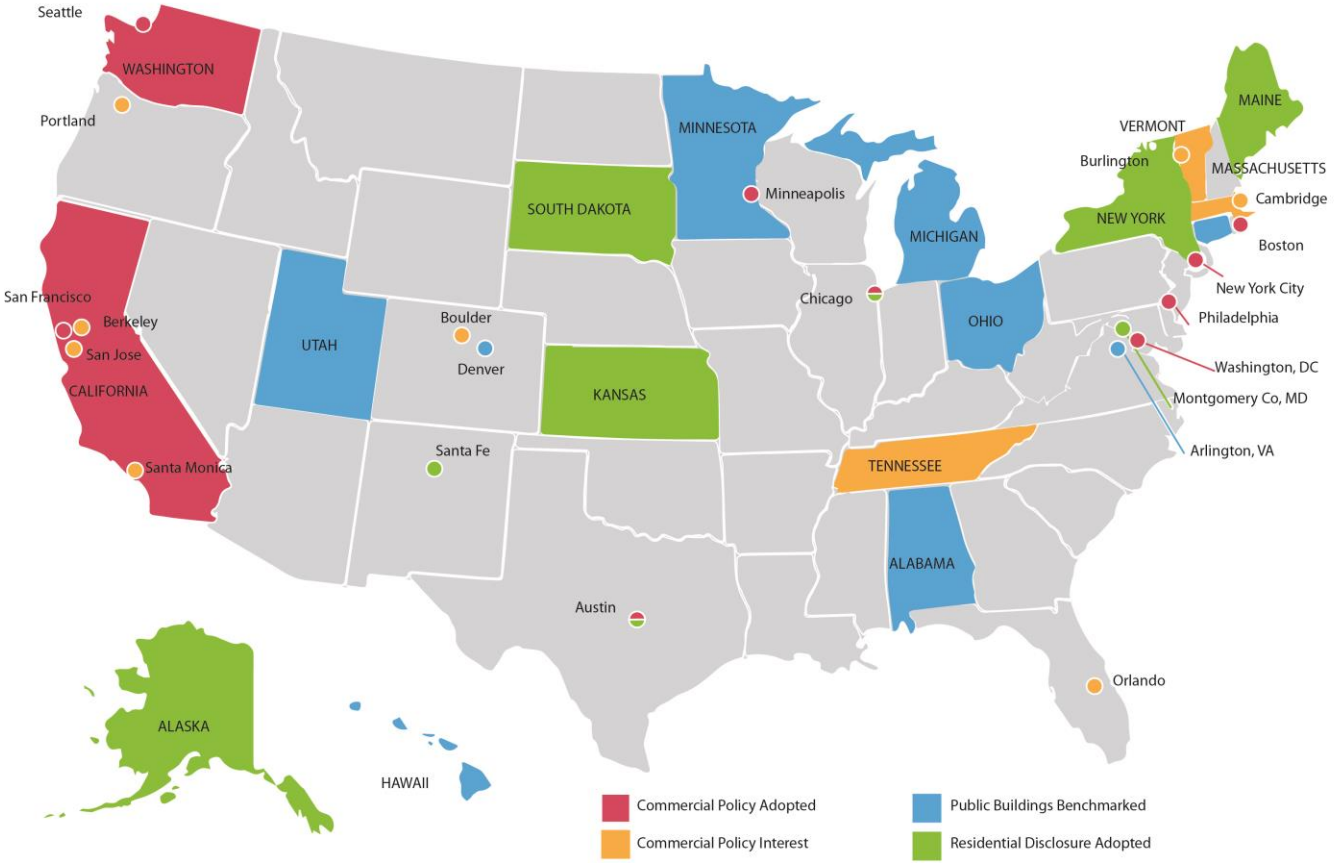
- Promote energy efficiency in real estate
- Differentiate efficient buildings in the marketplace (for tenants/buyers)
- Provide feedback on a building's potential and measured energy use
- Identify energy efficiency measures and value in reducing long-term energy costs
- Add to building performance 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 labeling and disclosure programs

Current State/Local Status

U.S. Building Benchmarking and Disclosure Policies



IMT
INSTITUTE
FOR MARKET
TRANSFORMATION

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

How is bEQ Different?

Different from Benchmark programs:

- Greater differentiation for high performing buildings and emphasis on zero net energy
- Expanded building categories covered via a table of median EUI values by climate zone
- Indentifies opportunities for improved energy performance (In Operation)
- Consistent process to assess energy performance
- Builds a relationship with an ASHRAE Certified Professional or licensed PE

How is bEQ Different?

Different from Green Building programs:

- Focuses solely on a building's energy use
- Focused on understanding energy use
- Indentifies opportunities for improved energy performance (In Operation)
- Allows for comparison between buildings with different operating variables (As Designed)
- bEQ could serve as a consistent energy rating method for both Existing Building and New Construction programs.

Benefits of bEQ

- Consistent analysis of a building's potential and actual energy performance
- Recommendations for reducing energy use with rough costs and paybacks
- Potential for continuous improvement in energy efficiency
- Ability to track and show effectiveness of improvements
- Demonstration of corporate responsibility
- Relationship with an ASHRAE certified professional or licensed PE

bEQ User Feedback

"Thanks to bEQ we were able to investigate the steam consumption data … and to realize that the EMS was totaling the data wrongly. Without the thorough approach encouraged by bEQ, we would likely not have caught that."

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."

bEQ Rating Types

In Operation (operational) rating

- Assessment of the building's structure/features and how it is operated
- Based on actual metered energy use of a building
- Applicable for buildings after at least 12-18 months of operation

bEQ Rating Types

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

Comparing bEQ Ratings

In Operation Rating:

- Actual metered energy use
- 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

bEQ *In Operation* Process

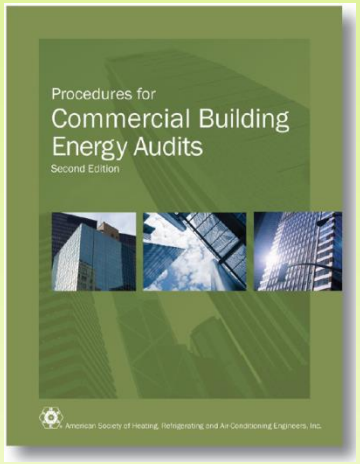
$$(EUI_{measured} / EUI_{median}) \times 100$$

- Compares actual metered energy use of candidate building to median/baseline EUI
- Leads to informed energy management decisions
- Provides information on building's IEQ
- Illustrates benefits of equipment and system investments

bEQ *In Operation* Features

- Includes an ASHRAE Level 1 Energy Audit
- Recommends actions to reduce energy use
- Identifies both peak demand reduction and energy management opportunities
- Recognizes energy use from on-site renewables
- Uses Median EUI's developed from CBECS, using ENERGY STAR Portfolio Manager
- Includes measurement-based IEQ indicators to assure levels of service are maintained

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

bEQ User Feedback

"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 *As Designed* Process

$$(EUI_{standardized} / EUI_{median}) \times 100$$

- Compares standardized modeled energy use of candidate building to median/baseline EUI
- Uses specified modeling inputs of building operating parameters
- Uses ENERGY STAR Target Finder to determine median/baseline EUI
- Includes a table of median/baseline EUIs by climate zone for additional building types

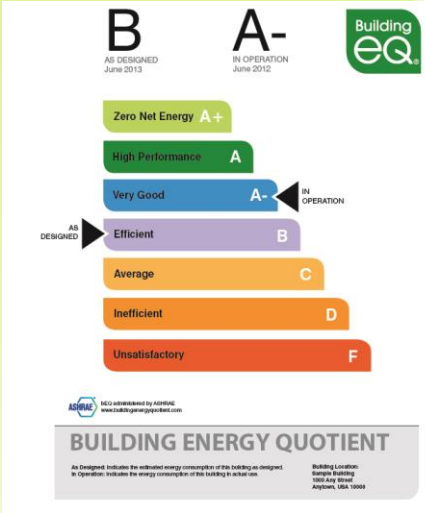
bEQ *As Designed* Features

- Isolates impact of a building's physical charactistics and systems
- Based on an energy model that normalizes for operational variables using standardized inputs and schedules
- Does not predict actual building energy consumption because operational and occupancy parameters aren't customized to the candidate building

Problems with Existing Asset Rating Methodologies

- Results are not comparable among buildings of the same type
- Occupancy parameters not normalized
- Impact of some physical variables neutralized
  - Building Massing
  - Percent of glazing below 40%
- Calculation procedures insufficiently rigorous
- Discrepancies between asset ratings and operational results misunderstood

The bEQ Rating Scale



- The bEQ scale is dimensionless
- Zero point on scale set to “zero net energy”
- Median value (100) set to national median EUI of CBECS for that building type
- Score can go below zero for net energy producing buildings
- Bottom half of scale exceeds 100 for “inefficient” and “unsatisfactory” buildings with high energy usage

The bEQ Rating Scale

Scale Range	Rating	Description
≤ 0	A+	Zero Net Energy
1-25	A	High Performance
26-55	A-	Very Good
56-85	B	Efficient
86-115	C	Average
116-145	D	Inefficient
>145	F	Unsatisfactory

Building Certification Requires Qualified Professionals

- bEQ program requires an ASHRAE certified professional or a PE licensed in the jurisdiction where the project is located
  - Building Energy Assessment Professional (BEAP) for the In Operation rating.
  - For information: www.ashrae.org/BEAP
  - Building Energy Modeling Professional (BEMP) for As Designed Rating
  - For information: www.ashrae.org/BEMP

Getting Started with a bEQ *In Operation* Rating

www.buildingenergyquotient.org

In Operation Workbook

- 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
- Metered Data Worksheets
- Additional Notes

In Operation Workbook

Building Energy Quotient
ASHRAE's Building Energy Labeling Program

Copyright ©2012 ASHRAE, Inc.

Worksheet Updated 4/8/2013

FORM 1 - BUILDING CHARACTERISTICS FOR IN OPERATION RATING

Building Name:		Assessment Date:	
Address:			
City:	State/Prov:	Zip/Post:	
Building Owner:			
Building Contact/Title:		Phone:	
Address:		E-mail:	
City:	State/Prov:	Zip/Post:	
Assessor/Company:		Phone:	
Address:			
City:			
DOE Climate Zone:			
Gross Floor Area (ft²):			
Conditioned Area, hea			
Number of Conditione			
Original Year of Constr			
Brief Building Descript			
Description of On-Site			
Description of Major R			
Building Systems Com			

- ☐ ENERGY STAR Ratin
- ☐ LEED Rating & Vers
- ☐ GreenGlobes Ratin
- ☐ Other Rating:
- ☐ Designed to meet
- ☐ Designed to meet
- ☐ Designed to meet
- (Specify):
- ☐ Designed to meet
- Version:

Building Energy Quotient
ASHRAE's Building Energy Labeling Program

Copyright ©2012 ASHRAE, Inc.

Worksheet Updated 4/8/2013

FORM 2 - ENERGY CALCULATIONS FOR IN OPERATION RATING

Utility Information and Rating Calculation

Annual Energy Use by Fuel Type	Value	Units	Conversion Factor	Site Energy - kBtu	Source-Site Ratio	Source Energy (kBtu)	Billed Energy Cost - $$
Electricity		kWH	3.413	0	3.34	0	
Natural Gas		Therm	100	0	1.047	0	
Fuel Oil (1,2,4,5,6,Diesel, Ker, etc)			12	0	1.01	0	
LPG		kBTU	1	0	1.01	0	
Steam		kBTU	1	0	1.21	0	
Hot Water		kBTU	1	0	1.28	0	
Chilled Water		kBTU	1	0	1.05	0	
Wood / Biomass		kBTU	1	0	1.0	0	
Coal/Coke		kBTU	1	0	1.0	0	
Other		kBTU		0	1.0	0	
TOTAL BUILDING ENERGY USE				0		0	
Qualified Renewable Energy				0	1.0	0	
Percent Qualified Upstream Renewable Energy:				0			
NET ENERGY USE				0		0	0
Gross Floor Area				0			
Measured EUIs (kBtu/ft²-yr)			Site EUI:	0	Measured Source EUI:	0	
Normalized Source EUI obtained from Portfolio Manager (for covered building types)					Normalized Source EUI:		
Building Type					Median EUI:		
BuildingEQ Rating					(Source/Median)*100:		

Building Energy Quotient
ASHRAE's Building Energy Labeling Program

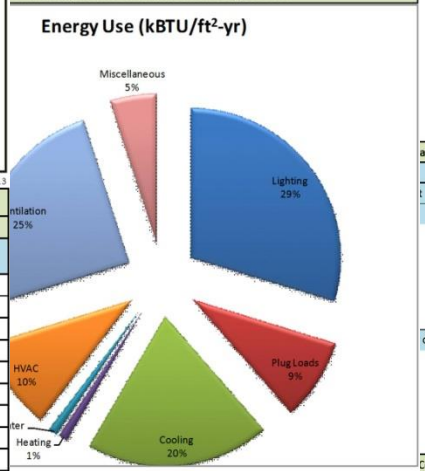
Copyright ©2012 ASHRAE, Inc.

Worksheet Updated 4-8-2013

FORM 5 - ENERGY END USE BREAKDOWN FOR IN OPERATION RATING

Optional Form - Use if data are available

automatically be built from entered data in the space below.



Building Energy Quotient
ASHRAE's Building Energy Labeling Program

Worksheet Updated 4-8-2013

QUALITY (IEQ) SCREENING INFORMATION

onditions

resolved issues for further investigation)

al Comfort

diffusers; personal fans or space heaters):

Comfort Issues (where applicable)

Instrument(s) last calibration date:

Outdoor CO_2

Required measurements

Optional space measurements

Location	Space Type	AIR T	RH	T FLR	VERT dT	dBA	FPM Air	CO_2	ABS psi

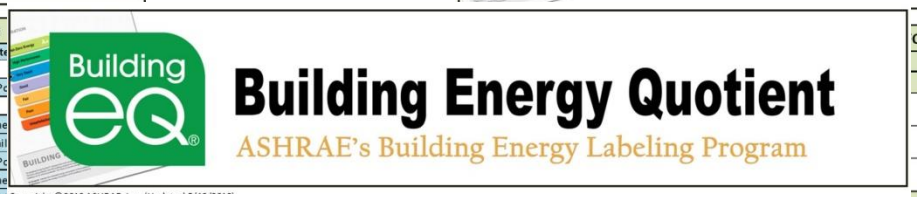
Getting Started with a bEQ *As Designed* Rating

www.buildingenergyquotient.org

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
- Additional Notes
- Standardized Modeling Input Workbook

As Designed Workbook



Copyright ©2012 ASHRAE, Inc.

Worksheet Updated 5-10-2013

FORM 1 - BUILDING CHARACTERISTICS FOR IN OPERATION RATING

Building Name:		Assessment Date	
Address:			
City:	State/Prov:	Zip/Pc	
Building Owner:			
Building Contact/Title:		Phone	
Address:		E-mail	
City:	State/Prov:	Zip/Pc	
Assessor/Company:		Phone	
Address:			
City:			
DOE Climate Zone:			
Gross Floor Area (ft^2):			
Conditioned Area, heated only (ft^2):			
Number of Conditioned Floors:			
Original Year of Construction:			
Brief Building Description:			
Description of On-Site Renewable Energy Sys			
Description of Major Renovations (including y			
Building Systems Commissioned (including y			

- ☐ ENERGY STAR Rating:
- ☐ LEED Rating & Version:
- ☐ GreenGlobes Rating:
- ☐ Other Rating:
- ☐ Designed to meet NBI Core Performance
- ☐ Designed to meet ASHRAE Advance Energ
- ☐ Designed to meet other new construction
- (Specify):
- ☐ Designed to meet state energy code
- Version:

Copyright ©2013 ASHRAE, Inc.

Worksheet Updated 5-10-2013

FORM 2 - ENERGY CALCULATIONS FOR AS DESIGNED RATING

Modeled Standardized Energy Use Information and Rating Calculation

Annual Energy Use by Fuel Type	Value	Units	Conversion Factor	Site Energy - kBtu	Source-Site Ratio	Source Energy (kBtu)
Electricity		kWH	3.413	0	3.34	0
Natural Gas		Therm	100	0	1.047	0
Fuel Oil (1,2,4,5,6,Diesel, Ker, etc)			12	0	1.01	0
LPG		kBTU	1	0	1.01	0
Steam		kBTU	1	0	1.21	0
Hot Water		kBTU	1	0	1.28	0
Chilled Water		kBTU	1	0	1.05	0
Wood / Biomass		kBTU	1	0	1.0	0
Coal/Coke		kBTU	1	0	1.0	0
Other		kBTU		0	1.0	0
TOTAL BUILDING ENERGY USE				0		0
Qualified Renewable Energy				0	1.0	0
Percent Qualified Upstream Renewable Energy:				0		
NET ENERGY USE				0		0
Gross Floor Area				0		
Modeled Standardized EUIs (kBtu/ft^2-yr)			Site EUI:	0	Source EUI:	0
Building Type					Median EUI:	
BuildingEQ Rating					**(Source/Median)*100:**	

STANDARDIZED MODELING INPUTS TABLE

	Heat Rate/ Heat Gain (Btu/occupant)		Minimum Ventilation (cfm/ft²)		Maximum Infiltration (ac/h)	
	Sensible	Latent	Off	On	On	Off
	246	171	0.00	0.32	0.32	0.29
	246	171	0.00	0.32	0.32	0.29
	246	171	0.00	0.32	0.32	0.29
			0.00	0.27	0.23	0.26
	100	250	0.00	0.25	0.23	0.26
	100	250	0.00	0.25	0.23	0.26
	100	250	0.00	0.25	0.23	0.26

OR AS DESIGNED RATING

Notes

Notes

t Construction Type		
Wall Area (ft^2)(m^2)		
w to Wall Ratio		
ndow Area (ft^2)(m^2)		
dow Shading (Y/N)		
t Construction Type		
Roof Area (ft^2)(m^2)		
t to Roof Ratio		
t Foundation Type	Other	
t Construction Type		
- Total Area (ft^2)(m^2)		
struction		
l Construction modeled		
l Wall Area (ft2)(m2)		
or Construction modeled		
l Floor Area (ft2)(m2)		
hermal Mass modeled		

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 Certificate

Building Energy Quotient Certificate

Building Address:	Building Owner:	Primary Contact for Facility:
Building Type:	Year Built:	Gross Floor Area (sq.ft.):

Name of certified Building Energy Modeling Professional (BEMP) :	Name of certified Building Energy Assessor Professional (BEAP) :

Part 1 - Building EQ Rating

ASHRAE Building Energy Quotient As Designed Rating	*ASHRAE Building Energy Quotient* In Operation Rating
Rating # = Description	Rating # = Description
Awarded: Month, Yr	Awarded: Month, Yr

Part 2 – EPA Energy Star Rating for Jurisdictional Compliance

EPA ENERGY STAR Target Finder Rating # For the Year of 20--	*EPA ENERGY STAR Portfolio Manager* Rating # For the Year of 20--
DATE of ENERGY STAR (SEDI) Statement of Energy Design Intent:	DATE of ENERGY STAR (SEP) Statement of Energy Performance:

Part 3 - Building Energy Use Summary

Standardized Energy Use Site	Standardized Energy Use Source	Energy Use Summary (kBtu)	Measured Energy Use Site	Measured Energy Use Source
0	0	Natural Gas	0	0
0	0	Electricity	0	0
0	0	Fuel Oil	0	0
0	0	Purchased Steam	0	0
0	0	Purchased Chilled Water	0	0
0	0	Other ( )	0	0
0	0	Other ( )	0	0
0	**0**	**Total Energy Use**	**0**	**0**
0	0	Qualified Renewable Energy	0	0
0	0	Renewable % of Total	0	0
0	**0**	**Net Energy Usage**	**0**	**0**

Energy Use Intensity (kBtu/sf-yr)

Standardized As-Built Site	Standardized As-Built Source	Measured Site	Measured Source
0	0	0	0

Area left blank intentionally

Information to be added

Energy Cost Index ($/sf/yr): NA

Electric Load Factor (%): _____

Peak Electricity Demand: kW ____ Month: ____

Electricity Tariff Type: _____

Natural Gas Tariff Type: _____

Other Tariff Type: _____

Design and Operational Details

Building name:

Part 4: Building Energy Design/Operational Features

- ☐ Designed to meet minimum state energy code: _____
- ☐ Designed to meet ASHRAE AEDG for building type: _____
- ☐ Designed for USGBC LEED rating. Rating _____ EA Points ____
- ☐ Designed for Green Globes. Rating: ____
- ☐ Designed to Earn the ENERGY STAR
- ☐ Designed to meet NBI Core Criteria
- ☐ Designed to meet a new construction program (specify) _____

List Top Five Energy Efficiency Design Features:

1. _____
2. _____
3. _____
4. _____
5. _____

- ☐ Design benchmarked to ASHRAE Standard 90.1-20___ following the procedures in Informative Appendix G and achieves a ___% improvement over the baseline.

Building Subsystem Design Performance Indicators

COMcheck Version: _____

Baseline Reference Code: _____

- ☐ This building envelope design achieves a _____% improvement over the baseline reference code.
- ☐ This building lighting design achieves a _____% improvement over the baseline reference code.
- ☐ This building HVAC design achieves a _____% improvement over baseline reference code.
- ☐ Design incorporates Submetering

Completed IEQ Measurements for:

- ☐ Thermal Comfort
- ☐ Lighting Quality
- ☐ Indoor Air Quality

Design Credentials:

- ☐ State Energy Code: _____
- ☐ Other: _____

Operational Credentials:

- ☐ Energy Star: Yr_____ Score_____
- ☐ Other: Yr_____ Score _____
- ☐ LEED (version): _____ Yr_____ EA Points_____

Energy Efficient Improvements since Construction:

Item: _____ Date: _____

Item: _____ Date: _____

Item: _____ Date: _____

On Site Renewable Energy Systems:

Item: _____ Capacity: _____

Item: _____ Capacity: _____

Commissioned Building systems:

Item: _____ Date: ____

Item: _____ Date: ____

Major Renovations:

Item: _____ Date: ____

Item: _____ Date: ____

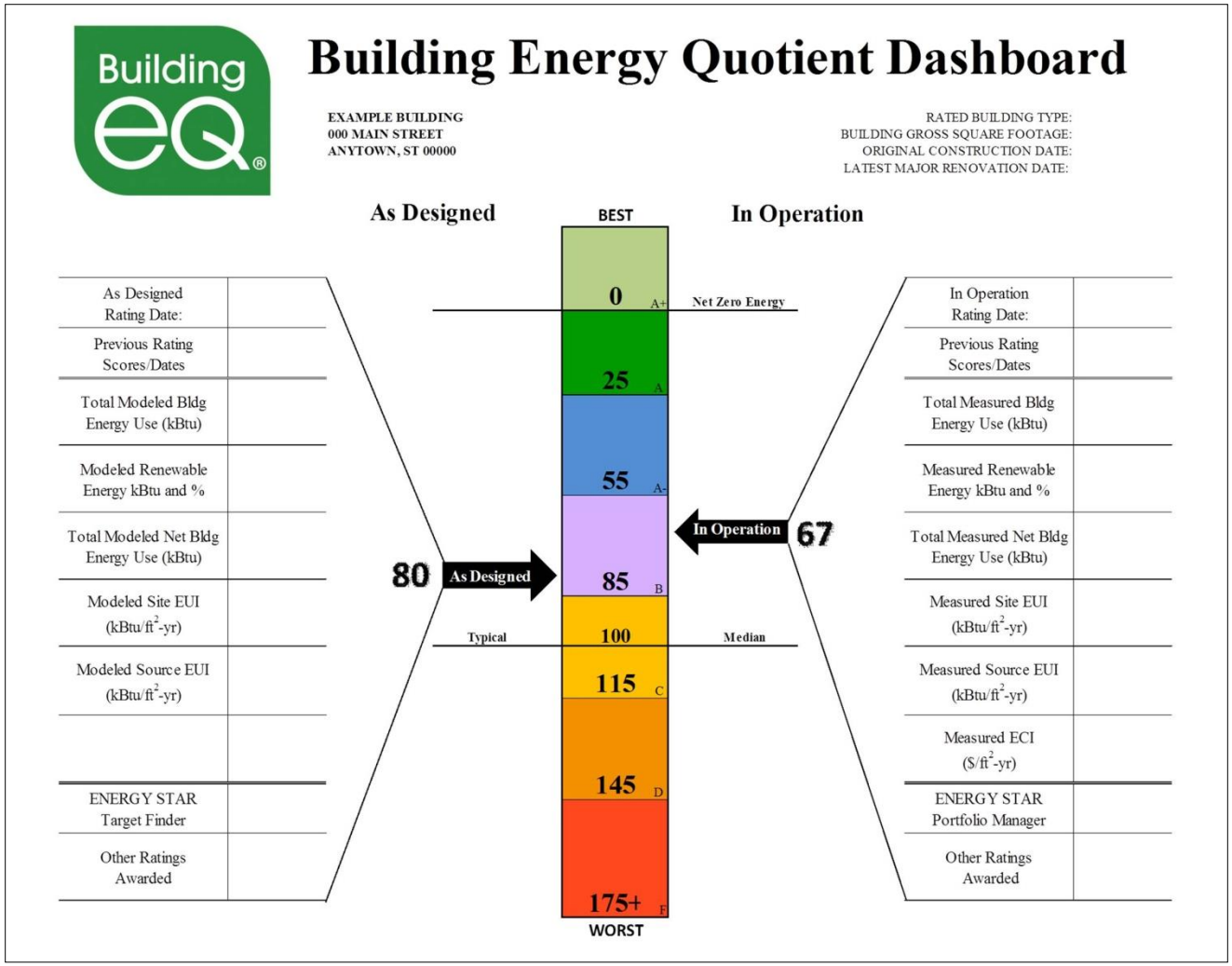
Recommendations for Energy Efficiency Improvements shown in attached list.

- ☐ Building includes Submetering

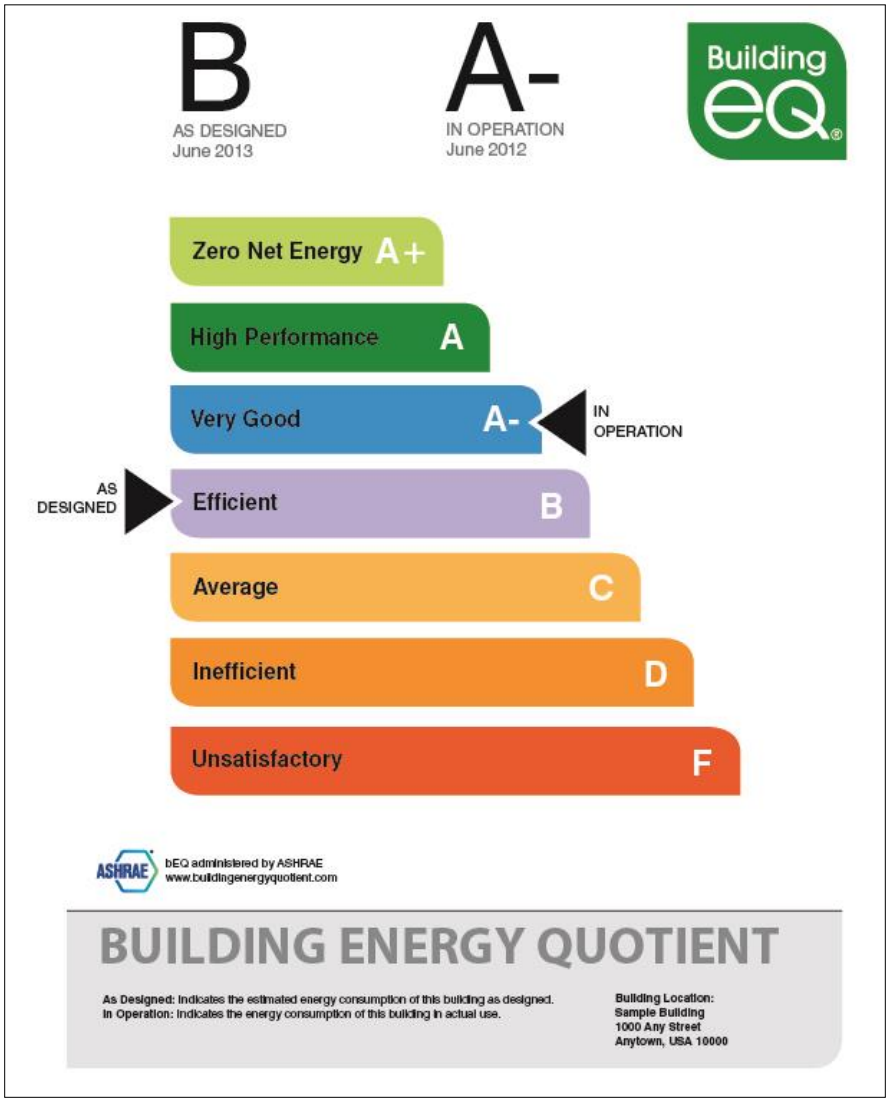
Building Energy Use by Subsystem End Use

Estimated Building Design by Subsystem End Use	kBtu/sf-yr	Measured Energy Use by Subsystem End Use
	Heating	
	Cooling	
	Fans & Pumps	
	Lighting	
	Service Water Heating	
	(Other)	
	(Other)	
0	**Total**	**0**

bEQ Dashboard



bEQ Plaque


B
AS DESIGNED
June 2013
A-
IN OPERATION
June 2012
Building eQ
Zero Net Energy A+
High Performance A
Very Good A-
IN OPERATION
AS DESIGNED
Efficient B
Average C
Inefficient D
Unsatisfactory F
ASHRAE
bEQ administered by ASHRAE
www.buildingenergyquotient.com
BUILDING ENERGY QUOTIENT
As Designed: Indicates the estimated energy consumption of this building as designed.
In Operation: Indicates the energy consumption of this building in actual use.
Building Location:
Sample Building
1000 Any Street
Anytown, USA 10000

bEQ Status

- *In Operation* Rating Available for 42 building types
- *As Designed* Rating Available for select building types
- Website: www.buildingenergyquotient.org
  - Download forms & brochure
  - Find a certified professional
  - Frequently asked questions

Thank You for Your Attention!

For More Information on bEQ:

www.buildingenergyquotient.org

General questions about bEQ:

info@buildingenergyquotient.org

Technical questions about bEQ:

assessement@buildingenergyquotient.org

Questions?

www.buildingenergyquotient.org