

Benchmarking EPA Portfolio Manager and Energy Star Certification



What is Benchmarking?

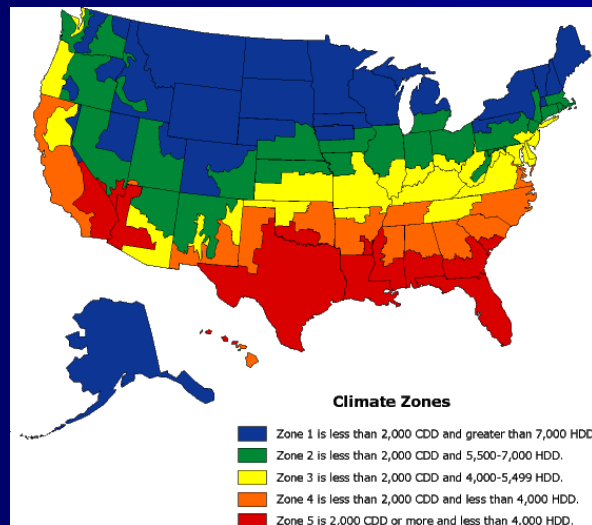
- Energy Benchmarking is the practice of comparing any given building to similar buildings for the purpose of evaluating energy performance.
- "How does my building compare to...
 - ...my building last year"
 - ...all buildings in the Northeast"
 - ...all buildings in the Northeast that use natural gas"
 - ...all buildings in the Northeast for which the primary activity is education"

Typical Benchmarking Criteria

- Building Use ("Primary Activity")
- Building Size
- Building Location
- Building Systems and Fuels

Building Location

- Benchmark against buildings in similar climatic regions



Building Systems

- Type of heating/cooling system
 - Efficiency and fuel type impact energy consumption and related emissions.



Performance Metrics

- Energy Use Intensity (EUI)
 - Normalizes energy use by square footage
 - Can focus on a specific energy source (i.e. electricity or fuel) or can include all energy sources
 - Can represent "Site" or "Source" energy usage

Other Performance Metrics

- Occupied W/SF
- Unoccupied W/SF
- Electricity Cost \$/SF
- Fuel Cost \$/SF
- Energy Consumption per Unit of Production (Manufacturing)

“Site” vs. “Source” Energy

- Site Energy

- Accounts for energy consumed on-site (electricity and fuel)

- Source Energy

- Accounts for energy consumed off-site for production and delivery (i.e. power plant inefficiencies for electricity, boiler inefficiencies for district heating)

"Site" vs. "Source" Energy



Source Energy



Site Energy

"Site" vs. "Source" Energy

Fuel Type	Source-Site Ratio
Electricity (Grid Purchase)	3.340
Electricity (on-Site Solar or Wind Installation)	1.0
Natural Gas	1.047
Fuel Oil (1,2,4,5,6,Diesel, Kerosene)	1.01
Propane & Liquid Propane	1.01
Steam	1.45
Hot Water	1.35
Chilled Water	1.05
Wood	1.0
Coal/Coke	1.0
Other	1.0

Source: EPA Portfolio Manager

Energy Use Intensity

- Expressed in kBtu/ft²
 - Conversion Factors:
 - 1 therm gas = 100kBtu
 - 1 gallon oil = 140kBtu
 - 1 kWh electricity = 3.413kBtu

Example: EUI Calculation

- In 2008, a 250,000ft² office building used:

- 5,579,100kWh
- 79,375therms of gas

- Site EUI

Electric: 76.2kBtu/ft²

Fuel: 31.8kBtu/ft²

Total: 108.0kBtu/ft²

- Source EUI

Electric: 76.2kBtu/ft² x 3.340 = 254.5kBtu/ft²

Fuel: 31.8kBtu/ft² x 1.047 = 33.3kBtu/ft²

Total: 287.8kBtu/ft²

Weather Normalization

- Corrects energy consumption for abnormal weather conditions
- Weather quantified in Heating and Cooling Degree-Days
 - # HDD = $65^{\circ}\text{F} - \text{avg. air temp}$
 - # CDD = $\text{avg. air temp} - 65^{\circ}\text{F}$
- "Typical Meteorological Year" data is a collection of weather observations produced by NREL

"Normal" Weather

Weather Norms

1971 - 2000

<http://www.weather.gov/climate/xmacis.php?wfo=box>

LOCATION: Boston, MA

Month	HDD	CDD	Total
January	1092	0	1092
February	941	0	941
March	804	1	805
April	493	4	497
May	226	32	258
June	46	144	190
July	4	285	289
August	7	240	247
September	81	80	161
October	337	7	344
November	596	1	597
December	930	0	930
TOTAL	5557	794	6351

LOCATION: Washington D.C.

Month	HDD	CDD	Total
January	894	0	894
February	730	0	730
March	549	5	554
April	262	22	284
May	67	113	180
June	4	314	318
July	0	467	467
August	1	414	415
September	20	213	233
October	195	34	229
November	462	4	466
December	757	0	757
TOTAL	3941	1586	5527

LOCATION: Chicago, IL

Month	HDD	CDD	Total
January	1314	0	1314
February	1060	0	1060
March	842	1	843
April	501	10	511
May	220	54	274
June	48	173	221
July	4	296	300
August	8	247	255
September	106	99	205
October	386	12	398
November	751	0	751
December	1146	0	1146
TOTAL	6386	892	7278

LOCATION: Minneapolis, MN

Month	HDD	CDD	Total
January	1594	0	1594
February	1271	0	1271
March	1017	0	1017
April	551	4	555
May	212	43	255
June	44	150	194
July	6	266	272
August	18	197	215
September	172	58	230
October	504	4	508
November	971	0	971
December	1433	0	1433
TOTAL	7793	722	8515

LOCATION: Miami, FL

Month	HDD	CDD	Total
January	57	161	218
February	35	159	194
March	13	245	258
April	1	322	323
May	0	451	451
June	0	518	518
July	0	577	577
August	0	576	576
September	0	525	525
October	0	440	440
November	4	297	301
December	37	199	236
TOTAL	147	4470	4617

LOCATION: El Paso, TX

Month	HDD	CDD	Total
January	631	0	631
February	423	1	424
March	277	8	285
April	105	72	177
May	10	251	261
June	0	487	487
July	0	545	545
August	0	482	482
September	8	304	312
October	94	73	167
November	383	2	385
December	619	0	619
TOTAL	2550	2225	4775



Example: Weather Normalization

Boston, MA	HDD	CDD	Total	Adjustment
Normal (TMY2)	5557	794	6351	n/a
2008	5426	789	6215	add 2.19%
2009	5653	591	6244	add 1.71%
2011	5268	968	6236	add 1.84%
2012	4961	915	5876	add 8.08%

Weather Normalization Applied

- Back to our 250,000ft² office building (2008 Data)
 - Electric EUI = 76.2kBtu/ft²
 - Natural Gas EUI = 31.8kBtu/ft²
 - Total EUI = 108.0kBtu/ft²
- Weather Normalized EUIs
 - Electric = $76.2 * 102.19\% = 77.9\text{kBtu/ft}^2$
 - Natural Gas = $31.8 * 102.19\% = 32.5\text{kBtu/ft}^2$
 - Total = 110.4kBtu/ft^2

Benchmarking Databases

- Benchmarking is only meaningful if the database provides an accurate comparison
- Commercial Buildings Energy Consumption Survey (CBECS)
- EPA Portfolio Manager (uses CBECS and other data sources)

Compare Your Building to Itself

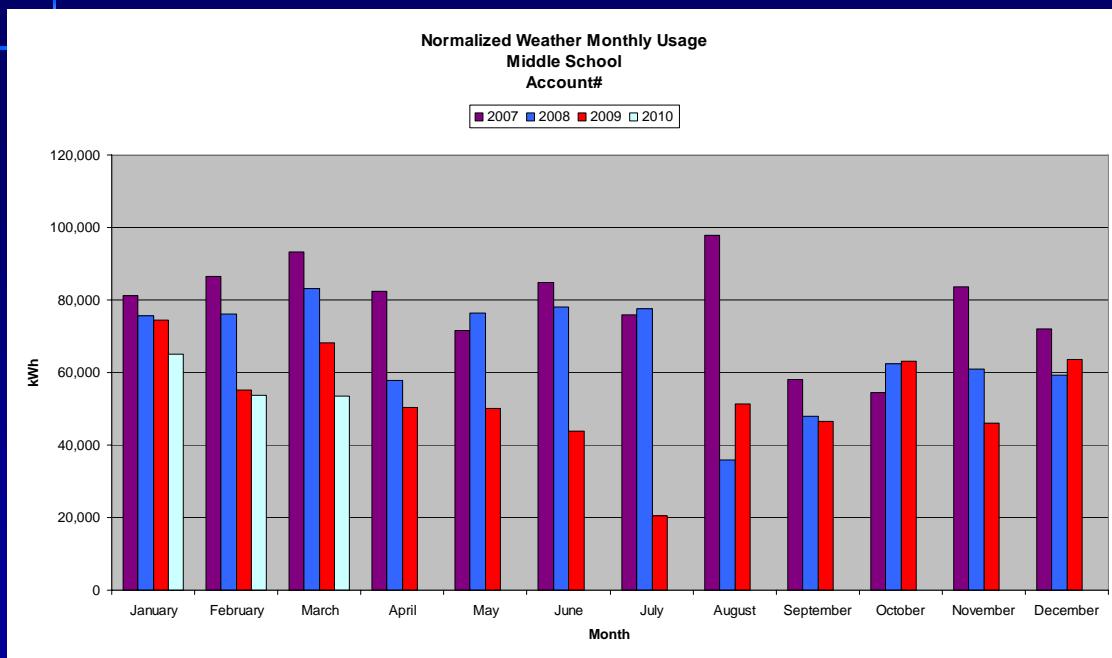
- Track changes in energy consumption
- Verify savings of energy efficiency projects
- Identify energy waste early
- Sub-metering adds resolution to data

Example: Internal Benchmarking

Middle School in Central Massachusetts; began RCx work at the end of 2007, continuing through 2008

Electricity Consumption	2007	2008	2009	% Savings (2009 relative to 2007)
Raw Data (kWh)	943,026	818,239	656,595	30.3%
Weather-Normalized (kWh)	941,826	791,336	633,256	32.8%

Example: Internal Benchmarking



Energy Management Process

- Assess current energy performance
- Establish baselines
- Determine target facilities
- Set reduction goals
 - Create an action plan and get commitments
 - Implement action plan
- Evaluate progress
 - Compare expected to actual savings
- Track and compare to predicted savings over time
- Recognition for improvements



Portfolio Manager

- Normalizes building variables affecting energy consumption
 - Weather
 - Hours of operation
 - Occupant density
- Benchmarks for comparison
- Compares to similar buildings nationally
- Creates a *whole building* rating

Portfolio Manager Performance Ratings

- Based on CBECS 2003 (does not “add to” or “update” the database for buildings in Portfolio Manager)
- Uses a linear regression analysis of several variables which impact energy usage (different variables for each building type)
- Predicts energy usage based on a building’s characteristics

Set Energy Performance Target

- One way of setting goals
- Can set goals by:
 - Specific target number
 - Targeted % reduction

Using Portfolio Manager for Documenting Energy Performance

- As a tool:
 - Download data to Excel for analysis
 - Import utility data for several facilities at once
 - Graphs and Comparison Charts
- To support business:
 - LEED for Existing Buildings (LEED-EB) requirements
 - Support mortgage, sale, and/or lease transactions
 - Document performance in energy service contracts
 - Communicate energy performance with tenants


Sample Benchmarks by Building Type

TABLE 1 2003 CBECS ¹ National Average Source Energy Use and Performance Comparisons by Building Type			
Building Use Description ²	Average Source EUI ³ (Kbtu/Sqft)	Average Percent Electric	Average Site EUI (Kbtu/SqFt)
Education	170	63%	76
K-12 School	<i>See Target Finder / Portfolio Manager</i>		
College/University (Campus-level)	280	63%	120
Food Sales	681	86%	225
Grocery Store/Food Market	<i>See Target Finder / Portfolio Manager</i>		
Convenience store (with or without Gas Station)	753	90%	241
Food Service	786	59%	351
Restaurant/Cafeteria	612	53%	302
Fast Food	1306	64%	534
Health Care: Inpatient (Specialty Hospitals, Excluding Children's)	468	47%	227
Hospital (Acute Care, Children's)	<i>See Target Finder / Portfolio Manager</i>		
Health Care: Long Term Care (Nursing Home, Assisted Living)	255	54%	124
Health Care: Outpatient	183	72%	73
Clinic/Other Outpatient Health	219	76%	84
Medical Office	<i>See Target Finder / Portfolio Manager</i>		

Energy Star Label

- Steps:
 - Score ≥ 75
 - Have PE verify building operations and score
 - Module 1: Physical Characteristics
 - Module 2: Operating Characteristics
 - Module 3: Energy Consumption
 - Module 4: Thermal Comfort (ASHRAE 55)
 - Module 5: Illumination (IESNA)
 - Module 6: Ventilation for Acceptable Indoor Air Quality (ASHRAE 62)
 - Submit Statement of Energy Performance and Application and Letter of Agreement.

Statement of Energy Performance



STATEMENT OF ENERGY PERFORMANCE
Office Sample Facility

Building ID: 1678984
For 12-month Period Ending: May 31, 2009
Date SEP becomes Ineligible: September 28, 2009

Date SEP Generated: August 27, 2009

<p>Facility Office Sample Facility 1234 Main Street Charlotte, NC 28227</p>	<p>Facility Owner Sample Owner 1500 Test Avenue Charlotte, NC 28227 555-555-5555</p>	<p>Primary Contact for this Facility Jane Smith 1500 Test Avenue Charlotte, NC 28227 555-555-5555 jms@jmsmith.com</p>
------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------

Year Built: 2000
Gross Floor Area (ft²): 53,232

Energy Performance Rating: (1-100) 85

Site Energy Use Summary¹	
Electricity - Grid Purchases (kBtu)	2,288,770
Natural Gas (kBtu) ²	1,162,996
Total Energy (kBtu)	3,451,766

Energy Intensity³	
Site (kBtu/ft ² -yr)	65
Source (kBtu/ft ² -yr)	169

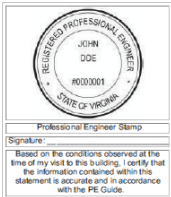
Emissions (based on site energy use)	
Greenhouse Gas Emissions (MTCO ₂ e/year)	409

Electric Distribution Utility	
Duke Energy Carolinas, LLC	

National Average Comparison	
National Average Site EUI	102
National Average Source EUI	261
% Difference from National Average Source EUI	-38%
Building Type	Office

Meets Industry Standards for Indoor Environmental Conditions:	
Verification for Acceptable Indoor Air Quality	Yes
Acceptable Thermal Environmental Conditions	Yes
Adequate Illumination	Yes

Professional Engineer
License Number: 0000203
State: NC
John Doe
33 Country Lane
Charlotte, NC 28227
555-555-7788



Professional Engineer Stamp
Signature: _____
Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate and in accordance with the PE Guide.

Notes:
1. Information for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR seal and seal approval is received from EPA.
2. The EPA Energy Performance Rating is based on site energy use. A rating of 70 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, averaged for a 12-month period.
4. Values for emissions are for carbon dioxide (CO₂), CH₄ and converted to site with adjustments made for emissions based on Facility use code.
5. Values represent energy intensity, averaged for a 12-month period.
6. Based on Energy STAR's Standard 10 for compliance to acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and Efficacy Lighting Handbook for lighting quality.

The government estimates the average time needed to build this form is 1 hour. Includes the time for entering energy data, PE facility inspection, and submitting the SEP and electronic registration to determine the level of effort based on average performance. (OMB control number for the Director, Collection Information Systems (15) EPA-3025-123) Personal use only. 1000 Washington, D.C. 20460.

EPA Form 5900-16 Tracking Number: SEP20090 8270001037162

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Part 6

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Benefits of Energy Star Label

- Decal on building provides visibility
- Improves image of company with potential investors and customers
- Sends positive message to employees or tenants regarding sustainability
- Better productivity
- Increased property/rental value