Benchmarking Your Building

Jean Ascoli
Registered Architect / Energy Analyst
SEDAC
University of Illinois at Urbana-Champaign
Presentation Overview

1. What is benchmarking?
2. Why benchmark?
3. Factors to consider
4. Types of benchmarking
5. How to benchmark your facility
1. What is benchmarking?

Comparing energy use of a single building or group of buildings:
- To a baseline from previous years
  And/Or
- To similar facilities
2. Why benchmark?

An integral part of **effective energy management**, benchmarking can help to:

- Assess current performance
- Prioritize facilities for improvements
- Identify best practices
- Set appropriate goals
- Evaluate and measure progress
- Rank facility performance
3. Factors to Consider

Things that can influence changes in annual building energy consumption:

- Weather
- Occupancy levels
- Schedules
- Tasks performed
- Equipment changes
- Energy efficiency measures
- Etc.
4. Types of Benchmarking

What is the basis for comparison?

A. **Single building** (i.e. baseline benchmarking)

B. **Multiple buildings** within one institution (e.g. all of one college’s facilities)

C. **Similar buildings** outside your institution (e.g. IGEN campuses, SEDAC database, etc.)

D. Similar buildings in a **national database** (e.g. ENERGY STAR® Target Finder)

➢ Let’s get started!
5. How to Benchmark

A. **Single building** (i.e. baseline benchmarking)

B. **Multiple buildings** within one institution (e.g. all of one college's facilities)

C. **Similar buildings** outside your institution (e.g. IGEN campuses, SEDAC database, etc.)

D. **Similar buildings in a national database** (e.g. ENERGY STAR® Target Finder)
5. How to Benchmark

A. **Single building** (i.e. baseline benchmarking):

   Create a baseline for your facility (or facilities) and use that information for ongoing comparisons.
   
i. Collect at least 12 months of energy bills
   
ii. Confirm the gross floor area
   
iii. Determine the baseline metrics
5. How to Benchmark

A. Single building (i.e. baseline benchmarking): Create a baseline for your facility (or facilities) and use that information for ongoing comparisons.
   
i. Collect at least 12 months of energy bills
   ii. Confirm the gross floor area
   iii. Determine the baseline metrics
5. How to Benchmark

A. Single building...Create a baseline for your facility (or facilities).
   
i. **Collect at least 12 months of energy bills** (24 or 36 months is even better). Input that information into a spreadsheet including all energy sources (typically electric and natural gas), and cost by energy source. Calculate total annual consumption and cost.

<table>
<thead>
<tr>
<th>&quot;Month&quot;</th>
<th>Total Usage (kBTU)</th>
<th>Usage (therms)</th>
<th>Gas Usage (kBTU)</th>
<th>Bldg. Gas (cost)</th>
<th>Usage (kWh) Building</th>
<th>Bldg Elec Usage (kBTU)</th>
<th>Bldg Elec. (cost)</th>
<th>Total Energy Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>April-10</td>
<td>31,749</td>
<td>166</td>
<td>16,600</td>
<td>$217.32</td>
<td>4,440</td>
<td>15149</td>
<td>$604.71</td>
<td>$822.03</td>
</tr>
<tr>
<td>May-10</td>
<td>17,576</td>
<td>27</td>
<td>2,700</td>
<td>$35.35</td>
<td>4,360</td>
<td>14876</td>
<td>$593.81</td>
<td>$629.16</td>
</tr>
<tr>
<td>June-10</td>
<td>20,463</td>
<td>4</td>
<td>400</td>
<td>$5.24</td>
<td>5,880</td>
<td>20063</td>
<td>$800.83</td>
<td>$806.06</td>
</tr>
<tr>
<td>July-10</td>
<td>18,588</td>
<td>3</td>
<td>300</td>
<td>$3.93</td>
<td>5,360</td>
<td>18288</td>
<td>$730.01</td>
<td>$733.93</td>
</tr>
<tr>
<td>August-10</td>
<td>22,410</td>
<td>3</td>
<td>300</td>
<td>$3.93</td>
<td>6,480</td>
<td>22110</td>
<td>$882.54</td>
<td>$886.47</td>
</tr>
<tr>
<td>September-10</td>
<td>18,998</td>
<td>3</td>
<td>300</td>
<td>$3.93</td>
<td>5,480</td>
<td>18698</td>
<td>$746.35</td>
<td>$750.28</td>
</tr>
<tr>
<td>October-10</td>
<td>16,859</td>
<td>13</td>
<td>1,300</td>
<td>$17.02</td>
<td>4,560</td>
<td>15559</td>
<td>$621.05</td>
<td>$638.07</td>
</tr>
</tbody>
</table>
A. **Single building**...Create a baseline for your facility (or facilities).

   ii. **Confirm the gross floor area = gross square footage (GSF):**

   The total gross floor area is measured between exterior wall surfaces. Include basements, mezzanines, penthouses, all primary and supporting function space, mechanical spaces, elevators, stairwells, atria (first level only), vent shafts, etc.

   Note: Gross floor area is not the same as leasable space.
5. How to Benchmark

A. Single building...Create a baseline for your facility (or facilities).

iii. **Determine the baseline metrics:**

EUI = Energy Use Intensity (kBtu/sf/year)

To get this you take one year’s worth of electric use (in kWh) multiplied by 3.412, plus the same year’s worth of gas use (in Therms) multiplied by 100 and you get total annual energy use in kBtu. Divide by the gross square footage and you get...
5. How to Benchmark

A. Single building...Create a baseline for your facility (or facilities).

iii. Determine the baseline metrics:

\[ \text{EUI} = \frac{(\text{Annual kWh} \times 3.412) + (\text{Annual Therms} \times 100)}{\text{Building GSF}} = \text{kWh/sf/yr} \]

NOTE: This is the site energy use intensity. Sometimes you’ll also see source energy use intensity (which accounts for generation and transmission losses). Plus...
5. How to Benchmark

A. Single building...Create a baseline for your facility (or facilities).

iii. Determine the baseline metrics:

There are lots of other metrics that you may find useful including:

**Energy Cost Intensity (ECI) = $/sf/yr**

$/sf per year (quick and dirty use with caution)

- Around $1/sf = good
- $1 to $2/sf = fair to slightly poor (typical)
- $2 to $3/sf = probably room for improvement
- $3/sf and above = oink (unless there is a process)
5. How to Benchmark

A. Single building...Create a baseline for your facility (or facilities).

iii. Determine the baseline metrics:

There are lots of other metrics that you may find useful including:

- Electric Use Intensity = kWh/sf/yr
- Gas Use Intensity = Therms/sf/yr
5. How to Benchmark

A. Single building...Create a baseline for your facility (or facilities). Example:

<table>
<thead>
<tr>
<th>Usage Index</th>
<th>(Building Area: 14,400 sf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>55.5 kBtu/sf/yr</td>
</tr>
<tr>
<td>Cost</td>
<td>0.90 $/sf/yr</td>
</tr>
<tr>
<td>Electricity</td>
<td>6.4 kWh/sf/yr</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>0.34 Therms/sf/yr</td>
</tr>
</tbody>
</table>

NOTE: Energy per sf per year – more accurate than dollar metrics (unit costs vary)
5. How to Benchmark

A few magic numbers

- 3,412 Btu per kWh
- 100,000 Btu per therm
- 1,000 Btu per kBtu
5. How to Benchmark

A. Single building (i.e. baseline benchmarking)

B. Multiple buildings within one institution (e.g. all of one college's facilities)

C. Similar buildings outside your institution (e.g. IGEN campuses, SEDAC database, etc.)

D. Similar buildings in a national database (e.g. ENERGY STAR® Target Finder)
5. How to Benchmark

B. Multiple buildings within one institution (e.g. all of one college's facilities)

Additional factors to consider:

i. Some campus buildings may fall into different classification types (e.g. dormitories, stand-alone food service facilities, theaters, automotive shops, etc.).

ii. Facilities in leased space may have fewer options for energy efficiency improvements.

iii. Schedules may vary significantly between different buildings.
5. How to Benchmark

A. Single building (i.e. baseline benchmarking)
B. Multiple buildings within one institution (e.g. all of one college's facilities)
C. Similar buildings outside your institution (e.g. IGEN campuses, SEDAC database, etc.)
D. Similar buildings in a national database (e.g. ENERGY STAR® Target Finder)
5. How to Benchmark

C. Similar buildings outside your institution (e.g. IGEN campuses, SEDAC database, etc.)

Illinois Green Economy Network
Illinois Community Colleges
5. How to Benchmark

C. Similar buildings outside your institution (e.g. IGEN campuses, SEDAC database, etc.)

We’ll discuss this one later!
5. How to Benchmark

C. Similar buildings – some summary stats:

<table>
<thead>
<tr>
<th>IGEN/SEDAC Median Values for Junior Colleges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
</tr>
<tr>
<td>Cost</td>
</tr>
<tr>
<td>Electricity</td>
</tr>
<tr>
<td>Natural Gas</td>
</tr>
</tbody>
</table>
5. How to Benchmark

A. Single building (i.e. baseline benchmarking)
B. Multiple buildings within one institution (e.g. all of one college's facilities)
C. Similar buildings outside your institution (e.g. IGEN campuses, SEDAC database, etc.)
D. Similar buildings in a national database (e.g. ENERGY STAR® Target Finder)
5. How to Benchmark

D. Similar buildings in a national database

- Oak Ridge National Laboratory (ORNL), Building Technology Center, Benchmark Your Building [eber.ed.ornl.gov/benchmark/bench.htm](http://eber.ed.ornl.gov/benchmark/bench.htm) (Source energy use intensity only)
- U.S. Environmental Protection Agency (EPA) ENERGY STAR® Target Finder [www.energystar.gov/targetfinder](http://www.energystar.gov/targetfinder)
- ENERGY STAR® Portfolio Manager [www.energystar.gov/portfoliomanager](http://www.energystar.gov/portfoliomanager)
5. How to Benchmark

D. Similar buildings in a national database


<table>
<thead>
<tr>
<th>Building Use Description</th>
<th>Median Source EUI(^3) (kBtu/Sqft)</th>
<th>Average Percent (%) Electric Use</th>
<th>Median Site EUI (kBtu/Sqft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-12 School</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>College/University (campus level)</td>
<td>244</td>
<td>63%</td>
<td>104</td>
</tr>
</tbody>
</table>

Median Site EUI for Colleges and University (campus level) = 104 kBtu/sf/year
5. How to Benchmark

D. Similar buildings in a national database: ENERGY STAR® Target Finder

www.energystar.gov/targetfinder

Where does your building fall? Target Finder Ratings
Scores 1-100
5. How to Benchmark

D. Similar buildings in a national database: ENERGY STAR® Portfolio Manager

www.energystar.gov/portfoliomanager
5. How to Benchmark

D. Similar buildings in a **national database**: Facilities types that can earn ENERGY STAR®

<table>
<thead>
<tr>
<th>Commercial Buildings</th>
<th>Supermarkets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bank branches</td>
<td>Warehouses</td>
</tr>
<tr>
<td>Courthouses</td>
<td><strong>Manufacturing Plants</strong></td>
</tr>
<tr>
<td>Data centers</td>
<td>Auto assembly plants</td>
</tr>
<tr>
<td>Dormitories</td>
<td>Cement plants</td>
</tr>
<tr>
<td>Financial centers</td>
<td>Container glass manufacturing</td>
</tr>
<tr>
<td>Hospitals</td>
<td>Cookie and cracker baking plants</td>
</tr>
<tr>
<td>Hotels</td>
<td>Flat glass manufacturing</td>
</tr>
<tr>
<td>House of worship</td>
<td>Frozen fried potato processing plants</td>
</tr>
<tr>
<td>K-12 schools</td>
<td>Juice processing</td>
</tr>
<tr>
<td>Medical offices</td>
<td>Petroleum refineries</td>
</tr>
<tr>
<td>Offices</td>
<td>Pharmaceutical manufacturing plants</td>
</tr>
<tr>
<td>Retailers</td>
<td>Pulp and paper plants</td>
</tr>
<tr>
<td>Senior Care</td>
<td>Wet corn mills</td>
</tr>
</tbody>
</table>
D. Similar buildings in a national database:
Facilities types that can earn ENERGY STAR®

- Commercial Buildings
- Bank branches
- Courthouses
- Data centers
- Dormitories
- Financial centers
- Hospitals
- Hotels
- House of worship
- K-12 schools
- Medical offices
- Offices
- Retailers
- Senior Care

- Supermarkets
- Warehouses
- Manufacturing Plants
  - Auto assembly plants
  - Cement plants
  - Container glass manufacturing
  - Cookie and cracker baking plants
  - Flat glass manufacturing
  - Frozen fried potato processing plants
  - Juice processing
  - Petroleum refineries
  - Pharmaceutical manufacturing plants
  - Pulp and paper plants
  - Wet corn mills

*Not Colleges or Universities (for now)*
5. How to Benchmark

Currently Colleges and Universities cannot be benchmarked using the ENERGY STAR Target Finder or Portfolio Manager or the ORNL data. But there are still lots of options left:

A. Single building (i.e. baseline benchmarking):

B. Multiple buildings within one institution (e.g. all of one college’s facilities)

C. Similar buildings outside your institution (e.g. IGEN campuses, SEDAC database, etc.)

D. Median Site EUI for colleges from CBECs (104 kBtu/sf/yr)
5. How to Benchmark

Currently Colleges and Universities cannot be benchmarked using the ENERGY STAR Target Finder or Portfolio Manager or the ORNL data. **But there are still lots of options left:**

A. **Single building** (i.e. baseline benchmarking):

B. **Multiple buildings** within one institution (e.g. all of one college’s facilities)

C. **Similar buildings** outside your institution (e.g. IGEN campuses, SEDAC database, etc.)

D. **Median Site EUI** for colleges from CBECS (104 kBtu/sf/yr) ➢ Or...E. all of the above!
Presentations will be available at: presentations.sedac.org

Web site: www.sedac.org
Contact: info@sedac.org
1-800-214-7954