The Demand for Lab Benchmarking

Jacob Werner
Introductions

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UMass Amherst – Physical Sciences Building
Abstract
Energy benchmarking is the first step in any ASHRAE energy audit; it is required for the AIA 2030 Challenge; it is a central part of building certifications such as LEED EBOM and ENERGY STAR; and its role is becoming ever more important as a means to contextualize building energy consumption data made public by energy use disclosure ordinances. Benchmarking for laboratory facilities is notoriously challenging, for reasons including the wide and complex variety of lab buildings’ functional requirements. This portion of the Lab Benchmarking Symposium will focus on the many use cases for lab energy benchmarking and the challenges frequently encountered.

Learning Objectives
• Summarize the results of the 2015 I2SL lab benchmarking survey to determine the community's needs and desires for benchmarking tools and services.
• Compare some common use cases for lab benchmarking.
• Explain the AIA 2030 benchmarking requirements for labs.
• Describe the unique and interesting challenges associated with whole-building energy benchmarking for new and existing lab facilities.
We asked you: The I2SL benchmarking survey

- **2015 March - May**
- **376 responses:**
  - Many facilities, design arch/eng, consultants
  - Most from USA
Survey says: You care about benchmarking

Important or very important to **80% of respondents**

- **Most important to:**
  - Energy managers
  - Energy consultants *(and me)*

- **Least important to:**
  - Occupants?
Survey says: Some of you use the tool

User Profiles

• Most use
  • Energy consultants
  • Facilities Managers / Owners
  • Designers (arch / eng)

• Least use
  • Occupants
  • Vendors

Labs21 tool uses match overall benchmarking uses

• Commonly claimed uses
  • Comparing energy performance against peers
  • Supporting business case for energy projects and efficient design
  • Quantifying typical loads for design
  • Encouraging occupants to conserve

• 3% said LEED EBOM
Energy Benchmarking – Use Cases

• Planning
  Example: Utility incentive programs, Maintenance planning, ASHRAE Energy Audit
  Tasks: Identify candidates for facilities improvements
  User: Facilities / Maintenance, Engineering

• Design
  Example: Building projects, Major renovations, Major utility / system upgrades
  Tasks: Identify comparables, Research EEMs, Evaluate performance
  User: Architects / Engineers, Commissioning Agents, Owners / Developers

• Building Rating Systems
  Example: LEED O+M, Minimum Energy Performance
  Tasks: Compare building performance to existing building peer group
         Very different than “new building” LEED!
  User: Owner, Consultants

• Public Policy
  Example: AIA 2030 Commitment
  Tasks: Compare projected performance to existing building peer group
  User: Architects/ Engineers
Minimum energy performance

Required

Intent
To reduce the environmental and economic harms associated with excessive energy use by establishing a minimum level of operating energy performance.

Requirements

Establishment
Calibrate meters within the manufacturer’s recommended interval if the building owner, management organization, or tenant owns the meter. Meters owned by third parties (e.g., utilities or governments) are exempt.

Performance
Meter the building’s energy use for a full 12 months of continuous operation and achieve the levels of efficiency set forth in the options below. Each building’s energy performance must be based on actual metered energy consumption for both the LEED project building(s) and all comparable buildings used for the benchmark.

Case 1. ENERGY STAR Rating
For buildings eligible to receive an energy performance rating using the Environmental Protection Agency (EPA) ENERGY STAR® Portfolio Manager tool, achieve an energy performance rating of at least 75. For projects outside the U.S., consult ASHRAE/ASHRAE/IESNA Standard 90.1–2010, Appendixes B and D, to determine the appropriate climate zone.

Case 2. Projects not eligible for ENERGY STAR Rating
Option 1. Benchmark against typical buildings

Path 1. National average data available

Demonstrate energy efficiency performance that is 25% better than the median energy performance of similar buildings by benchmarking against the national source energy data provided in the Portfolio Manager tool.

Path 2. National average data not available

If national average source energy data are unavailable for buildings of similar type, benchmark against the building site energy data of at least three similar buildings, normalized for climate, building use, and occupancy. Demonstrate a 25% improvement.

OR

Option 2. Benchmark against historical data

If national average source energy data are unavailable, compare the building’s site energy data for the previous 12 months with the data from three contiguous years of the previous five, normalized for climate, building use, and occupancy. Demonstrate a 25% improvement.
Minimum Energy Performance Case 2 Calculator
LEED 2009 for O+M - EA Prerequisite 2: Minimum Energy Performance and EA Credit 1: Optimize Energy Performance

Step 1.
Enable macros.
Note: This calculator is for use with Excel for Mac 2011 and Excel 2007 or later.

Step 2.
Unit of measurement
Note: This selection must match the unit of measurement chosen during project registration.

Step 3.
Complete the Space Types tab. Use the results of the table to complete the applicable Option tab.

For projects whose ENERGY STAR rating was not available because of insufficient metered energy information
Obtain the missing information and complete the ENERGY STAR rating for use with Case 1. This calculator should not be used.

Step 4.
Upload the completed spreadsheet to LEED Online. Complete any related summary fields in the LEED credit form with the results of the calculator.
## Option 1 for Labs

### Project source energy use intensity

<table>
<thead>
<tr>
<th>Project's annual weather-normalized source energy use intensity from Portfolio Manager (kBtu/sq ft)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>For projects using SI units</td>
<td>Project's annual weather-normalized source energy use intensity converted to IP units (kBtu/sq ft)</td>
</tr>
</tbody>
</table>

### Labs21 peer facility average

Enter the project's building energy use on the [Labs21 website](https://www.labs21.org) and follow the guidance for determining the project's peer facility average. Enter the results below.

### Peer facility average (from the project's Labs21 Benchmark Statistics) (kBtu/sq ft)

<p>| |</p>
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<th></th>
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</thead>
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### Percentile points above national average

| Percentile points above national average | 0 |
This technical bulletin provides guidance on how to use the Labs21 benchmarking tool in the context of the LEED for Existing Buildings: Operations and Maintenance (LEED-EBOM) rating system, version 2009. This bulletin assumes that the reader is familiar with LEED-EBOM as well as the Labs21 benchmarking tool. Procedures described here also apply to LEED EB: O&M v2008, though some wording may differ slightly between the two programs.

1. Introduction: Benchmarking Requirements in LEED-EBOM

LEED-EBOM requires the use of energy benchmarking in EA prerequisite 2 and EA Credit 1. There are two cases:

Case 1: Buildings that are eligible for an Energy Star rating are required to use the Energy Star Portfolio Manager tool to obtain a rating.

Case 2: Buildings that are not eligible to receive an Energy Star rating have to use an off-line spreadsheet calculator provided by the USGBC. There are two options under case 2:

• Option 1: Obtain a score based on national average source energy intensity for similar buildings. The USGBC calculator provides national average source energy intensity for several building types not ratable by Energy Star.
• Option 2: Obtain a score based on historical data and/or comparable buildings.

Case 1 does not apply to laboratories because they are not eligible to receive an Energy Star rating.
AIA 2030 Commitment – pEUI vs. benchmarks

**FIGURE 3. 2030 Challenge Goals**

- **Fossil Fuel Energy Consumption**
- **Fossil Fuel Energy Reduction**
- **Carbon Neutral (Using no fossil fuel energy to operate)**

Source: ©2010 2030 Inc. / Architecture 2030 All Rights Reserved
The AIA is working to increase energy analysis in architectural practice with new education and resources such as the AIA+2030 Online Series and the AIA 2030 Design Data Exchange.
AIA 2030 Commitment – Reporting

- Complete list of all projects in design or construction
- Track predicted energy from energy models
- Compare to Baseline energy use (CBECS / Labs21)
AIA 2030 Commitment – Project Record

• Project records capture **a lot of data**
• Location, size, type, occupancy
• Architectural and mechanical systems
• As well as holistic energy metrics
AIA 2030 Commitment – Benchmarking Inputs

AIA 2030 Design Data Exchange

PROJECT VIEW

PREDICTED
Not Determined
kBtu/sf/yr
[Predicted Energy Use Intensity]

BASELINE
kBtu/sf/yr
[Baseline Energy Use Intensity]

GOAL
kBtu/sf/yr
[Energy Use Intensity]

SAVINGS

CHALLENGE
2030 = 100% (Carbon Neutrality)
2020 = 90%
2020 = 80%
2020 = 70%
2014 = 60%
[2030 Challenge]

3. Baseline & Target Energy Use Intensity

Define Baseline *

- ENERGY STAR Target Finder™
- National Average
- Other

<Enter>
kBtu/sf/yr

BASELINE

GOAL *

PREDICTED *
Not Determined
kBtu/sf/yr
[Not Determined]

4. Additional Inputs

Lighting Power Density

Occupancy Sensor Included?

Watts/sf

[2030 Challenge]
AIA 2030 Commitment – Benchmarking Inputs

“Predicted” EUI from eModel

“Actual” EUI from benchmarking (CBECS / Labs21)

Baseline * challenge = Goal

“Challenge” = Predicted EUI as a fraction of benchmark EUI (i.e. 80% less than benchmark)

Success = eModel EUI < Goal
- Dashboard aggregates all projects input by the user
- And provides useful overall metrics
AIA 2030 Commitment – Tracking

Research tab compares user data to full dataset
Provides useful filters and graphic displays
Energy Benchmarking – Datasets and Tools

• Labs 21 Benchmarking Tool
  Increasingly popular!
  Anonymous, voluntary, small set, but with useful metrics (ex. lab type)

• CBECS / Energy Star Target Finder
  Anonymous, large set, not very useful for labs (important metrics not tracked)

• “Building Energy Disclosure” Ordinances
  Example: BERDO, Boston, MA: www.cityofboston.gov/eeos/reporting
  Disclosed, mandatory, moderate utility (metrics not tracked)

• New Aggregating Tools
  Example: Seventh Wave: www.seventhwave.org/accelerateperformance
  Increase sample size, some include Labs21 data

• Private Data
  Owner utility data, architect / engineering firm project records, etc.
  Example: Wilson Architects projects
  Full project data, small set, very relevant sample
Benchmarking Tools – Target Finder

Target Finder Results
Based on the information you have provided, we have calculated metrics to help you understand the energy efficiency associated with your current design and/or target. (Jump to the detailed table below.) For a print out of this information, you can download your Statement of Energy Design Intent.

Your Design Score

N/A

Your Design's estimated energy and GHG emissions are 920.1% worse than your Design's target.

Download Your Statement of Energy Design Intent (SEDII)
This document provides an overview of your design and metrics. It is also used for Designed to Earn the ENERGY STAR applications.

Download & Print Statement

Energy Use Intensity (EUI)

About this Property's Design

Target: Target % Better than Median: 75
Uses: Laboratory (100.0%)
Energy Types: Electric - Grid (100.0%)
Building Energy Reporting and Disclosure Ordinance

In 2013, the City of Boston enacted the Building Energy Reporting and Disclosure Ordinance (BERDO). This Ordinance requires Boston's larger and medium-sized buildings to report their annual energy and water use to the City of Boston, after which the City makes the information publicly available. Additionally, every five years, buildings need to complete an energy assessment or energy action; exemptions are provided for buildings that are already efficient or are making significant progress on energy efficiency.

As a key component of Boston's plan to reduce greenhouse gas emissions 25 percent by 2020, energy reporting and disclosure is intended to provide information and encourage building owners and tenants to increase energy efficiency, reduce energy costs, and utilize incentives such as Renew Boston.

Explore Building Energy Metrics and Findings
The first year of energy metrics for large buildings in Boston is now available, including an interactive map to see building energy and water usage. Findings from the data on different sectors and building types are also available.

How to Comply
Reporting Deadline: May 15, 2016

Reporting Requirements
The following properties are required to report on their energy and water use this May:

- All non-residential buildings over 35,000 gross square feet
- All residential buildings over 50,000 gross square feet or with 50 or more residential units
- Any tax parcel with multiple buildings that sum to at least 100,000 gross square feet or 100 residential units must report on all of its buildings.

Getting Started
Benchmarking Tools – City Disclosure Ordinances
Benchmarking Tools - Aggregators

Labs21 Data (minus square footage values)
Laboratory Benchmarking Working Group

Lead: Alison Farmer

Group Purpose
The Laboratory Benchmarking Working Group was formed in September 2014 to evaluate the current state of energy benchmarking for labs, and to investigate (then implement) useful enhancements or supplements to the available tools. The group's efforts will focus on projects with strong business use cases which benefit a significant segment of the community of lab owners, consultants, and researchers.