Laboratories for the 21st Century

Technical Bulletin

Guidance on Using the Labs21 Benchmarking Tool for LEED-EB

The U.S. Green Building Council (USGBC) has issued a credit ruling indicating that the Labs21 benchmarking tool may be used for benchmarking laboratories that are pursing LEED for Existing Buildings Operations and Maintenance (LEED-EB) certification. This technical bulletin provides guidance on how to use the Labs21 benchmarking tool for this purpose, and assumes that the reader is familiar with LEED-EB as well as the Labs21 benchmarking tool.

1 Introduction: Benchmarking Requirements in LEED-EB

LEED-EB[1] requires the use of energy benchmarking in EA prerequisite 2 and EA Credit 1. Three options are provided:

> Option A: Use the Energy Star Portfolio Manager Tool for building types that are eligible to receive a rating.
>
> Option B: For buildings not eligible to receive a rating with the Energy Star Portfolio Manager Tool, benchmark against national average source energy use intensity provided in the Portfolio Manager tool.
>
> Option C: For buildings not eligible to receive a rating using Portfolio Manager, and also not suited for Option B, use an alternative method described in the LEED-EB reference guide.

Option A does not apply for laboratories, since they are not eligible to receive a rating in Portfolio Manager.

Option B is also not viable for laboratories, since Portfolio Manager does not provide a national average for laboratories. Laboratories would have to use the national average for buildings classified as "other". As noted in the documentation: "this category is not well-defined, therefore source energy use varies greatly with source EUI ranging over 1500 kBTU/sqft…..'other' may include airplane hangers, laboratory, crematorium, data center, etc."

This only leaves Option C for laboratories. Toward that end, the USGBC issued a credit ruling on February 4, 2008 which states in part:

"An alternative approach for your laboratory building would be to use the Energy Benchmarking Tool available through Laboratories for the 21st Century (Labs21), which is a resource co-sponsored by the EPA and DOE for the design, construction, and operation of laboratories. The Energy Benchmarking Tool can be found here: http://www.labs21century.gov/toolkit/benchmarking.htm. Using the metrics provided by the tool, calculate your project's percent reduction in energy use compared to the benchmark. You can then calculate the corresponding number of LEED points."

[1] The current version of LEED-EB is officially referred to as LEED for Existing Buildings Operations and Maintenance (LEED-EB O&M). For simplicity, it is referred to as LEED-EB in this document.

2 Using the Labs21 Tool for LEED-EB

The Labs21 tool allows users to input data on their buildings and compare them to other buildings in the database, using whole building metrics (e.g. total kBTU/sf-yr) as well as system level metrics (e.g. ventilation system W/cfm). The tool allows users to filter the data set to obtain an appropriate peer group based on four parameters: climate zone, lab type, lab area ratio, and occupancy hours. However, unlike the Energy Star Portfolio Manager tool, the Labs21 tool does not provide a 1-100 rating which can directly be used to determine points for EA credit 1. Therefore, users may use the following simple 3-step procedure, analogous to option B in EA credit 1:

Step 1: Retrieve benchmarking data for 'Total Building kBTU/sf', applying filters as appropriate (see guidelines below)

Step 2: Calculate average value of 'Total Building kBTU/sf' and percentage better than average for the subject building i.e. the building being benchmarked.

Step 3: Determine the number of points based on percentage better than the average, using the same criteria as that provided for option B.

Guidelines for filtering the dataset:

As noted earlier, the tool allows users to filter the dataset based on climate zone, lab type, lab area ratio, and occupancy hours. These parameters can be used to obtain benchmarking data for a subset of buildings that are more comparable to the subject building. However, if the filtering is too restrictive, there may not be enough buildings to benchmark against. (The database currently has just over 100 buildings). Therefore, it is recommended that the following guidelines be used for filtering the dataset.

(Note: Users should use their judgment when applying these guidelines, and should document the rationale for how the filters were applied. Users should benchmark with at least 6- 10 data points, and preferably more.)

1. Climate zone should be used as the primary filter. If the selected climate zone has inadequate data points, include data from adjacent climate zones to obtain an adequate data set. For example, zone 4B has only 1 data point. Including zones 4B and 4C will provide a total of 25 data points.
2. Lab area ratio: Select the narrowest range that yields an adequate number of data points. The range should be selected such that the lab area ratio of the subject building is in the middle of the range.
3. Lab type: If the selected lab-type does not have adequate data points, include other lab types to yield an adequate number of data points, using the order shown below for each lab type:

   Chemical: Add chemical/biological, biological, combination, physical

   Biological: Add chemical/biological, chemical, combination, physical

   Physical: Add combination, biological, chemical/biological, chemical

   Combination/Other: Add chemical/biological, chemical, biological, physical
4. Operation hours: If the selected operation hours category has inadequate data points, include both categories.

3 Background Information: Benchmarking Data and Methodology

3.1 Data Sources

What are the data sources for the Labs21 tool?

Most of the data in the Labs21 tool are from Labs21 partners, which include federal government agencies, universities, pharmaceutical companies, and a few other organizations. Identities of the specific buildings in the database are masked for confidentiality. The Labs21 database also includes selected buildings from the CBECS dataset (see question on CBECS below).

Note that although the Labs21 dataset is larger than the CBECS lab data set, it is not designed to be a statistically representative sample of the U.S. building stock. The non-CBECS buildings in the Labs21 dataset tend to be larger and more energy intensive labs, most of which are chemical and biological labs. While the CBECS dataset in and of itself would, in theory, represent a statistically representative sample of the U.S. building stock, the data on laboratory buildings is very limited (see question on CBECS below).

Are the energy use data in the Labs21 tool measured or estimated?

Almost all the whole building energy use data is measured data from existing buildings. In a few cases estimated data are used. The benchmarking charts indicate whether each data point is based on measured or estimated data.

Does the Labs21 tool include laboratory buildings from the CBECS database?

Labs21 tool includes 14 buildings from the CBECS database. The table below indicates the selection criteria and the resulting number of buildings after each criterion was applied.

Criteria	*Number remaining*
"Principal building activity" is classified as "laboratory"	43
Exclude buildings in which energy use is imputed i.e. buildings for which actual energy use data were not available.	19
Exclude buildings for which location could not be narrowed to one of the ASHRAE climate zones (The location of CBECS buildings is specified only by census division)	18
Exclude buildings served by district chilled water (CBECS does not report district chilled water use)	14

3.2 Benchmarking Methodology

Does the Labs21 tool provide a rating between 1 and 100, like the Energy Star Portfolio Manager?

No. The Labs21 tool allows users to input data on their buildings and compare them to other buildings in the database, using various building and system level metrics. Labs21 is collaborating with Energy Star to collect data from many more laboratory buildings. This will eventually allow for the development of a rating system based on a multi-parameter regression model that normalizes for various parameters such as climate, lab area ratio, lab type, operation hours, equipment loads, etc. (see question on normalization below).

The application of data filters is limited by the number of data points. Has Labs21 investigated the use of normalization techniques so that the entire data set can be utilized to provide a more "apples to apples" comparison?

Yes. Normalization is typically done with either a regression-based approach or simulation model-based approach. A more detailed description is available in the publication listed in the reference. Excerpts are provided below:

Regression-based approach: In this approach, a multiple regression yields an equation that relates the normalizing parameters to the metric of interest. This equation is then used to normalize the value of the metric for each building. This approach is used in EnergyStar, and works well provided there is a large enough representative dataset (including normalizing parameters) to run a regression. In the case of laboratories, such a dataset does not yet exist. Furthermore, laboratory buildings will likely require a relatively larger number of normalizing parameters. As the database grows, Labs21 will continue to explore regression-based normalization.

Simulation-based approach: In this approach, a simulation model is used to calculate a benchmark (typically representing an "ideal" case or a "basecase") against which the actual energy use can be compared. The model accounts for the relevant normalizing parameters. Labs21 developed a simulation-based DOE-2 benchmark model, which has two separate building modules, one for the laboratory area and one for the non-laboratory area. The enclosure, HVAC, and lighting specifications represent best practices, as the model is meant to be representative of an "ideal" case, against which actual energy use is to be compared. The ratio of the ideal benchmark energy use to actual energy use is the energy effectiveness ratio (EER). The higher the EER, the more efficient the building. EER for different facilities can be compared, as it represents a normalized metric. This simulation-based benchmarking model is not currently integrated into the Labs21 benchmarking tool, but will likely be available in the future.

Given the limited degree of normalization, what are the appropriate uses for the Labs21 tool?

The primary purpose of this tool is to screen facilities for energy efficiency potential. It thereby helps prioritize facilities for further energy audits. The system level benchmarking also helps prioritize which systems to focus on within particular facility (e.g. a high value for ventilation W/cfm indicates efficiency opportunities to reduce pressure drop and/or increase the efficiency of fan motors and drives.)

There is an inherent tradeoff between accuracy and ease of data collection. Benchmarking is not an "audit in a box" and is not intended to provide the same degree of accuracy afforded by an energy audit. Rather, it should be used to focus and prioritize audit activity and track performance over time.

4 References

Mathew, P., D. Sartor, O. van Geet, S. Reilly. "Rating energy efficiency and sustainability in laboratories: Results and lessons from the Labs21 program," Proceedings of the 2004 ACEEE Summer Study of Energy Efficiency in Buildings. ACEEE, Washington, D.C. Manuscript available at: http://www.labs21century.gov/pdf/bench_aceee_508.pdf

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